

SPECIFICATIONS

Central Railroad of New Jersey Terminal Building

Interior and MEP Restoration

Jersey City, Hudson County, N.J.

DPMC PROJECT # P1107-00

STATE OF NEW JERSEY

Honorable Chris Christie, Governor

Honorable Kim Guadagno, LT. Governor

DEPARTMENT OF THE TREASURY

Andrew P. Sidamon-Eristoff, Treasurer



DIVISION OF PROPERTY MANAGEMENT AND CONSTRUCTION

Steven Sutkin, Director

STV Architects, Inc.

820 Bear Tavern Road, Suite 200, Trenton, NJ 08628-1021

Date: December 2014

STATE OF NEW JERSEY
DEPARTMENT OF TREASURY
DIVISION OF PROPERTY MANAGEMENT AND CONSTRUCTION
OFFICE OF DESIGN & CONSTRUCTION
PO BOX 034, TRENTON, NJ 08625-0034

PROJECT # P1107-00
Interior and MEP Restoration
Central Railroad of New Jersey Terminal Building
Jersey City, Hudson County, NJ

A/E: STV Architects, Inc.

DATE: 1/14/15

BULLETIN "A"

Bidder must acknowledge receipt of this Bulletin on bid form in the space provided therefor.

This Bulletin is issued for the purpose of amending certain requirements of the original Contract Documents, as noted hereinafter, and is hereby made part of and incorporated in full force as part of the Contract Documents. Unless specifically noted or specified hereinafter, all work shall comply with the applicable provisions of the Contract Documents.

- 1. All technical sections of project specifications that reference manufacturers and products are hereby revised to include, (Or Approved Equal).**
2. In accordance with N.J.S.A. 45:16A-1, *et seq.*, the State Heating, Ventilating, Air Conditioning and Refrigeration Contracting License Law (HVACR Law), and the regulations enacted to implement the HVACR Law, N.J.A.C. 13:32A-1, *et seq.* (HVACR Regulations), all mechanical contractors will be required to obtain the new HVACR license in order to continue to perform such work in New Jersey. Consistent with enactment of the HVACR Law and HVACR Regulations, contractors currently classified by DPMC must apply for and obtain the new HVACR license in order to bid on and perform State work either as a prime contractor or subcontractor.

Under N.J.A.C. 13:32A-6 of the HVACR Regulations, certain persons who have been engaged in the practice of "installing, servicing, maintaining, planning the installation, laying out the installation, and supervising the installation and/or servicing of HVACR systems" for at least two years prior to the date of application may apply for and obtain an HVACR license without satisfying the educational and examination requirements for licensure.

For purposes of DPMC's bidding opportunities, at the time of Notice of Intent to Award, a prime contractor or subcontractor in any trade for which an HVACR license is required must produce proof that it holds a valid license. In the case of a prime contractor or subcontractor entitled to licensure without satisfaction of the educational and examination requirements of the HVACR Regulations, it shall be sufficient for such contractor or subcontractor to produce proof of application for the license with a copy of the canceled check representing payment of the application fee. Should such prime contractor or subcontractor fail to produce the required

licensure documentation at the time of Notice of Intent to Award, the bidder in question shall be deemed not responsible and its bid shall be rejected.

For additional information regarding application for and issuance of the HVACR license, interested parties should contact the State Board of Examiners of Heating, Ventilating, Air Conditioning and Refrigeration Contractors at (973) 504-6250.

3. All references to HVAC (C039) must be changed to HVACR (C032).
4. Delete section - 051200, 1.07E. **Fabrication:** Replace with **“All work must be performed in accordance with AISC code”**.
5. DIVISION 14 – CONVEYING EQUIPMENT, Section 14 01 20: Delete pages 14 01 20 - 1 through pages 14 01 20 - 22
6. DIVISION 14 – REQUEST FOR ELEVATOR BIDDER QUALIFICATIONS, Section 14 24 23: Delete pages 14 24 23 - 1 through pages 14 24 23 - 4

END OF BULLETIN “A”

STATE OF NEW JERSEY
DEPARTMENT OF TREASURY
DIVISION OF PROPERTY MANAGEMENT AND CONSTRUCTION
OFFICE OF DESIGN & CONSTRUCTION
PO BOX 034, TRENTON, NJ 08625-0034

PROJECT # P1107-00
Interior and MEP Restoration
Central Railroad of New Jersey Terminal Building
Jersey City, Hudson County, NJ

A/E: STV Architects, Inc.

DATE: 1/21/15

BULLETIN "B"

Bidder must acknowledge receipt of this Bulletin on bid form in the space provided therefor.

This Bulletin is issued for the purpose of amending certain requirements of the original Contract Documents, as noted hereinafter, and is hereby made part of and incorporated in full force as part of the Contract Documents. Unless specifically noted or specified hereinafter, all work shall comply with the applicable provisions of the Contract Documents.

1. **All construction work must be completed in 180 calendar days.**
2. As per Section 14 24 23; 2.11 – New Elevator Cab (\$20,000 Net Total Allowance) must be included in base bid.
3. Any reference to “voluntary DEDUCT alternate” in specifications are deleted. For all substitutions, please refer to “ARTICLE 4 – THE CONTRACTOR; 4.7 Shop Drawings and Other Submittals” and “ARTICLE 4 – THE CONTRACTOR; 4.11 Equipment and Materials” and “ARTICLE 5 – SUBCONTRACTORS; 5.1 SUBCONTRACTOR AND MATERIAL SUPPLIER APPROVALS.
4. In Section 042116 – INTERIOR BRICK AND TILE RESTORATION; II. MATERIALS; I. In-Painting/Glazing Spall Coating; 1. Delete – “Benjamin Moore Aura (as supplied by Cathedral Stone Products, Hanover, MD 800-684-0901), or approved equal” and replace with, “Benjamin Moore Aura or approved equal”.

END OF BULLETIN "B"



State of New Jersey

DEPARTMENT OF TREASURY
DIVISION OF PROPERTY MANAGEMENT & CONSTRUCTION
P O Box 034
TRENTON NJ 08625-0034

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

ANDREW P. SIDAMON-ERISTOFF
State Treasurer

STEVEN SUTKIN
Director

January 28, 2015

SUBJECT: Bulletin "C" dated January 26, 2015
RE: Project # P1107-00
Interior and MEP Restoration
CRRNJ Terminal Building
Liberty State Park, Jersey City, NJ - Hudson County

Gentlemen:

We are forwarding a copy of the above referenced bulletin. Please acknowledge receipt by returning this form to the address listed below. Fax copy will also be acceptable.

Division of Property Management & Construction
Attention: Richard Ferrara
Contracts & Procurement
P.O. Box 034
Trenton, New Jersey 08625-0034
FAX# 609-777-1970

Very truly yours,

Richard Ferrara, Assistant Deputy Director
Contracts & Procurement

Date Received

Firm Name

Address

Signature

Title

Attachment(s)
ODC-513

STATE OF NEW JERSEY
DEPARTMENT OF TREASURY
DIVISION OF PROPERTY MANAGEMENT AND CONSTRUCTION
OFFICE OF DESIGN & CONSTRUCTION
PO BOX 034, TRENTON, NJ 08625-0034

PROJECT # P1107-00
Interior and MEP Restoration
Central Railroad of New Jersey Terminal Building
Jersey City, Hudson County, NJ

A/E: STV Architects, Inc.

DATE: 1/26/15

BULLETIN "C"

Bidder must acknowledge receipt of this Bulletin on bid form in the space provided therefor.

This Bulletin is issued for the purpose of amending certain requirements of the original Contract Documents, as noted hereinafter, and is hereby made part of and incorporated in full force as part of the Contract Documents. Unless specifically noted or specified hereinafter, all work shall comply with the applicable provisions of the Contract Documents.

The State has awarded a separate contract (Project P1107-02) for the pre-purchasing of long lead MEP & FP equipment. This equipment will be purchased and delivered to the project site, along with manufacturer and/or supplier technical support, field representation, training and O&M manuals. Therefore, the cost of this equipment & services shall be excluded from this bid. The equipment includes the emergency generator, prefabricated fire pump house, hydronic pumps, high efficiency boilers, heat exchangers, switchgear / MDP, chillers, and overcurrent study. For a complete list and further details of pre-purchased equipment & services and other important information, please refer to the documents attached to Bulletin 'C' as follows:

1. The "EQUIPMENT PRE-PURCHASE" bid package P1107-02 in its entirety, as was issued to the bidders, along with Bulletin's A and B.
2. All P1107-02 submittals provided by the awarded Contractor, Gabe Sganga Inc., to date. Please note that some of these submittals are still under review by STV and may require resubmission.
3. **Please delete in its entirety:** P1107-00 Central Railroad of New Jersey Terminal Building, Interior and MEP Installation, **DIVISION 14 – CONVEYING EQUIPMENT, Sections 140120 and Sections 142423.**

Replace with attached: DIVISION 14, SECTION 14 24 23 TECHNICAL SPECIFICATIONS FOR ONE (1) HYDRAULIC PASSENGER ELEVATOR AT CENTRAL RAILROAD OF NEW JERSEY (CRRNJ).

All bidders are responsible for carefully reviewing and understanding all information provided in this Bulletin "C", and becoming fully & thoroughly familiar with its contents and the Scope of Work (equipment & services) being provided by Gabe Sganga Inc., under contract P1107-02. The successful bidder will be exclusively responsible for all required coordination, directly with Gabe Sganga Inc.

END OF BULLETIN "C"



State of New Jersey

DEPARTMENT OF TREASURY
DIVISION OF PROPERTY MANAGEMENT & CONSTRUCTION
P O BOX 034
TRENTON NJ 08625-0034

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

ANDREW P. SIDAMON-ERISTOF
State Treasurer

STEVEN SUTKIN
Director

February 19, 2015

SUBJECT: *Bulletin "D" Dated February 18, 2015*

RE: *P1107-00
Interior and MEP Restoration
CRRNJ Terminal Building, Liberty State Park*

Gentlemen:

We are forwarding a copy of the above referenced bulletin. Please acknowledge receipt by returning this form to the address listed below. Fax copy will also be acceptable:

Division of Property Management and Construction
Attention: R. Ferrara
Contracts & Procurement
PO Box 034
Trenton NJ 08625-0034
Fax #: 609-777-1970

Very truly yours,

Richard M. Ferrara
Assistant Deputy Director
Contracts and Procurement

Date Received

Firm Name

Address

Signature

Title

STATE OF NEW JERSEY
DEPARTMENT OF
TREASURY
DIVISION OF PROPERTY MANAGEMENT AND
CONSTRUCTION
PO BOX 034, TRENTON, NJ 08625-0034

PROJECT #: P1107-00
Interior and MEP Restoration
Central Railroad of New Jersey Terminal Building
Jersey City, Hudson County, NJ

A/E: STV Architects, Inc.

DATE: 2/18/15

BULLETIN "D"

Bidder must acknowledge receipt of this Bulletin on bid form in the space provided therefore.

This Bulletin is issued for the purpose of amending certain requirements of the original Contract Documents, as noted hereinafter, and is hereby made part of and incorporated in full force as part of the Contract Documents. Unless specifically noted or specified hereinafter, all work shall comply with the applicable provisions of the Contract Documents.

Questions and Answers

Questions from Hall Construction Co., Inc.

- Q1. General Conditions Article 13.4.2 notes Builder's Risk Insurance will be provided by the State but Sub Paragraph #5 states it "shall not apply to alterations, repairs, maintenance and installations of systems, equipment and other items of work which do not result in creating additional habitable space". Please confirm the State of New Jersey is providing the Builder's Risk insurance policy.
- A1. **The successful bidder for this work will not be required to provide Builder's Risk coverage.**
- Q2. Please confirm the Contractor is to engage and pay for testing services.
- A2. **Yes, the contractor shall be responsible for engaging and paying for all testing & inspection services.**
- Q3. Detail I/S-101 Annex Foundation Plan shows the extent of new 12" slab but note #4 states the slab is 10" thick. Please advise which is correct.
- A3. **The slab at the base of the tank should be 10" thick (NOTE #4 IS CORRECT)**
- Q4. Detail I/S-102 Equipment Platform and Water Tank Roof Plan shows the extent of new 12" slab but note #5 states the slab is 8" thick. Please advise which is correct.
- A4. **The slab at the tank roof should be 8" thick (NOTE #5 IS CORRECT).**
- Q5. General Conditions Article 4.20 notes the Contractor is to provide a field office for DPMC personnel. Please confirm a DPMC field office is required.

A5. Please see the following section of this bulletin:

SUPPLEMENTARY GENERAL INFORMATION

D). AMENDMENTS TO THE GENERAL CONDITIONS OF THE CONTRACT

ARTICLE 4 – THE CONTRACTOR

Q6. Section 015000 – Temporary Facilities and Controls paragraph 3.2.C directs the Contractor to provide watchman services during non-work hours. Please confirm watchman service is required.

A6. Yes, the cited service is required as stated in the contract documents.

Q7. For unit prices P-Fire Protection and N-Plumbing, please define the finished wall surface (gypsum board, glazed brick, woodwork, etc.) to be used in calculating the unit price.

A7. **These walls represent existing conditions in the Terminal Building that may need to be opened up (selectively demolished) in order to access the distribution pipes behind the wall, replace it and restore the wall & its finish. These wall types are the same as indicated on the contract drawings. The contractor is responsible for verifying the existing conditions and providing unit prices for the work required in the impacted walls.**

Questions from Hall Construction Co., Inc. (RFI #2)

Q1. Please confirm that millwork replacement components are to match the existing current specie and cut of wood as some species and cuts on the project are not historically correct.

A1. **Millwork to match existing woodwork in specie and cut.**

Q2. Spec. section 060140-8 paragraph 3.4 A1 Refinishing notes to prepare surfaces for clear finishes with no mention of a staining step to match the existing color tone. Please confirm if a similar color match is required.

A2. **As per Spec Section 060140 paragraph 1.7.C. "Finish Restoration: Prepare three (3) samples using materials and methods specified for each type of finish. The new finish shall match the original in color, transparency, and reflectance quality. Following any revisions requested by Architect, the approved sample shall form a quality standard for all further work." If varnish is insufficient to achieve color match, provide stained samples and submit all documentation for stain product (MSDS and PDS) demonstrating compatibility with proposed varnish.**

Q3. Drawing HA. 1 does not note any mold remediation work for the doors/frames and windows in the waiting room. To treat or replace the associated millwork will require disassembly of door jambs and casings along with temporary support needed for above assemblies. Please confirm treatment is required at these locations.

A3. **Please see Specification Section 028501 – Mold Remediation, including, but not limited to, Section 3.2 Description of Work**

Q4. Drawing A-134 Room 107-North wall has a task note HPW-1 but no quantity is listed, please provide.

A4. **A-134 (Room 107) HPW-1 = 1200sq ft. of woodwork refinishing.**

Q5. Drawing A-136 General Note # I states to replace custom cabinetry. Please provide scope and details for this work.

A5. **Any reference to finished cabinetry is hereby eliminated from the contract documents.**

Q6. Please confirm the task quantities listed on Drawings A-131 through A-134, A-139 cover the scope listed for General Notes 2, 4 & 5.

A6. **Task quantities for repair work (patching, material replacement) include overages, but conditions may have developed since survey that would require additional quantities. Bricks and tiles with 40% surface loss may result from cleaning. Repointing quantities are not included, provide qualified bid for repointing/regrouting of open joints including open joints**

resulting from cleaning and repair work.

- Q7. Please confirm the task quantities listed on Drawing A-135 covers the scope listed for General Notes 2, 4 & 6.
- A7. **Task quantities for repair work (patching, material replacement) include overages, but conditions may have developed since survey that would require additional quantities. Bricks and tiles with 40% surface loss may result from cleaning. Cleaning quantities not included. Clean masonry 100% to an elevation 8' above finished floor unless otherwise noted. Repointing quantities not included, provide qualified bid for repointing of open joints including open joints resulting from cleaning and repair work. Woodwork quantities included.**
- Q8. Please confirm the task quantities listed on Drawing A-136 covers the scope listed for General Notes 4, 6 & 8.
- A8. **Task quantities for repair work (patching, material replacement) include overages, but conditions may have developed since survey that would require additional quantities. Bricks and tiles with 40% surface loss may result from cleaning. Cleaning quantities not included. Clean 100% of green glazed brick. All other quantities included.**
- Q9. Please confirm the task quantities listed on Drawing A-137 covers the scope listed for General Notes 2, 4, 5 & 6.
- A9. **Task quantities for repair work (patching, material replacement) include overages, but conditions may have developed since survey that would require additional quantities. Bricks and tiles with 40% surface loss may result from cleaning. Cleaning quantities not included. Clean masonry 100% to an elevation 8' above finished floor unless otherwise noted. All other quantities included in task quantities.**
- Q10. Please confirm the task quantities listed on Drawing A-138 covers the scope listed for General Notes 2, 5 & 6.
- A10. **Task quantities for repair work (patching, material replacement) include overages, but conditions may have developed since survey that would require additional quantities. Bricks and tiles with 40% surface loss may result from cleaning. Repointing quantities are not included, provide qualified bid for repointing/regrouting of open joints including open joints resulting from cleaning and repair work.**
- Q11. Drawing A-130, General Note under Stone states to rake & repoint all open limestone & bluestone mortar joints. Please quantify the amount of joints to be raked and repainted.
- A11. **Repointing quantities are not included, provide qualified bid for repointing/regrouting of open joints including open joints resulting from cleaning and repair work.**
- Q12. Drawing A-130, General Note under Glazed Brick & Tile notes to repoint or re-grout open tile joints to match existing grout or mortar. Please quantify the amount of joints to be raked and repainted.
- A12. **Repointing quantities are not included, provide qualified bid for repointing/regrouting of open joints including open joints resulting from cleaning and repair work.**
- Q13. Drawing A-130, HPS-5 is not called out or quantified on Drawings A-131 through A-139. Please provide quantities.
- A13. **HPS-5 is a typo on drawing A-131. Granite piers at base of steps are labeled "HPS-4" rather than "HPS-5" Task quantity for HPS-5 is 200sq ft. for cleaning and polishing at this location.**

Questions from D&K Construction Company, Inc.

- Q1. Liquidated damages will be assessed at 1/20 of 1%. Liquidated damages shall be in addition to other

compensatory or consequential losses or damages that the state may incur by reason of such delay, such as, but not limited to, added costs of the project and the cost of furnishing temporary services, if any. Please clarify what is the amount of liquidated damage?

- A1. **Liquidated damages will be assessed at 1/20 of one percent (.05%) of the value of this contract (minimum of \$250.00). Note: The value of this contract is your lump sum bid amount. Also see General Conditions: ARTICLE 7.5 - DELAY, DISRUPTION AND INTERFERENCE, 7.5.3 and 7.5.5.**

Questions from *Haverstick – Borthwick Company (RFI#1)*

- Q1. The restoration work related to the existing conditions and proposed finishes is difficult to quantify on the bid documents. Can an additional day during the week of Feb 16 to the 20th be provided for site visits?
- A1. **The State project team has allowed for two (2) secondary site visits. Due to project schedule limitations, the State project team will not be adding any additional days for contractor or sub-contractor site visits.**
- Q2. Per drawing A-131 thru A 139
The Task items provide information, scope and quantities. The General notes however inform us that there is work that is not in the Task items. For example is task item HPT -2 the same as general note #4 on dwg.131 ? If not, are glazed tiles that have 40% damaged limited to the Waiting room 101 under the Stringcourse ? Or is it the intent to replace any 40% damaged glazed tile in the building?
- A2. **The quantities listed for each task item include the general notes and overages. So if a tile with 40% damage is found that is not in a location where HPT-2 is called out, that tile should still be repaired in accordance with the HPT-2 treatment notes. This is intended to cover any conditions that developed after the survey was conducted. The scope of repairs is limited to areas under the stringcourse (except where specifically noted).**
- Q3. Per drawing A-131, For general note 5 [this is not a task item]
Please provide quantity required. Or it is the intent of the general note 5 that 100% of the mortar joints in the building are require to be raked out and repointed. Please clarify.
- A3. **Note should read “Rake and repoint open mortar joints” This is intended to cover any joints that are opened in the course of cleaning or repair as well as any joints that are currently open. Note this applies to drawings A-131, A-132, A-133, A-138. Quantity cannot be provided as it is intended to cover a future condition. Bidders should qualify bid by noting estimated percentage of repointing.**
- Q4. The drawings do not have any elevations, photos, plans of the concourse to determine the height of the Concourse or the sizes and quantity of trusses. Will any additional information be provided?
- A4. **No further drawings of the concourse are available, other than what is already provided in the bid set. The contractor should be able to estimate the quantities based on the provided data**
- Q5. Per drawing A-131, For general note 5 [this is not a task item]
Is all hardware to be removed cleaned and re-installed? This SCOPE requires removal of all doors in order to remove hinges, locksets , panic hardware, etc.
NOTE: There is no guarantee that the process of removing the screws to clean the hardware will not damage the historic fabric .Screws may not come out in one piece making reinstallation of the existing hinge or any other hardware in the original location an impossibility. Would a change order be issued to relocate the hinge or any other scope to dig out the remaining section of the fastener and install a different fastener? Please clarify.
- A5. **All wood doors and non-fixed windows have note HPW-5 “Test all interior windows and doors for operability. Repair damaged woodwork to operable condition and refinish to match existing. Retain existing hardware (see metals for treatment).” As part of this scope, all hardware is to be checked for operability and cleaned then reinstalled. Contractor is to use particular care when removing hardware from doors, etc. from historic fabric. Any damage done to historic fabric is to**

be repaired by the contractor as per General Note 3. This includes the use of wood fill, Dutchmen, etc. in accordance with the Woodwork Restoration specification. Anchors that cannot be removed intact may be cored out and the woodwork repaired to provide a sound substrate, but this is to be a last resort.

Questions from *Haverstick – Borthwick Company (RFI#2)*

- Q1. Drawing S-101 shows new 12" slab. Note #4 states 10" thick. Drawing S-201 Section A shows 10" base slab. Please clarify.
A1. **Note #4 is correct – Slab is 10" thick.**
- Q2. All platforms are galvanized. Is there any paint required in addition to the galvanizing?
A2. **The galvanized platforms are not painted.**
- Q3. Drawing S-311 Detail 1 concrete pad for relocated transformer Note #2 anchorage of transformer to concrete pad is to be designed and detailed by others. Who is "others"?
A3. **Anchorage is to be by PSE&G per their typical details. The contractor is responsible for all coordination with all utility providers including PSE&G.**
- Q4. Drawing A-051 Space 103A Note 03b – is this work already completed? Isn't the existing drywall already removed where it shows on the drawings to be removed?
A4. **Some of this work has been done by the using agency, but it is not completed. The contractor shall be responsible for the complete removal, selective demolition, cleaning, cutting, trimming, and the rest of scope of work as delineated in the contract drawings & spec.**
- Q5. Does the underside of the East and West Concourse concrete ceiling get painted?
A5. **Concourse scope of work – See drawing A-111 note 14a.**
- Q6. On Drawing A-140 – is the total amount of pointing 2,000 linear feet in the areas marked HPF-1?
A6. **For drawing A-140 – 2000 linear feet includes areas noted on drawing plus overages for joints opened during course of work/cleaning.**
- Q7. Spec section 096400 wood flooring – where does this apply? Please provide room numbers if applicable.
A7. **Wood Flooring is in Room 108a – Ticketing.**
- Q8. Are the electric heater for the fire tank and the air compressor part of the pre-purchase for the fire suppression system?
A8. **The cited electric heater for the fire tank and the air compressor are part of this bid package (P1107-00) and are not part of the pre-purchase contract (P1107-02). For the exact scope of materials, equipment, services and other components of the pre-purchase package (P1107-02), please refer to Bulletin C, which includes both the bid documents of the package, as well as the submittals by Gabe Sganga Inc. Any / All items, materials, equipment, services and / or other components that are not part of the pre-purchase package (P1107-02) shall be part of and included in this bid (P1107-00).**
- Q9. It is my understanding that there may be water in the crawl space due to the river being tidal. Can you verify this?
A9. **This is correct. The contractor shall be responsible for verifying the existing conditions in the crawl space.**

- Q10. On Drawing E-002 Detail 1 – who is responsible to demolish the existing 13.8 KV primary conduit and feeders? Does PSE&G demolish the switchgear, meter and generator?
- A10. **The contractor is responsible to demolish the existing 13.8kV conduit, switchgear, meter and generator. PSE&G is responsible for removing the feeders. The contractor is responsible for the excavation, backfill, conduits and concrete work. The contractor is responsible for the demolition of the conduit; PSE&G is responsible for the primary (medium voltage) feeder.**
- Q11. On Drawing E-002 Detail 2 – Is PSE&G responsible for the excavation, backfill, conduits and concrete work?
- A11. **See electrical responses above (A10).**
- Q12. On Drawing E-010 –who is responsible to demolish PSE&G incoming medium voltage line?
- A12. **See electrical responses above (A10).**

Per spec section 099123 Interior Painting
Section A – Work included but not limited to:

1. Painting of all exposed surfaces whether or not included on drawings or schedule

Q13. Does this mean the entire building gets painted?

A13. **No**

Q14. Is there any painting required on the exterior?

A14. **The scope of painting is defined on the drawings.**

Q15. At the walk-thru we were informed that the concourse steel column and trusses, and the ceiling get painted; however, no document or finish schedule of this area is shown. Will concourse documents be issued?

A15. **Concourse scope of work – See drawing A-111 note 14a. No further documents will be issued.**

2. Painting of all exposed bare and covered pipe and ducts (including color coding), primed metal surfaces.

Q16. Is this for all work in the building?

A16. **The areas subject to this scope of work are defined on the drawings**

Q17. Is this also for crawl space?

A17. **Yes**

Q18. Is this also for exterior piping?

A18. **Yes as defined on the drawings.**

Q19. Is this for all existing and new piping?

A19. **Both, as defined on the drawings.**

Q20. Is this also for conduit?

A20. **THE CONDUITS SHALL NOT BE COLOR-CODED. For HVAC work, Anticorrosive paint, insulation, jacketing and indication specified in div 23.**

Questions from Haverstick – Borthwick Company (RFI#3)

Q1. On the bid form pages 4 through 6 are for unit prices. Under the unit prices are line items for adds and deducts. Are we to assume that we will provide an add price only. That all of the “adds” will be totaled at the end and will be subtracted from the line item allowances.

The remaining money would then be credited back to the state? Is this correct?

A1. **Yes, that is correct. The deduct fields of the Bid Proposal Form should be left blank.**

Questions from *Haverstick – Borthwick Company (RFI#4)*

Q1. DRAWING A-111 – Room 103A Note b – Furnish/Install new gypsum wall board 9'-0" AFF and metal studs – on drawing A-134 it shows the drywall is removed to approximately 5' to 7' AFF – Do we remove the remaining drywall up to 9' AFF. Also are new metal studs required. Is it required to remove and reinstall the existing door and window moldings to perform this work?

A1. **Some of the existing dry walls have been partially removed by the owner, but this removal is incomplete since some dry walls & most of the damaged studs still remain & require removal. As indicated on the contract drawings & the spec (selective demolition), the contractor shall be responsible for removing all dry walls & existing damaged studs & wall framing to the indicated height(s). Any / all removed studs & wall framing shall be replaced in kind with new sections. The existing doors, frames, moldings and any other fixtures may need to be removed & reinstalled, as required to complete the work. This is means & methods.**

Questions from *Paul Otto Building Company*

Q1. Note # 6 on drawings HA.1 states "contractor shall clean and preserve the stained glass ceiling..." Can you provide additional clarification as to the scope of work related to this note? Also, please advise as to what hazardous elements apply to the stained glass, or direct us to where this information is contained in the documents.

A1. **Please see Specification Section 028501 – Mold Remediation, including, but not limited to, Section 3.2 Description of Work**

Q2. Would it be possible to gain access to the building for one more additional walk through? Coordination of multiple vendors schedule is a difficult task, therefore, it was difficult to have all vendors present for the pre-bid mtg. and subsequent walk through dates, which were the next two days following. Wednesday 2/18/15 at 11:00am would be ideal if amenable.

A2. **The State project team has allowed for two (2) secondary site visits. Due to project schedule limitations, the State project team will not be adding any additional days for contractor or sub-contractor site visits.**

Questions from *Merrell & Garaguso*

Q1. On Print E-212 There are (2) Remote Heads outside of Room # 101---Where are these tied too, it doesn't show?

A1. **STV assumes the two remote heads are along the west wall in between columns E and G. These two remote heads are connected to the concourse outside of the building. No work is required for these.**

Q2. Who is responsible for the purchase of all of the Mechanical Disconnects that are being replaced on all of the Mechanical equipment?

A2. **The General Contractor is responsible for purchase of equipment.**

Q3. Who is the current Fire Alarm Vender that is Maintaining and Monitoring the Fire Alarm System for this complex?

A3. **Triad Security. The current account manager is John Ornowski.**

Q4. Please clarify/explain NOTE # 21 on Print # E-001? The Allowance should be a Fixed amount set by the NJDPMC?

A4. **Note 21 shall be revised as follows:**

IT IS THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR TO INSPECT THE EXISTING CONDITIONS AND IDENTIFY ALL ELECTRICAL ITEMS OUTSIDE THE SCOPE OF WORK AREA AND THAT ARE AFFECTED AS A RESULT OF THE NEW WORK. THE ELECTRICAL CONTRACTOR SHALL NOTIFY THE DESIGN TEAM AND THE STATE OF ANY UNFORESEEN CONDITIONS NOT IDENTIFIED IN THESE DOCUMENTS PRIOR TO COMMENCING WORK.

- Q5. Is it possible to get a better Print (more clear) conduit Plans for the crawl Space Prints E-011 & E-111)?
A5. See attached PDFs.
- Q6. Please confirm that the existing Electrical Panels that are stated Existing to Remain (ER), are in fact staying, as they are not listed under the Panel Schedules: LP-3P, LP-1A, LP-2N?
A6. Per E-400, Panel LP-2N is existing to remain and Panels LP-3P and LP-1A are to be demolished. Per E-401, Panel LP-3P will be replaced by LP-FPP, via pull boxes, and Panel LP-1A will be replaced in its existing location.
- Q7. Please confirm that the following Panels are being installed, they are listed in the One-Line Diagram, but do not show up in the Panel Schedules: Panel-K (S1 & S2), and LP1A?
A7. Panel K is existing to be demolished. Replacement Panel LP-1A panel schedule is located on drawing E-503.

SUPPLEMENTARY GENERAL INFORMATION

A) Bid Proposal Form, Unit Prices - DEDUCT fields should be left blank.

B) NOTICE OF POST-BID MEETING:

- a. After the bids are received and opened, the Apparent Low Bidder is required to attend a Post-Bid meeting at the State's offices at the date, time and location listed herein.
- b. The Apparent Low Bidder must bring the following to the Post-Bid meeting concerning the work they are performing by their own forces.
 - i. A detailed breakdown of your 180 day construction schedule
 - ii. The itemized estimate used in preparation of the bid submission
 - iii. The estimator, or other authorized person who can discuss the itemized estimate
 - iv. An employee of the company who is authorized to sign the Post-Bid Review meeting minutes.
- c. Each if the Apparent Low Bidder's "Named Sub-Contractors" must attend the meeting and bring the following concerning the work they are performing by their forces:
 - i. The itemized estimate used in preparation of the bid submission
 - ii. The estimator, or other authorized person who can discuss the itemized estimate
- d. A Post-Bid meeting will be held:
DATE: 2/26/15
TIME: 10:00AM
LOCATION: 20 West State Street, 3rd Floor Conference Room North, Trenton, NJ 08625

C) SECTION 02 85 01 – MOLD REMEDIATION

1.2 CONTRACTOR REQUIREMENTS AND QUALIFICATIONS

- A. Bidders or sub-contractors must be prequalified by the State of New Jersey, Department of the Treasury, Division of Property Management and Construction for C103 Microbial Remediation.

Delete 1.2.A. and replace with the following:

A. It is recommended, but not required, that the General Contractor select a subcontractor Classified in C103 Microbial Remediation for the work scheduled as part of this section.

D) AMENDMENTS TO THE GENERAL CONDITIONS OF THE CONTRACT

Amend the General Conditions of the Contract as follows:

ARTICLE 4 – THE CONTRACTOR

4.12 TEMPORARY FACILITIES

4.12.1 Field Offices -

Add the following sub-paragraph

4.12.1.1 (Added) – *The Contractor's required field office must be a field office to be shared with DPMC and owner which includes a common meeting room, internet access via mobile hotspot and printer.*

4.20 DPMC FIELD OFFICE

Delete 4.20.1 in its entirety:

Delete 4.20.2 in its entirety:

Add the following sub-paragraph:

4.20.3 (Added) – *A separate on-site field office for the use of DPMC personnel is not required for this project.*

Note: Contractor must still comply with 4.12 TEMPORARY FACILITIES in General Conditions and added paragraph 4.12.1.1 of 4.12.1 Field Offices as stated above.

ARTICLE 6 – CONSTRUCTION PROGRESS SCHEDULE

Revise Article 6 as follows:

6.1 GENERAL

Delete 6.1 in its entirety

Add the following sub-paragraph

6.1.1 (Added) **GENERAL**

The Contractor shall be required to provide Graphic Progress Schedules, as defined in section 6.4 below.

6.2 CONSTRUCTION PROGRESS SCHEDULE (CRITICAL PATH METHOD – CPM CONSULTANT RETAINED BY THE STATE).

Delete 6.2 in its entirety:

6.3 CONSTRUCTION PROGRESS SCHEDULING PROVIDED BY THE CONTRACTOR

Delete 6.3 in its entirety:

Add the following sub-paragraphs:

6.4 CONSTRUCTION PROGRESS SCHEDULING: GRAPHIC FORMAT. (Added)

6.4.1 (Added) *The contractor shall be responsible for preparing and furnishing to the Director through the architect/engineer, before the first contract requisition date or other date specified by the State, a progress schedule that incorporates all of the work included in the project. The schedule shall be in the form of an arrow network diagram, bar chart or other recognized graphic progress schedule format, in sufficient detail to satisfy the architect/engineer and the Director. This submission shall be no later than thirty 30 calendar days after the award of the contract.*

6.4.2 (Added) *The progress schedule, based upon the contractor's logic and time estimates, shall indicate in suitable detail for display, all significant features of the work, including the placing of orders and anticipated delivery dates for critical items, submissions and approvals of shop drawings, all work activities to be performed, the beginning and time duration thereof, and the dates of substantial and final completion of the work.*

6.4.3 (Added) *Immediately upon such approval, the contractor shall prepare and distribute copies of the schedules in the format and quantity as required by the Director for his, the project's and the architect/engineer's use.'*

6.4.4 (Added) *The contractor shall furnish sufficient labor and construction plant and equipment to ensure the prosecution of the work in accordance with the project schedule. If the latest completion time for any significant task does not come within the time allowed by the project schedule, the sequence of tasks and/or the time for performance of tasks shall be revised by the contractor through concurrent operations, additional manpower, additional shifts, overtime, etc. until it is assured that the contract completion date will be met. No additional charges to the State will be allowed the contractor for overtime, additional manpower, equipment, additional shifts, etc. (except as may be provided elsewhere in the contract), if such expediting procedures or measures are necessary to meet the agreed completion date.*

6.4.5 (Added) *Each contractor agrees that it will make no claim for, and have no right to, additional payment or extension of time for completion of the work, or any other concession because of any misinterpretation or misunderstanding on the contractor's part of the project schedule, the contractor's failure to attend the pre- bid conference, or because of any failure on the contractor's part to become fully acquainted with all conditions relating to the project schedule and the manner in which it will be used on the project, or because of any other contractor's failure to properly participate in the development of a schedule or to perform the contract in accordance with the schedule.*

6.4.5 (Added) *At each biweekly project meeting, the contractor shall provide an updated project schedule that includes all activities; including any activities added for change order work approved to date. The updated progress schedule shall include the progress achieved for each activity that was scheduled including the actual dates the work was started and completed. The contractor agrees that this information shall constitute the official historical record of project progress.*

6.4.6 (Added) *At each biweekly project meeting the contractor shall also provide a two week "look ahead" schedule/work plan. This schedule/work plan shall focus on the activities to be completed in the next two week period. This schedule/work plan shall be in greater detail than the overall project schedule. This schedule/work plan shall include, but not be limited to, the contractor's activities that impact the*

operations and occupants of the State building or facility.

6.4.7 (Added) The contractor shall include a copy of the most recent updated project schedule with each progress payment request. Failure to include an updated project schedule with each progress payment request shall be cause for rejection of the progress payment request.

END OF BULLETIN "D"

Project no. P1107-00
 Project name: CRRNJ
 Interior and MEP Restoration



STATE OF NEW JERSEY
 DEPARTMENT OF TREASURY
 DIVISION OF CONTRACTS &
 CONSTRUCTION

STV Architects, Inc.
 800 Blair Street, Suite 700
 Trenton, NJ 08611-1211

STV INC.
 225 Park Avenue, Suite 200
 New York, NY 10021-3217

BLACCI Inc.
 300 Alexander Park, Suite 360
 Princeton, New Jersey 08540

ARCHITECTURAL CONSULTANTS
 JAE DESIGN BUILDING CONSULTATION, INC.
 40 West 27th Street, Suite 121
 New York, NY 10001

USA Environmental Management, Inc.
 24 West Bragg Street
 Trenton, New Jersey 08611

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 24 West Bragg Street
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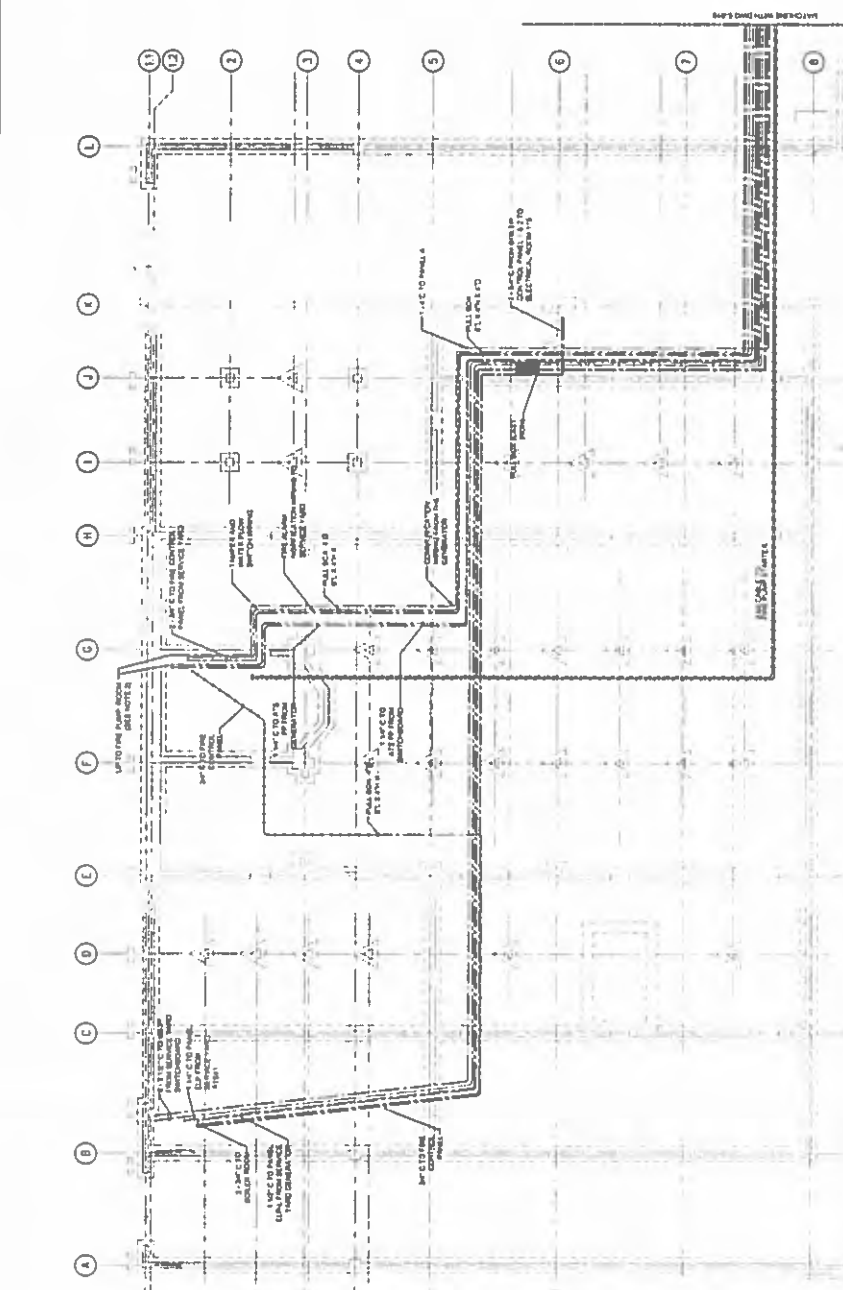
USA Environmental Management, Inc.
 24 West Bragg Street
 Trenton, New Jersey 08611

E-011

**ELECTRICAL
 CRAWL SPACE
 DEMOLITION PLAN**

GENERAL NOTES:
 1. ALL EXISTING ELECTRICAL WORK TO BE DEMOLISHED AS SHOWN.
 2. DEMOLITION TO BE ACCORDING TO ALL APPLICABLE REGULATIONS AND PERMITS.
 3. ALL DEMOLITION TO BE COMPLETED WITHIN THE SPECIFIED TIME FRAME.
 4. ALL DEMOLITION TO BE ACCORDING TO ALL APPLICABLE REGULATIONS AND PERMITS.
 5. ALL DEMOLITION TO BE ACCORDING TO ALL APPLICABLE REGULATIONS AND PERMITS.

NO.	DESCRIPTION
1	EXISTING TO REMAIN CONDUIT AND CABLE
2	EXISTING TO DEMOLISH CONDUIT CASES (TYPE DEMOLISHED)
3	TO BE DEMOLISHED CONDUIT AND CABLE



ⓐ CRAWL SPACE POWER PLAN - DEMOLITION
 SCALE 3/8" = 1'-0"

- REMOVE ALL EXISTING ELECTRICAL WORK AS SHOWN.
- DEMOLISH ALL EXISTING CONDUIT CASES (TYPE DEMOLISHED).
- REMOVE ALL EXISTING CONDUIT AND CABLE.
- REMOVE ALL EXISTING ELECTRICAL WORK AS SHOWN.
- DEMOLISH ALL EXISTING CONDUIT CASES (TYPE DEMOLISHED).
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- REMOVE ALL EXISTING ELECTRICAL WORK AS SHOWN.
- DEMOLISH ALL EXISTING CONDUIT CASES (TYPE DEMOLISHED).
- REMOVE ALL EXISTING CONDUIT AND CABLE.

GENERAL NOTES:
 1. ALL EXISTING ELECTRICAL WORK TO BE DEMOLISHED AS SHOWN.
 2. DEMOLITION TO BE ACCORDING TO ALL APPLICABLE REGULATIONS AND PERMITS.
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3	TO BE DEMOLISHED CONDUIT AND CABLE

Project no. P1107-00
 Project name: CRRNJ
 Interior and MEP Restoration



STATE OF NEW JERSEY
 DEPARTMENT OF TREASURY
 DIVISION OF PROPERTY MANAGEMENT &
 CONSTRUCTION

STV Architects, Inc.
 120 West 57th Street, Suite 202
 New York, NY 10019-1121

STV Inc.
 225 Park Avenue South
 New York, NY 10003-3237

DRS, L.P.
 100 West 57th Street, Suite 202
 New York, NY 10019-1121

CONSTRUCTION CORPORATION INC
 40 West 57th Street, 8th Fl.
 New York, NY 10019

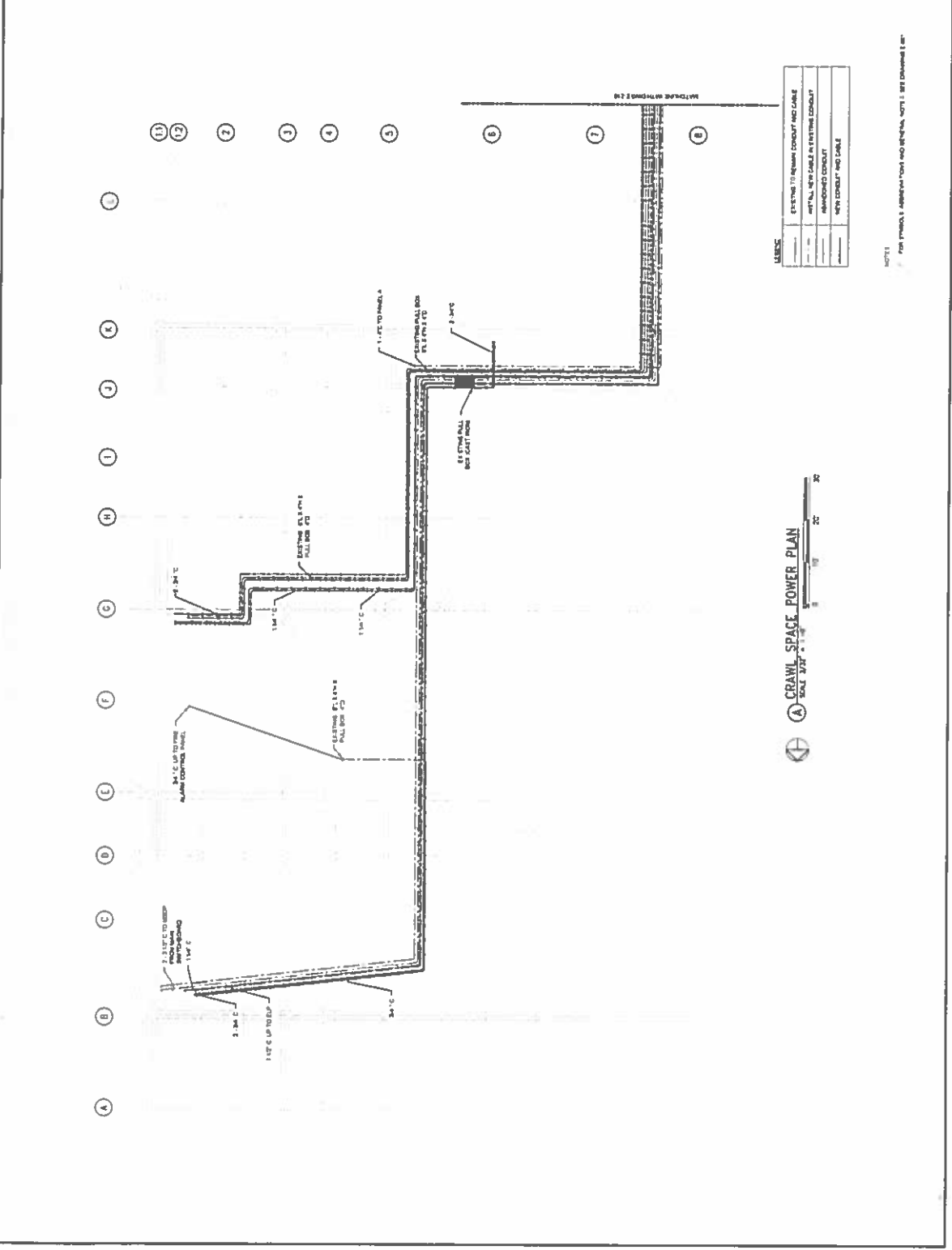
USA Environmental Management, Inc
 344 West 34th Street
 New York, NY 10018

VJI Associates & Associates
 5 Ryeport Street, Suite 214
 Livingston, New Jersey 07033

VJ Associates of New Jersey, Inc
 1500 Long Complex Road, Suite 300
 Eatontown, New Jersey 08817

No.	Date	Final CD Submittal
1	12/20/11	Final CD Submittal
2	01/10/12	Final CD Submittal
3	02/02/12	Final CD Submittal
4	02/02/12	Final CD Submittal
5	02/02/12	Final CD Submittal
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100	02/02/12	Final CD Submittal

Project: Central Railroad of New Jersey (CRRNJ)
 Electrical Building
 100 West 57th Street
 New York, NY 10019-1121
 Drawing No: E-111
 Date: December 30, 2014
 Scale: 1/8" = 1'-0"
 Sheet: 1 of 175



LEGEND

---	EXISTING 1 1/2" RIGID CONDUIT AND CABLE
- - -	NEW 1 1/2" RIGID CONDUIT AND CABLE
---	NEW 1/2" RIGID CONDUIT AND CABLE
---	NEW 1/2" RIGID CONDUIT
---	NEW CONDUIT AND CABLE

NOTES:
 1. FOR FINISH, REFER TO ARCHITECTURAL DRAWINGS.

SCALE: 1/8" = 1'-0"



ELECTRICAL CRAWL SPACE POWER PLAN

PART I: INSTRUCTIONS TO BIDDERS AND GENERAL CONDITIONS

INSTRUCTIONS TO BIDDERS & GENERAL CONDITIONS

PART II: TECHNICAL SPECIFICATIONS

DIVISION 01 - GENERAL REQUIREMENTS

012100 ALLOWANCES
012221 UNIT PRICES FOR FIRE PROTECTION
012222 UNIT PRICES FOR PLUMBING
013300 SUBMITTAL PROCEDURES
013591 HISTORIC TREATMENT PROCEDURES
014000 QUALITY REQUIREMENTS
014200 REFERENCES
015000 TEMPORARY FACILITIES AND CONTROLS
015410 BUILDING SECURITY AND CONTRACTOR USE OF THE PREMISES
017300 EXECUTION
017700 CLOSEOUT PROCEDURES
017823 OPERATION AND MAINTENANCE DATA

DIVISION 02 - EXISTING CONDITIONS

024119 SELECTIVE DEMOLITION
024500 REMOVAL, STOCKPILE AND DISPOSAL OF HISTORIC FILL MATERIAL
026000 MISCELLANEOUS HAZARDOUS MATERIALS REMOVAL
028210 HAZARDOUS MATERIAL ASBESTOS ABATEMENT – ROOFING
028300 LEAD-BASED PAINT RELATED WORK
028501 MOLD REMEDIATION

DIVISION 03 – CONCRETE

031000 CONCRETE FORMWORK
032000 CONCRETE REINFORCEMENT
033000 CAST-IN-PLACE CONCRETE

DIVISION 04 - MASONRY

040130 INTERIOR MASONRY RESTORATION
040140 INTERIOR MASONRY CLEANING
042000 UNIT MASONRY
042116 INTERIOR GLAZED BRICK AND TILE RESTORATION

DIVISION 05 – METALS

051200 STRUCTURAL STEEL
055000 METAL FABRICATIONS
055119 METAL GRATING STAIRS

055213 PIPE AND TUBE RAILINGS
055313 BAR GRATINGS
057000 ORNAMENTAL METAL RESTORATION
057330 DECORATIVE METAL GATES

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

060140 ARCHITECTURAL WOODWORK RESTORATION
061053 MISCELLANEOUS ROUGH CARPENTRY

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

070150.19 PREPARATION FOR REROOFING
071416 COLD FLUID-APPLIED WATERPROOFING
072100 THERMAL INSULATION
075216 STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE
ROOFING
076200 SHEET METAL FLASHING AND TRIM
078413 PENETRATION FIRESTOPPING
079200 JOINT SEALANTS

DIVISION 08 - OPENINGS

081113 HOLLOW METAL DOORS AND FRAMES
083113 ACCESS DOORS AND FRAMES
087100 DOOR HARDWARE
088000 GLAZING

DIVISION 09 - FINISHES

092116.23 GYPSUM BOARD SHAFT WALL ASSEMBLIES
092216 NON-STRUCTURAL METAL FRAMING
092900 GYPSUM BOARD
096400 WOOD FLOORING
096516 RESILIENT SHEET FLOORING
099123 INTERIOR PAINTING

DIVISION 10 – SPECIALTIES

102800 TOILET ACCESSORIES

DIVISION 12 - FURNISHINGS

122113 HORIZONTAL LOUVER BLINDS
123661 SIMULATED STONE COUNTERTOPS

DIVISION 14 – CONVEYING EQUIPMENT

140120 MAINTENANCE OF ELEVATORS
142423 HYDRAULIC PASSENGER ELEVATORS

DIVISION 21 - FIRE SUPPRESSION

210513	COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT
210517	SLEEVES AND SLEEVE SEALS FOR FIRE SUPPRESSION PIPING
210518	ESCUTCHEONS FOR FIRE SUPPRESSION PIPING
210533	HEAT TRACING FOR FIRE SUPPRESSION PIPING
210548	VIBRATIONS AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENTS
210553	IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT
210585	FIRE PROTECTION FIRESTOPPING
211200	FIRE-SUPPRESSION STANDPIPES
211313	WET-PIPE SPRINKLER SYSTEMS
211316	DRY-PIPE SPRINKLER SYSTEMS
213213	ELECTRICAL DRIVEN VERTICAL TURBINE FIRE PUMPS WITH PRE-FABRICATED PUMP HOUSE

DIVISION 22 - PLUMBING

220513	COMMON MOTOR REQUIRMENTS FOR PLUMBING EQUIPMENT
220517	SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING
220518	ESCUTCHEONS FOR PLUMBING PIPING
220519	METER AND GAGES FOR PLUMBING PIPING
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220533	HEAT TRACING FOR PLUMBING PIPING
220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220719	PLUMBING PIPING INSULATION
221116	DOMESTIC WATER PIPING
221119	DOMESTIC WATER PIPING SPECIALTIES
221316	SANITARY WASTE AND VENT PIPING
221319	SANITARY WASTE PIPING SPECIALTIES
221329	SANITARY SEWERAGE PUMPS
221413	FACILITY STORM DRAINAGE PIPING
221423	STORM DRAINAGE PIPING SPECIALTIES
223300	ELECTRIC, DOMESTIC-WATER HEATERS
224213.13	COMMERCIAL WATER CLOSETS
224213.16	COMMERCIAL URINALS
224216.13	COMMERCIAL LAVATORIES
224216.16	COMMERCIAL SINKS
224713	DRINKING FOUNTAINS

DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING

230130	HVAC AIR-DISTRIBUTION SYSTEM CLEANING
230130.51	HVAC AIR-DISTRIBUTION SYSTEM CLEANING (SUPPLEMENTAL)
230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230517	SLEEVES AND SLEEVE SEALS FOR HVAC PIPING
230518	ESCUTCHEONS FOR HVAC PIPING
230519	METERS AND GAGES FOR HVAC PIPING

230523	GENERAL-DUTY VALVES FOR HVAC PIPING
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
230548	VIBRATION AND SEISMIC CONTROLS FOR HVAC
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230716	HVAC EQUIPMENT INSULATION
230719	HVAC PIPING INSULATION
230900	INSTRUMENTATION AND CONTROL FOR HVAC
230993	SEQUENCE OF OPERATIONS FOR HVAC CONTROLS
231123	FUEL GAS PIPING
232113	HYDRONIC PIPING
232115	CONDUIT PIPING SYSTEMS
232116	HYDRONIC PIPING SPECIALTIES
232513	WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS
235100	BREECHINGS, CHIMNEYS, AND STACKS
238229	RADIATORS
238236	FINNED-TUBE RADIATION HEATERS
238239.13	CABINET UNIT HEATERS
238239.16	PROPELLER UNIT HEATERS

DIVISION 26 - ELECTRICAL

260500	COMMON WORK RESULTS FOR ELECTRICAL
260507	ACCESS DOORS AND COLOR-CODED IDENTIFICATION IN GENERAL CONSTRUCTION
260510	ELECTRICAL GENERAL
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
260548	VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
260923	LIGHTING CONTROL DEVICES
262213	LOW-VOLTAGE DISTRIBUTION TRANSFORMERS
262413	SWITCHBOARDS
262416	PANELBOARDS
262726	WIRING DEVICES
262813	FUSES
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
263213	DIESEL ENGINE-DRIVEN GENERATOR SET
264300	SURGE PROTECTIVE DEVICE SYSTEM
265100	INTERIOR LIGHTING

DIVISION 31 - EARTHWORK

316299 MICROPILES

PART III: APPENDICES

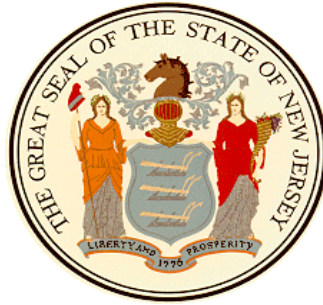
APPENDIX A - GEOTECHNICAL REPORT

APPENDIX B –HEALTH AND SAFETY PLAN

APPENDIX C - HAZARDOUS MATERIALS REPORT

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STATE OF NEW JERSEY
DEPARTMENT OF THE TREASURY
DIVISION OF PROPERTY MANAGEMENT AND CONSTRUCTION



REVISED
MAY 2014

INSTRUCTIONS TO BIDDERS
AND
GENERAL CONDITIONS

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INSTRUCTIONS TO BIDDERS

IB 1 Bid Proposals

IB 1.1 Sealed proposals for the work described herein must be received and time-stamped in the Plan Room, Division of Property Management and Construction (DPMC), 9th Floor, 33 West State Street, P O Box 034, Trenton, NJ 08625-0034. The closing date and time for bids will be stated in the Advertisement for Bid. Bidders are cautioned that reliance on the US Postal Service or other mail delivery or courier service for timely delivery of proposals is at the bidders' risk. Failure by a bidder to have a sealed proposal reach DPMC by the prescribed time will result in rejection of the unopened submission.

IB 1.2 Bids may be accepted on the following branches of work, as applicable:

- a. Lump Sum All Trades
- b. General Construction
- c. Structural Steel
- d. Plumbing
- e. Heating, Ventilating and Air Conditioning
- f. Electrical
- g. Special Categories as may be required

IB 1.3 Contractors classified by DPMC may obtain contract documents at the DPMC address above, or upon written request, subject to payment of applicable fees. Each bidder is herewith put on notice that its general classification by DPMC is not the sole basis for qualification for the award of work. The Director reserves the right to deny award to any bidder that is not clearly responsible, based upon experience, past performance, financial capability or other material factors, to perform the work required herein.

IB 1.4 The schedule of non-refundable bid fees below is based upon individual trade construction cost estimates. Upon request and at no cost the DPMC will furnish a set of the contract documents for review in the offices of the division at the address noted in paragraph IB1.1 above.

DPMC BID DOCUMENTS FEE SCHEDULE (PER PACKAGE):

<u>TRADE ESTIMATE</u>	<u>DOCUMENT FEE</u>	<u>MAILING FEE</u>
\$100,000 or less	No charge	\$25.00
Greater than \$100,000	\$ 65.00	\$25.00

IB 1.5 Bid proposals based upon the plans, specifications, general, special and supplementary conditions and bulletins shall be deemed as having been made by the contractor with full knowledge of the conditions therein. Bidders are required to visit the site prior to submitting proposals for the work herein described, and to have thoroughly examined the conditions under which the contract is to be executed, including those reasonably observable conditions of the premises which would hinder, delay, or otherwise affect the performance of the contractor required under the terms of the contract. The State will not allow claims for additional costs as a result of the contractor's failure to become aware of the reasonably observable conditions affecting its required performance. The bidder is required to make appropriate allowances in the preparation of the bid for the

accommodation of such conditions. Bidders must warrant in the bid documents that the bidder is familiar with conditions existing at the site at the time the bid is submitted.

IB 1.6 Bid proposals shall be submitted on the standard form provided by DPMC, enclosed in a sealed envelope issued by DPMC. The name and address of the bidder must be indicated on the envelope, as well as indication of the DPMC project number, project location and other appropriate identification.

IB 1.7 All amounts in the bid documents shall be stated in numerical figures only.

IB 1.8 The bidder must include in the bid envelope: (1) the proposal signed by the bidder, (2) the executed affidavit of non-collusion, (3) the executed Source Disclosure Certification Form as further described in section IB1.11, (4) the executed Disclosure of Investment Activities in Iran Form and (5) bid security as further described in Section IB6.

IB 1.9 Proposals shall remain open for acceptance and may not be withdrawn for a period of 60 calendar days after the bid opening date.

IB 1.10 Proposals not submitted and filed in accordance with instructions contained herein and in the Advertisement for Bids may be rejected as non-responsive.

IB 1.11 Procurement Reform

- a. **RESTRICTIONS ON POLITICAL CONTRIBUTIONS** – In accordance with N.J.S.A. 19:44A-20.13, *et seq.*, bidders submitting a bid on or after October 15, 2004, shall be required to submit a Certification and Disclosure Form and Ownership Disclosure Form for all Business Entities. These forms must be submitted by the bidder and approved prior to contract award.

N.J.S.A. 19:44A-20.13, *et seq.*, prohibits State departments, agencies and authorities from entering into a contract that exceeds \$17,500 with an individual or entity that has made a contribution to that political party committee. N.J.S.A. 19:44A-20.13, *et seq.*, further requires the disclosure of all contribution to any political organization organized under section 527 of the Internal Revenue Code that also meets the definition of “continuing political committee” within the meaning of N.J.S.A. 19:44A-3(n) and N.J.A.C. 19:25-1.7. The successful bidder shall also be required to adhere to all continuing obligations contained in N.J.S.A. 19:44A-20.13, *et seq.*, regarding contributions and disclosures as required in N.J.S.A. 19:44A-20.13, *et seq.*

- b. **Source Disclosure Certification** - Pursuant to N.J.S.A. 52:34-13.2, *et seq.*, all bidders submitting a proposal shall be required to complete a Source Disclosure Certification that all services will be performed in the United States. The bidder shall disclose the location by country where services under the contract will be performed and any subcontracted services will be performed. The Source Disclosure Certification will be attached to the bid proposal.
- c. **MacBride Principles** - Pursuant to N.J.S.A. 52:34-12.2, a bidder must complete a certification on the DPMC form provided prior to contract award to attest, under penalty of perjury, that neither the person or entity, nor any of its parents, subsidiaries, or affiliates pursuant to N.J.S.A. 52:34-12.2, that the bidder has no ongoing business activities in Northern Ireland and does not maintain a physical

presence therein through the operation of offices, plants, factories, or similar facilities, either directly or indirectly, through intermediaries, subsidiaries or affiliated companies over which it maintains effective control; or will take lawful steps in good faith to conduct any business operations it has in Northern Ireland in accordance with the MacBride principles of nondiscrimination in employment as set forth in N.J.S.A. 52:18A-89.8 and in conformance with the United Kingdom's Fair Employment (Northern Ireland) Act of 1989, and permit independent monitoring of their compliance with those principles. If a contractor who would otherwise be awarded a contract or agreement does not complete the certification, then the Director may determine, in accordance with applicable law and rules, it is in the best interest of the State to award the contract or agreement to the next responsible bidder who has completed the certification. If the Director finds the contractor to be in violation of the principles which are the subject of this law, s/he shall take such action as may be appropriate and provided for by law, rule or contract, including, but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the contractor in default and seeking debarment or suspension of the contractor.

- d. Investment Activities in Iran - Pursuant to N.J.S.A. 52, 32-55, *et seq.*, any person or entity that submits a bid or proposal or otherwise proposes to enter into or renew a contract must complete a certification with their bid on the DPMC form provided to attest, under penalty of perjury, that neither the person or entity, nor any of its parents, subsidiaries, or affiliates, is identified on the Department of Treasury's Chapter 25 list as a person or entity engaging in investment activities in Iran. The Chapter 25 list is found on the Division of Purchase and Property's website at www.state.nj.us/treasury/purchase/pdf/Chapter25List.pdf. Bidders must review this list prior to completing the certification. Failure to complete the certification may render a bidder's proposal non-responsive. If the Director finds a person or entity to be in violation of law, s/he shall take action as may be appropriate and provided by law, rule or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the party.

IB 2 Bid Modification

IB 2.1 A bidder may modify its bid proposal by electronic mail or letter at any time prior to the scheduled closing time for receipt of bids, provided such communication is received by the DPMC prior to such closing time. A mailed confirmation of any modification signed by the bidder must have been mailed and time-stamped by the US Postal Service prior to the specified closing time. Such confirmation, whether transmitted electronically or by mail, shall be accompanied by a newly executed affidavit of non-collusion.

IB 2.2 Communications shall not reveal the basic bid price but shall only provide the amount to be added, subtracted or modified so that the final prices or terms will not be revealed until the sealed proposal is opened. If written confirmation of the telegraphic modification is not received within two working days after the scheduled closing time, no consideration will be given to the telegraphic modification.

IB 2.3 Bids may be withdrawn upon receipt of a bidder's written request prior to the time fixed for the bid opening. A bidder's right to withdraw a bid is lost after a bid has been opened. If an error has been made in the bid amount, request for relief from the bid may be made in writing to the Director. The written request shall be signed by an authorized corporate officer. A determination of whether the bidder will be released shall be at the sole discretion of the Director, who shall issue a finding within five working days of receipt of all pertinent information relating to such request for relief.

IB 3 Consideration of Bids

IB 3.1 Award of Contracts or Rejection of Bids:

- a. Contracts will be awarded to the lowest responsible bidder. The awards will be made, or the bids rejected, within 60 calendar days from the date of the opening of bids. At the discretion of the Director, a bid extension may be requested from the bidders if circumstances warrant an extension.
- b. The Director reserves the right to award the contract on the basis of the single bid for the entire work, or on the basis of a separate bid and alternate, or any combination of separate bids and alternates, which the Director deems best serves the interest of the State.
- c. The Director reserves the right to waive any bid requirements when such waiver is in the best interests of the State, and where such waiver is permitted by law. Such waiver shall be at the sole discretion of the Director.
- d. The Director reserves the right to reject any and all bids when such rejection is in the best interests of the State. The Director also may reject the bid of any bidder which, in the Director's judgment, is not responsible or capable of performing the contract obligations based on financial capability, past performance, or experience. A bidder whose bid is so rejected may request a hearing before the Director by filing a written notice.

IB 3.2 The bidder to be awarded the contract shall execute and deliver the requisite contract documents, including payment and performance bonds, within the time specified. Upon the bidder's failure or refusal to comply in the manner and within the time specified, the Director may either award the contract to the next low responsible bidder or re-advertise for new proposals. In either case, the Director may hold the defaulting bidder and its surety liable for the difference between the applicable sums quoted by the defaulting bidder and the sum which the State may be obligated to pay to the contractor which is contracted to perform and complete the work of the defaulting bidder.

IB 4 Awards

IB 4.1 In executing a contract, the successful bidder agrees to perform the required work in a good and workmanlike manner to the reasonable satisfaction of the Director, and to complete all work within the number of calendar days specified in its contract.

IB 4.2 Successful bidders will be notified of the time and place for the signing of contracts. Key requirements in the contract, including, but not limited to, the number of days of performance of the contract, manner and schedule of payments, and other administrative details will be reviewed at the award meeting. The time and place of the first job meeting will be announced at the award meeting.

IB 4.3 The State reserves the right to award the contract upon the basis of a single bid for the entire work, or on the basis of separate bids for each prime trade when the total of the separate bids is less than the single bid. Alternates will be accepted or rejected in numerical sequence as cited in the bid documents and shall not be selected at random except as provided herein. Add alternates and deduct alternates will be specified separately. The State may choose from the add and deduct alternates without priority between the two groups so long as selection within each group is in numerical sequence from the first to the last. This limitation shall not apply, however, to any alternates concerning proprietary items. The Director, with the approval of the Using Agency, may accept alternates out of sequence, provided the Director states the reasons for so doing, in writing, within five working days following the opening of bids.

IB 4.4 Should submission of unit prices be required for specified items of work in bid proposals, they will be considered in the evaluation of bids as set forth in the bid proposal form.

IB 4.5 The successful bidder and all of its subcontractors are required to comply with the requirements of N.J.S.A. 10:5-31 et seq., regarding Equal Employment Opportunity in Public Works Contracts.

IB 5 Qualification of Bidders

IB 5.1 If the successful bidder is a corporation not organized under the laws of the State of New Jersey or is not authorized to do business in this State (foreign corporation), the award of the contract shall be conditioned upon the prompt filing by the said corporation of a certificate to do business in this State and complying with the laws of this State in that regard. This filing must be made with the Division of Revenue. No award of contract will be made until the Division of Revenue confirms this authorization.

IB 5.2 The State requires that each contractor, except in the case of a single contractor, shall perform a minimum of 35 percent of the contract work by the contractor's own forces. However, the Director has the sole discretion to reduce this percentage depending upon the nature and circumstances in any particular case, if the Director determines that to do so would be in the best interests of the State, and provided that the bidder submits a written request with the original bid proposal.

IB 5.3 The State reserves the right to reject a bidder at any time prior to the signing of a contract if information or data is obtained which, in the opinion of the Director, adversely affects the responsibility and/or the capability of the bidder to undertake and to complete the work, regardless of the bidder's previous qualification or classification. The State may

conduct any investigation as it deems necessary to determine the bidder's responsibility and capacity, and the bidder shall furnish all information and data for this purpose as requested by the State.

IB 5.4 Each bidder must be classified by DPMC in accordance with the provisions of the classification statute, N.J.S.A. 52:35-1, *et seq.*. In the case of a single bid for all of the work, the bidder shall include in the bid the names of its principal subcontractors (in categories as listed in IB1.2 above), which must also be classified in accordance with the said statute.

IB 5.5 At the time of the bid due date, the bidder and the subcontractors must be registered in accordance with “The Public Works Contractor Registration Act”, N.J.S.A. 34:11-56.48, *et seq.* All questions regarding registration shall be addressed to:

Contractor Registration Unit
New Jersey Department of Labor
Division of Wage & Hour Compliance
P O Box 389
Trenton NJ 08625-0389
Telephone: 609-292-9464
FAX: 609-633-8591

IB 5.6 In accordance with N.J.S.A. 52:32-44, *et seq.* Public Law 2001, Chapter 134, all contractors and subcontractors providing goods/services to State agencies and authorities are required to provide the contracting agency or authority with proof of registration with the Department of Treasury, Division of Revenue. The basic registration process involves the filing of Form NJ-Reg., which can be filed online at www.state.nj.us/njbgs/services.html or by calling (609) 292-7077 or (609) 292-1730.

IB 6 Deposit and Bid Bond

IB 6.1 The Proposal, when submitted, shall be accompanied by a Bid Bond satisfactory to the Director, for the sum of not less than fifty percent (50%) of the Total Bid including alternates, if applicable.

IB 6.2 The Bid Bond shall be properly filled out, signed, and witnessed.

IB 6.3 The Bid Bond shall be accompanied by a copy of the power of attorney executed by the surety company or companies. The power of attorney shall set forth the authority of the attorney-in-fact who has signed the bond on behalf of the surety company to bind the company and shall further certify that such power is in full force and effect as of the date of the bond.

IB 6.4 If the bidder whose proposal is accepted is unable to provide the performance and payment bonds or fails to execute a contract, then such bidder and the bid bond surety, where applicable, shall be obligated to pay to the State the difference between the amount of the bid and the amount which the State contracts to pay another party to perform the work. The bidder and the surety shall pay, upon demand, the entire amount of the State's difference in cost. Should there be a deficiency in excess of the bid deposit, the bidder shall make immediate payment to the State for any such deficiency. Nothing contained herein shall be construed as a waiver of any other legal remedies that the State may have against the contractor.

IB 6.5 Attorneys-in-fact who sign bid bonds or contract bonds must file a certified power-of-attorney with the State indicating the effective date of that power.

IB 7 Performance and Payment Bond

IB 7.1 The successful bidder shall furnish within ten (10) calendar days after notice of award both a performance bond in statutory form in an amount equal to one hundred percent (100%) of the total contract price as security for the faithful performance of this contract and a payment bond in statutory form in amount equal to one hundred percent (100%) of the contract price as security for the payment of all persons and firms performing labor and furnishing materials in connection with this contract. The performance bond and the payment bond may be combined or in separate instruments in accordance with law. If combined, they must be for 200% of the award amount. No contract shall be executed unless and until each bond is submitted to and approved by the State. The surety must be presently authorized to do business in the State of New Jersey. In addition to the other coverage provided, the Bond shall cover all Contract guarantees and any other guarantees/warranties issued by the Contractor.

IB 7.2 The cost of all performance and payment bonds shall be paid for by the successful bidder.

IB 7.3 If at any time the State, for justifiable cause, is dissatisfied with any surety which has issued or proposes to issue a performance or payment bond, the contractor shall, within ten calendar days after notice from the State to do so, substitute an acceptance bond (or bonds). The substituted bond(s) shall be in such form and sum and executed by such other surety or sureties as may be satisfactory to the State. The premiums on such bond(s) shall be paid by the contractor. No contract shall be executed and/or no payment made under a contract until the new surety or sureties shall have furnished such an acceptable bond to the State.

IB 7.4 Bonds must be legally effective as of the date the contract is signed. Each must indicate the contractor's name exactly as it appears on the contract. Current attorney-in-fact instruments and financial statement of the surety must be included with the bonds. Bonds must be executed by an authorized officer of the surety. Bonds furnished under this section shall conform in all respects to the requirement and language of NJSA 2A:44-143 to 147.

IB 8 Bulletins and Interpretations

IB 8.1 No interpretation of the meaning of the plans, specifications or other pre-bid documents will be provided to any bidder unless such interpretation is made in writing to all prospective bidders prior to the opening of bids. Any such interpretations must be identified in bid proposals submitted. Any interpretations which are not entered in accordance with this provision shall be unauthorized and not binding upon the State.

IB 8.2 Every request for an interpretation relating to clarification or correction of the plans, specifications, or other bid documents must be made in writing, addressed to the architect/engineer and the DPMC Director, and must be received at least five (5) working days prior to the date fixed for the opening of the bids. Any and all interpretations, clarifications or corrections and any supplemental instructions must be issued by the Director in the form of written bulletins and mailed by certified mail, return receipt requested, or by electronic notice to all prospective bidders not later than three (3) working days prior to the date of the opening of bids. All bulletins issued shall become part of the

contract documents and shall be acknowledged in all bid proposals. Failure of a bidder to acknowledge receipt of all such bulletins and interpretations by the time of bid opening shall result in its proposal being considered non-responsive, at the option of the Director.

IB 8.3 Each bidder shall be responsible for thoroughly reviewing the contract documents prior to the submission of bids. Bidders are advised that no claim for expenses incurred or damages sustained as a result of any error, discrepancy, omission, or conflict in the contract documents shall be recognized by the State unless, and only to the extent that, a written request for interpretation, clarification or correction has been submitted in compliance with Section IB8.2 and provided the matter has not been addressed by the State through the issuance of a bulletin interpreting, clarifying or correcting such error, discrepancy, omission or conflict.

IB 9 Assignments

IB 9.1 The contractor shall not assign all or any part of this contract without written consent of the State. Money due (or to become due) the contractor hereunder shall not be assigned for any purposes whatsoever.

IB 10 Federal Excise Taxes and State Sales Tax

IB 10.1 In general, bidders, in preparing bids, must take into consideration applicable Federal and State tax laws.

IB 10.2 Materials, supplies or services for exclusive use in erecting structures or buildings or otherwise improving, altering or repairing all State-owned property are exempt from the State sales tax. The successful bidder must submit Division of Taxation form ST13, Exempt Use Certificate, to the seller of all materials, supplies or services that will be incorporated into the Work.

IB 10.3 Bidders must determine the current status and applicability of any tax laws, and the contractor may make no claim based upon any error or misunderstanding as to the applicability of any tax laws.

IB 10.4 Purchases or rentals of equipment are not exempt from any tax under the State Sales Tax Act.

IB 11 Restrictive Specifications

IB 11.1 Should any bidder determine before the bid due date that any portion of the specifications or drawings specify a particular product which can be provided by only one supplier or manufacturer, with the result that competitive prices are not available, the bidder shall immediately notify the Director in writing of such fact.

IB 11.2 If such notice is not given in a timely manner, it shall be assumed that the bidder has included the estimate of such sole source in the bid. However, if the Director is notified in a timely manner of the sole source of supply or manufacture, the Director may order the product re-bid or take other lawful action. Such action shall be at the Director's sole discretion.

IB 12 Offer of Gratuities

IB 12.1 Bidders are advised that the laws of New Jersey (NJSA 52:34-19) make it a misdemeanor to offer, pay or give any fee, commission, compensation, gift or gratuity to any person employed by the State. Also, Executive Order #189 (1988) requires that all requests for proposals and contracts issued by the State specify prohibitions on vendor (contractor) activities, the violation of which shall render the vendor liable to ineligibility for State contracts, pursuant to the debarment procedures set forth in N.J.A.C. 17:19-4.1., *et seq.* These prohibited activities include the following:

- a. No vendor shall pay, offer to pay, or agree to pay, either directly or indirectly, any fee, commission, compensation, gift, gratuity, or other thing of value of any kind to any State officer or employee or special State officer or employee, as defined by NJSA 52:34D-13b. and e., in the Department of Treasury or any other agency with which such vendor transacts or offers or proposes to transact business, or to any member of the immediate family, as defined by NJSA 52:13D-13i., of any such officer or employee, or any partnership, firm, or corporation with which they are employed or associated, or in which such officer or employee has an interest within the meaning of NJSA 52:13D-13g.
- b. The solicitation of any fee, commission, compensation, gift, gratuity or other thing of value by any State officer or employee or special State officer or employee from any State vendor shall be reported in writing forthwith by the vendor to the Attorney General and the Executive Commission on Ethical Standards.
- c. No vendor may, directly or indirectly, undertake any private business, commercial or entrepreneurial relationship with, whether or not pursuant to employment, contract or other agreement, express or implied, or sell any interest in such vendor to, any State officer or employee or special State officer or employee having any duties or responsibilities in connection with the purchase, acquisition or sale of any property or services by or to any State agency or any instrumentality thereof, or with any person, firm or entity with which he is employed or associated or in which he has an interest within the meaning of NJSA 52:13D-13g. Any relationships subject to this provision shall be reported in writing forthwith to the Executive Commission on Ethical Standards, which may grant a waiver of this restriction upon application of the State offer or employee or special State officer or employee upon a finding that the present or proposed relationship does not present the potential, actuality or appearance of a conflict of interest.
- d. No vendor shall influence, or attempt to influence or cause to be influenced, any State officer or employee or special State officer or employee in his official capacity in any manner which might tend to impair the objectivity or independence of judgment of said officer or employee.
- e. No vendor shall cause or influence, or attempt to cause or influence, any State officer or employee or special State officer or employee to use, or attempt to use, his official position to secure unwarranted privileges or advantages for the vendor or any other person.

- f. The provisions cited above in paragraphs IB12.1.a. through e. shall not be construed to prohibit a State officer or employee or special State officer or employee from receiving gifts from or contracting with vendors under the same terms and conditions as are offered or made available to members of the general public subject to any guidelines the State Ethics Commission on Ethical Standards may promulgate under paragraph IB12.1.c. above.

END OF INSTRUCTIONS TO BIDDERS

GENERAL CONDITIONS

ARTICLE 1 - GENERAL PROVISIONS

1.1 DEFINITIONS:

1.1.1 Architect/Engineer: The Architect/Engineer (“A/E”) is the consultant engaged by the DPMC to prepare the design and perform certain contract administration functions in accordance with the provisions of its contract with the DPMC.

1.1.2 Bulletin: A document, issued by DPMC prior to the opening of bids, which supplements, revises or modifies the bid document(s).

1.1.3 Change in the Work: A change in the Project and the Contract Documents, including, but not limited to, an increase or decrease in the Work, an acceleration or extension of time for the performance of the Work.

1.1.4 Change Order: A written order, directing or authorizing a Change in the Work executed by the DPMC and agreed to by the Contractor (except in the case of unilateral change orders executed by DPMC) that includes all adjustments to work, compensation and/or time warranted by the Change in the Work.

1.1.5 Code Official: the individual licensed by the NJ Department of Community Affairs authorized to enforce the NJ Uniform Construction Code (UCC) and approve or reject the Work for NJ UCC compliance.

1.1.6 Construction Management Firm or “CMF”: A person or firm that may be engaged by the DPMC to assist DPMC in the administration of its contracts.

1.1.7 Contract: The entire and integrated agreement between the Contractor and the DPMC encompassing all of the Contract Documents.

1.1.8 Contract Documents: The executed form of Contract, General Conditions, Supplementary Conditions, Supplementary Instructions, Bulletins, plans, specifications, instructions to bidders, addenda, responses to requests for information, Price Proposal, Change Orders, other amendments, including construction change directives, and all exhibits, appendices and documents attached to or referenced in any of the foregoing materials.

1.1.9 Contract Limit Lines The lines shown on the Contract Drawings that define the boundaries of the Project, and beyond which no construction work or activities may be performed by the Contractor unless otherwise noted on the drawings or specifications.

1.1.10 Contractor: The business entity with whom the DPMC enters a contract for the performance of the construction of a construction Project by the terms set forth in the Contract Documents.

1.1.11 Contract Price: The sum stated in the Contract, as it may be adjusted in accordance with the Contract Documents, that represents the total amount payable by the DPMC to the Contractor for performance of the Work.

1.1.12 Day: A calendar day, unless otherwise designated.

1.1.13 Director: The person authorized by statute to administer the design, engineering and construction of all State buildings and facilities. The Director is the contracting officer representing the State personally or through authorized representatives in all relationships with Contractors, consultants and Architects/Engineers. This includes designees or an authorized administrative contracting officer acting within the limits of his or her authority. The Director or his or her duly authorized representative is the interpreter of the conditions of this contract and the judge of its performance.

1.1.14 Division of Property Management and Construction (DPMC): The State of New Jersey's contracting agency for the design and construction of State facilities.

1.1.15 Final Acceptance and Completion: The date following receipt and acceptance by DPMC of all administrative and close-out documents. Following acceptance, the DPMC will issue a Certificate of Final Acceptance and Completion for the Project.

1.1.16 Generally Accepted Accounting Principles: The common set of accounting principles, standards and procedures that companies use to compile their financial statements. Accounting records must identify all labor and material costs and expenses, whether they are direct or indirect. The identity must include at least the Project number for direct expenses and/or account number for indirect expenses.

1.1.17 NJUCC or Code: The New Jersey Uniform Construction Code which governs the permit and approval process for construction projects.

1.1.18 Notice: A written directive or communication given by DPMC to the Contractor to act or perform work or carry out some other contractual obligation, or a written communication to be served by the Contractor upon the State. A notice served on the Contractor will be deemed to have been duly served if delivered to an individual or member of the firm or entity or to an officer of the corporation for whom it was intended. This includes regular mail, e-mail, delivery by courier, or registered or certified mail, or facsimile to the Contractor's business address cited in the Contract documents. A notice from the Contractor to the State shall be deemed to have been duly served only if delivered to the Director or the Director's duly authorized representative.

1.1.19 Notice to Proceed: The written communication issued by the DPMC to the Contractor directing the Contractor to begin the Work. The contract calendar day duration period will commence on the effective date noted.

1.1.20 Project: The term for the entire public works engagement. It includes the design, construction work and all administrative aspects required to fully complete the engagement.

1.1.21 Punch List: The list of incomplete or defective Work, compiled by DPMC and/or its authorized representative, which remains to be completed after achievement of Substantial Completion.

1.1.22 Schedule: The time tracking mechanism that establishes the Project's allotted time requirements for completion as more specifically described in Article 6 of these General Conditions. When the construction activity items of the schedule have a monetary value associated with them, the schedule is referred to as a "costed" or "cost-loaded" schedule.

1.1.23 Site: The geographical location of the facility or property at which the Work under the Contract is to be performed.

1.1.24 State or Owner: The State of New Jersey, acting through DPMC.

1.1.25 Subcontractor: The business entity that enters into an agreement with the Contractor for the performance of work or materials under this Contract. Also refers to any agreement between a Subcontractor and any of lower tier Subcontractors. Such an agreement creates no relationship, legal or otherwise, between the DPMC and the Subcontractor(s) and/or lower tier Subcontractor(s).

1.1.26 Substantial Completion: The date when all essential requirements of the Contract Documents have been satisfied so that the purpose of the Contract Documents is accomplished, as determined by the DPMC including training of staff by the Contractor on all equipment, and resulting in the issuance of a temporary Certificate of Occupancy, a permanent Certificate of Occupancy or a permanent Certificate of Acceptance and when the Work and the facility can be safely occupied and used in accordance with its intended purpose. DPMC may condition issuance of a Certificate of Substantial Completion upon satisfactory receipt of critical documents.

1.1.27 Unit Schedule Breakdown: A detailed list of the Work activities required for Project construction, other elements associated with fulfilling the requirements of the Contract (bonds, insurance, etc.), major items of material, labor or equipment, and the prices associated with each of them.

1.2.28 Using Agency: The State department or agency for whom the construction project is being completed.

1.1.29 Work: All construction, supervision, labor, material and equipment necessary to complete the obligations under the Contract including Operation and Maintenance Manuals, Punch List completion, and As-Built Documents.

1.2 CONTRACT DOCUMENTS TO BE PROVIDED BY DPMC

Upon Contract award, the DPMC will furnish to the Contractor, free of charge, three copies of the drawings and specifications, and any additional instructions by means of supplemental contract documents as otherwise necessary for the proper execution of the Work, unless otherwise provided in the Contract Documents. Upon request, additional copies of the contract documents will be furnished at the Contractor's expense.

1.3 INTENT OF THE CONTRACT

1.3.1 The drawings, specifications and all of the Contract Documents are intended to require the Contractor to provide for everything necessary to accomplish the proper and complete finishing of all work. For the Project, the Contractor shall perform all of the obligations and work identified in the Contract Documents, regardless of the manner in which it is divided among the trades or the order in which it appears in the Contract Documents. All work and materials included in the specifications and not shown on the drawings, or shown on the drawings and not in the specifications shall be performed and/or furnished by the Contractor. The Contractor shall include any incidental materials

and/or Work not indicated in the drawings and/or the specifications which are nevertheless necessary for the development of the Project and are reasonably inferable from the contract documents and industry practice. The Contractor shall perform all such work and furnish all such materials as if particularly delineated or described in the contract documents as part of the bid proposal.

1.3.2 The Contractor acknowledges that in preparing its bid, the Contractor had the obligation to raise any reasonably observable errors, omissions, ambiguities or discrepancies and request an interpretation of the alleged errors, omissions, ambiguities or discrepancies. If the Contractor failed to do so, it will have waived all rights to a Change Order or claim and the Contractor will be responsible to complete the Work as required, consistent with the intent of the Contract Documents as interpreted by the DPMC, without additional compensation.

1.3.3 No interpretation of the meaning of the plans, specifications or other Contract Documents provided prior to bid submission shall be binding upon the State for any purpose unless issued in a Bulletin.

1.3.4 The Contractor shall abide by and comply with the intent and meaning of the Contract Documents taken as a whole, and shall not take advantage of any error or omission, should any exist. Should the Contractor become aware of the existence of any error, omission or discrepancy, the Contractor shall immediately notify the DPMC and the Architect/Engineer of any such errors, omissions, ambiguities or discrepancies and seek correction or interpretation thereof prior to commencement of the Work at issue. The Architect/Engineer shall issue a written interpretation. The Contractor shall do no work outside of the Contract Documents, unless written authorization to proceed from the DPMC is received by the Contractor.

1.3.5 Each and every provision required by law to be inserted in the Contract Documents is deemed to have been inserted therein. If any such provision has been omitted or has not been correctly inserted, then upon application of either party, the Contract may be modified to provide for such insertion or correction.

1.3.6 The order of precedence pertaining to interpretation of Contract Documents is as follows:

- a. Executed Contract
- b. Bulletins and Instructions
- c. Supplemental General Conditions
- d. Specifications and General Conditions
- e. Drawings, in the following order of precedence:
 - (1) Notes on drawings
 - (2) Large scale details
 - (3) Figured dimensions
 - (4) Scaled dimensions

1.3.7 Where there may be a conflict in the Contract Documents not resolvable by application of the provisions of this Article, then the more expensive labor, materials, or equipment shall be assumed to be required and shall be provided by the Contractor.

1.3.8 On all work, it shall be the responsibility of the Contractor, by personal inspection of the existing building, facility, plant or utility systems, to ascertain the accuracy of any information given. This shall be the case, whether or not such information is indicated on the drawings, included in the specifications, or shown in any other documentation that is available. The Contractor shall have an affirmative duty to make reasonable inquiry for all available information. The Contractor shall include the costs of all material and labor required to complete the Work based on inspection and reasonably observable conditions.

1.4 WORKDAYS

Regular working hours will be defined in the Contract Documents. Changes thereto may be granted with written approval of the DPMC representative. Any work required to be performed after regular working hours or on Saturdays, Sundays, or legal holidays as specially set forth in the Contract documents, as may be reasonably required and consistent with contractual obligations, shall be performed at the amount set forth in the Contractor's bid without additional expense to the State. The Contractor shall obtain written approval of the DPMC representative for performance of work after regular working hours or on non-regular workdays at least forty-eight (48) hours prior to the commencement of overtime, unless such overtime work is caused by an emergency. If the Contractor seeks such approval for the overtime work, same shall be performed at no additional cost to the DPMC except in the event of an emergency, at which time, the DPMC, in its sole discretion, shall determine if the submitted overtime is compensable.

1.5 ASSIGNMENTS

The Contractor shall not assign all or any part of this Contract without the written consent of the Director. Money due (or to become due) the Contractor hereunder shall not be assigned for any purpose whatsoever without the written consent of the Director.

1.6 STATE SALES TAX

1.6.1 Materials, supplies or services for exclusive use in the construction of structures or buildings or otherwise improving, altering or repairing all State-owned property are exempt from the State sales tax.

1.6.2 Purchases or rentals of equipment are not exempt from any tax under the State Sales Tax Act.

ARTICLE 2 - OWNER/DPMC

2.1 DPMC'S REPRESENTATION

The DPMC will be represented on the Project by DPMC's designated representative(s). DPMC's designated representative(s) have only those duties that are required of the Owner under this Contract.

2.2 RIGHT TO PERFORM WORK

The DPMC may, and reserves the right to, enter upon the premises at any and all times during the progress of the Work, or cause others to do so, for the purpose of performing any work or installing any apparatus or carrying on any construction not included in the Contract Documents, or for any other reasonable purpose.

The DPMC shall have the right to defer the beginning of Work or to suspend the whole or any part of the Work whenever, in the sole discretion of the DPMC, it may be necessary or expedient for the State to do so.

2.3 MEANS AND METHODS

The State will not be responsible for, nor have control or charge of construction means, methods, techniques, sequences of procedures, or safety precautions and programs in connection with the Work. The State will not be responsible for, nor have control or charge of, the acts or omissions of the Contractor, Subcontractors, or any of their agents or employees, or any other person performing any of the Work.

ARTICLE 3 - ARCHITECT/ENGINEER

3.1 DUTIES AND RESPONSIBILITIES

3.1.1 The Architect/Engineer (“A/E”) is the consultant engaged by the DPMC to prepare the design and perform certain contract administration functions in accordance with the provisions of its contract with the DPMC.

3.2 PROGRESS MEETINGS

The Architect/Engineer will attend, chair and issue record minutes of bi-weekly job progress meetings.

3.3 SITE OBSERVATIONS

3.3.1 The Architect/Engineer will monitor the execution and progress of the Work. The Architect/Engineer will at all times be provided access to the Work. The Contractor shall provide facilities for such access so as to enable the Architect/Engineer to perform its functions.

3.3.2 The Architect/Engineer will not be responsible for, nor have control or charge of construction means, methods, techniques, sequences of procedures, or safety precautions and programs in connection with the Work. The Architect/Engineer will not be responsible for, nor have control or charge of, the acts or omissions of the Contractor, Subcontractors, or any of their agents or employees, or any other person performing any of the Work.

3.4 SHOP DRAWINGS AND SUBMITTALS AND INVOICES

As more specifically described in Article 4, the Architect/Engineer will review, approve or take other appropriate action relating to Contractor’s submittals, including shop drawings, product data and samples, and as – built drawings, to assure conformance with the requirements of the Contract. Such actions shall be taken with reasonable promptness. Approval of a specific item shall not indicate approval of an assembly of which the item is a component.

3.5 PAYMENT APPROVALS

3.5.1 The Architect/Engineer is responsible for the timely review of all invoices submitted by the Contractor. The Architect/Engineer shall inform the Contractor of any deficiencies therein. When the payment voucher is deemed accurate, the Architect/Engineer shall recommend approval of Contractor invoices.

3.5.2 The Architect/Engineer will review and recommend approval of Contractor closeout documentation in conjunction with the final application for payment.

ARTICLE 4 - THE CONTRACTOR

4.1 REVIEW OF THE CONTRACT DOCUMENTS AND FIELD CONDITIONS

4.1.1 The Contractor has the duty to thoroughly examine and be familiar with all of the Contract Documents and the Project site. The Contractor shall investigate and accurately determine the nature and location of the Work, the current building equipment and systems, labor and material conditions, and all matters which may in any way affect the Work or its performance.

4.1.2 The Contractor shall be deemed to have verified all reasonably observable conditions outside the Contract limit lines to determine whether any conflict exists with the Work that the Contractor is required to perform under the Contract. This includes but is not limited to a check on elevations, utility connections and other site data. If a condition changed from the time of the bid to the time of the issuance of the Notice to Proceed, the Contractor shall notify the Architect/Engineer immediately. The Contractor shall immediately report any conflicts prior to the bid proposal due date or waive any claim for additional compensation arising from such conflict.

4.1.3 During the progress of the Work, the Contractor shall immediately report in writing any alleged error, inconsistency, ambiguity or omission in the Contract Documents to DPMC. The Contractor shall not continue with any work that is affected by such alleged error, inconsistency, ambiguity or omission until the DPMC has had the opportunity to respond. Any error, inconsistency, ambiguity or omission shall be addressed pursuant to appropriate procedures set forth in these General Conditions.

4.1.4 Following notification of an alleged error, inconsistency, ambiguity or omission, the DPMC may issue supplemental instructions for the proper execution of the Work. The Contractor shall do no work without proper supplemental instructions. In giving such supplemental instructions, the DPMC will have the right to direct the Contractor to make minor changes in the Work without payment of additional monies. This provision is not intended to infringe upon or limit the DPMC's authority to otherwise direct changes in the Work, described elsewhere in these general conditions.

4.1.5 Where certain work is shown in complete detail, but not repeated in similar detail in other areas of the drawings, or if there is an indication of continuation with the remainder being shown only in outlines, the Work shown in detail shall be understood to be required in other like portions of the Project.

4.1.6 Unless otherwise directed in writing by the DPMC, the Contractor shall perform no portion of the Work without appropriate approvals as may be applicable and required by the Contract Documents.

4.1.7 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all labor, equipment, materials, tools, construction equipment and machinery, water, heat, utilities, transportation and other facilities and services necessary for the proper execution, protection, and completion of the Work.

4.2 INSURANCE

The Contractor shall secure and maintain in force, for the term of the Contract, insurance coverage provided in Section 13.4. The Contractor shall provide the State of New Jersey with current certificates of insurance for all coverage and renewals thereof which must contain a provision that the insurance provided in the certificate shall not be canceled for any reason except after thirty (30) calendar day's written notice to the State of New Jersey. If cancellation occurs, the Contractor shall immediately procure new coverage, not allowing any lapse of coverage to occur.

4.3 PERMITS, LAWS, AND REGULATIONS

4.3.1 The DPMC shall obtain and pay for the construction permits and inspections (building, plumbing, electrical, elevator and fire), required by the Department of Community Affairs (DCA). When permits are issued by DCA, the appropriate licensed Contractors and/or Subcontractors shall be required to fill out the Contractor section of the Sub-Code Technical Section and sign and affix their raised seal thereto.

4.3.2 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for all other permits and governmental fees, licenses and inspections necessary for the proper execution and completion of the Work, and which are legally required at the time of receipt of bids.

4.3.3 All work must be done in accordance with the NJUCC. No work requiring inspections and approval by construction NJUCC code officials is to be covered or enclosed prior to inspection and approval by the appropriate NJUCC enforcement officials.

4.3.4 The Work performed pursuant to this Contract is exempt from local ordinances, codes and regulations as related to the building and the Site on which it is located, except in certain limited circumstances, where construction could adversely affect adjacent property, public sidewalks and/or streets. In those instances, the Contractor shall coordinate its activities with municipal and/or highway authorities having appropriate jurisdiction.

4.3.5 Immediately upon receipt of the contract award documents from the DPMC, the Contractor shall notify all utility companies involved regarding utility services required for completion of the Work. Such notification shall be in addition to any notification requirements imposed by law, including, without limitation, the Underground Facility Protection Act, N.J.S.A. 48:2-73, et seq.

4.3.6 The Contractor shall perform all soil conservation measures in accordance with County Soil Conservation District requirements.

4.3.7 The Contractor shall perform all sewage disposal work in conformance with the regulations of the State's Department of Environmental Protection.

4.3.8 The Contractor shall be responsible for obtaining timely NJUCC inspections of the Work from the applicable State agency. The Contractor shall request such

inspections through DPMC authorized representatives allowing for sufficient notice to enable NJUCC inspections to be scheduled without delay to the Work.

4.3.9 Consistent with section 4.4 of these General Conditions, the Contractor shall be responsible for its own actions and protect, defend and indemnify the State from all fines, penalties or loss incurred for, or by reason of, the violation of any municipal ordinance or regulation or law of the State while the said work is in progress.

4.3.10 The Contractor shall comply with the Federal Occupational Safety and Health Act of 1970 and all of the rules and regulations promulgated there under.

4.3.11 If the Contractor causes a substantial violation of a State, local or federal statute or regulation on the Project, DPMC may declare the Contractor to be in default, and/or terminate the Contract.

4.3.12 Prior to the start of any crane equipment operations, the Contractor shall make all necessary applications and obtain all required permits from the Federal Aviation Administration (F.A.A.). When the F.A.A. has jurisdiction, the sequence of operations, timing and methods of conducting the Work shall be approved by the F.A.A.

4.3.13 The Contractor will establish an approved Silica Health and Safety Program when tasks generating crystalline silica dust are being performed. This program shall include engineering, work practice, and respiratory protection controls to reduce worker exposure to airborne respirable crystalline dust to levels that are as low as reasonably achievable. When tasks are performed that generate airborne crystalline dust, the Contractor will minimize worker exposure to dust by one, or a combination of the following methods: 1) dust suppression with water, 2) local exhaust ventilation to a high-efficiency dust collector, and/or 3) appropriate respiratory protection devices. The Contractor shall provide a trained, competent person, as defined by OSHA 29 CFR 1926, on site at all times to implement the Silica Health and Safety Program when tasks generating crystalline silica dust are being performed.

4.4 RESPONSIBILITY FOR THE WORK

4.4.1 The Contractor shall be responsible to the State and to any separate Contractors and/or consultants including, without limitation, the Architect/Engineer, for the acts, errors and omissions of its employees, Subcontractors and their agents and employees that injure, damage or delay such other Contractors and/or consultants in the performance of their work.

4.4.2 The Contractor shall be responsible for all damage or destruction caused directly or indirectly by its operations to all parts of the Work, both temporary and permanent, and to all adjoining property.

4.4.3 The Contractor shall, at its own expense, protect all finished work and keep the same protected until the Project (or identifiable portions thereof, that are declared as substantially complete and being used) is completed and accepted.

4.4.4 The Contractor shall be responsible for safety and for any damage or injury which may result from the Contractor's failure or improper construction, maintenance or operation.

4.4.5 In order to protect the lives and health of its employees, the Contractor shall comply with all applicable statutes and regulations and pertinent provisions of the "Manual of Accident Prevention in Construction" issued by the Associated General Contractors of America, Inc. and shall maintain accurate records of all cases of death, occupational disease, and injury requiring medical attention or causing loss of time from work arising out of and in the course of employment on work under the Contract. If a conflict should exist with the requirements of the Federal Occupational Safety and Health Act of 1970, then the most stringent statute or pertinent provision shall apply.

4.5 INDEMNIFICATION

4.5.1 The Contractor shall assume all risk of and responsibility for, and agrees to protect, defend and indemnify the State of New Jersey, its agents, and its employees, from and against, any and all claims, demands, suits, actions, recoveries, judgment and costs of expenses in connection therewith on account of the loss of life, property, injury or damage to the person, body or property of any person or persons whatsoever, resulting from the Contractor's performance on the Project or through the use of any improper or defective machinery, implements or appliances, or through any act or omission on the part of the Contractor or its agents, employees or servants, which shall arise from or result directly or indirectly from the Work and/or materials supplied under this Contract. This indemnification obligation is not limited by, but is in addition to, the insurance obligations contained in this Contract.

4.5.2 In any and all claims against the State or any of its agents or employees, any employees of the Contractor or Subcontractor or anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation under this section shall not be limited in any way as to the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under worker's compensation acts, disability benefit acts, or other employee benefit acts.

4.6 SUPERVISION

4.6.1 The Contractor shall attentively supervise and direct the Work. The Contractor shall be solely responsible for all construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract.

4.6.2 The Contractor shall employ a full-time competent superintendent and necessary foremen and assistants, who shall be in attendance on the Project Site during the progress of the Work. The superintendent shall represent the Contractor, and all communications given to the superintendent shall be binding upon the Contractor. The State reserves the right to require a change in superintendent if the superintendent's performance, as judged by the DPMC, is deemed to be inadequate. Upon application in writing, and if deemed appropriate and expressly approved by the DPMC, the requirement for a full-time superintendent may be waived. If such a waiver is permitted, the Contractor shall employ a full-time competent foreman who shall be in attendance on the site during the progress of work and shall represent the Contractor, and all communications given to the foreman

shall be binding upon the Contractor. The Contractor shall not employ persons unfit or unskilled in the assigned area of work.

4.6.3 The Contractor shall ensure that its Subcontractors shall likewise have competent superintendents in charge of their respective portions of the Work at all times. Upon application in writing, and if deemed appropriate and expressly approved by the DPMC, the requirement for a full-time superintendent may be waived. If such a waiver is permitted, the Subcontractor shall employ a full-time competent foreman who shall be in attendance on the site during the progress of work and shall represent the subcontractor, and all communications given to the foreman shall be binding upon the subcontractor. The Subcontractor shall not employ persons unfit or unskilled in the assigned area of work. If it becomes apparent that a Subcontractor does not have its portion of the Work under control of a competent foreman, the Contractor shall have the obligation to take appropriate steps to immediately provide proper supervision.

4.6.4 The Contractor shall employ qualified competent craftsmen in their respective lines of work. The State may require evidence that all employees have received sufficient training to execute the Work.

4.6.5 If, due to a trade agreement or project labor agreement, standby personnel are required to supervise equipment installation or for any other purpose during the normal working hours of other trades, the Contractor normally required to provide the standby services shall be deemed to have evaluated and included the costs thereof in its bid price and shall provide said services without additional charge.

4.6.6 The Contractor shall at all times enforce strict discipline and good order among its employees and shall not employ any unfit person or anyone not skilled in the task assigned.

4.7 SHOP DRAWINGS AND OTHER SUBMITTALS

4.7.1 The Contractor shall, within two weeks of the Notice to Proceed, submit to the Architect/Engineer, shop drawings and sample submission schedule for approval, which shall be used as a basis for complying with the overall progress schedule. The Contractor shall obtain, from its Subcontractor(s), all submittals including shop drawings, details, and schedules. The Contractor shall review the submittals for completeness and conformity with the Contract Documents, and shall stamp the submittals "approved". The Contractor shall promptly forward two copies of each submittals in reproducible form to the Architect/Engineer, so as to cause no delay in its own work or that of any other contractor. The DPMC Project number and the drawing and specification references shall be written or typed on all submissions. Failure to comply with these instructions will be sufficient reason to return the drawing to the Contractor without approval and any resulting delay in the Project shall be the sole responsibility of the Contractor.

4.7.2. The Architect/Engineer will review shop drawings and other submittals with reasonable promptness. The Contractor shall promptly make any corrections, if required by the Architect/Engineer, and resubmit a reproducible copy for approval. Within five (5) working days of final approval, the Contractor shall send the Architect/Engineer a

minimum of seven (7) prints of the finally approved shop drawings as well as seven (7) copies of all catalog cuts.

4.7.3 The Contractor shall prepare original shop drawings, and not simply copy the Contract Drawings for submission as shop drawings. All shop drawing sizes shall be in multiples of 9" x 12" (e.g., 18" x 24", 24" x 27", 24" x 36", etc.) as approved by the Architect/Engineer.

4.7.4 Any deviations or changes from the requirements of the Contract Documents, must be approved by the Architect/Engineer. A Contractor seeking approval for any deviations or changes must: a) make a written request for the proposed change; b) provide to the Architect/Engineer a detailed narrative description of the proposed change; c) highlight on the applicable drawing the proposed change; and d) furnish a detailed description of all potential impacts on the schedule and project budget.

4.7.5 Substitutions

4.7.5.1 Where any particular brand or manufactured article is specified, it shall be regarded as a standard. Similar products of other manufacturers, capable of equal performance and quality, may be accepted if approved by the Architect/Engineer and accepted by DPMC in writing.

4.7.5.2 In the event that a Contractor proposes a substitution to the specified equipment or materials, it shall be the Contractor's responsibility to submit proof of equality and to provide and pay for any tests which may be required by the DPMC in order to evaluate the proposal. If there is a substantial cost savings between the substitution and the specified equipment or material, the difference will be returned to the State in the form of a credit Change Order.

4.7.5.3 The application for the approval of a substitution must be submitted on the State form within 10 days of Notice to Proceed. Further, the submission shall include the following requirements:

- a. A Full and complete identification information;
- b. The identification of the paragraph and section of the specifications for which the substitution is proposed. The attachment of data indicating in detail whether and how the equipment or material differs, if at all, from the article specified;
- d. A detailed explanation of any effect the proposed substitution will have on the scope of the Work and a certification that the Contractor agrees to be responsible for any and all resulting added costs to its Work and to any additional costs incurred by the Architect/Engineer in time, labor and/or redesign of the Contract Documents;
- e. The submission of documents that demonstrate proof of equality, along with an agreement to have such tests performed at the Contractor's own expense as may be required for approval by the DPMC and/or the Architect/Engineer. The Contractor shall be responsible for the cost of reviews by the Architect/Engineer of subsequent submissions of additional information.

4.7.5.4 No Contractor shall base a bid on a substitution that may have been approved on previous Projects. Bids shall be based solely on plans and specifications of this Project.

4.7.5.5 The Contractor shall not proceed with the purchase or installation of a substitution without the written approval of DPMC. Any such installation may result in the assessment of costs for its removal at the Contractor's expense, and/or other damages and/or termination of the Contract for default.

4.7.6 Additional Submissions

4.7.6.1 Samples: The Contractor shall furnish, for approval, all required samples. Such samples shall be submitted in accordance with the shop drawing and sample submittal schedule. All work must be installed in accordance with approved samples.

4.7.6.2 Utility Service Connections: With respect to plumbing, fire-protection, HVAC, electrical and other machinery and mechanical equipment items requiring utility service connections, the Contractor must submit the respective shop drawings with the manufacturer's certified rough-in drawings, indicating accurate locations and sizes of all service utility connections.

4.7.6.3 Sleeve and Opening Drawings: Prior to installing service utilities or other piping, through structural elements of the building, the Contractor shall prepare and submit, for approval by the Architect/Engineer, accurate dimensional drawings indicating the positions and sizes of all sleeves and openings required to accommodate the Work and installation of the Contractor's piping, equipment, etc. All such drawings must contain reference to the established dimensional grid of the building. Such drawings must be submitted in accordance with the approved shop drawing and sample submission schedule.

4.7.6.4 Control Valve and Circuit Location Charts and Diagrams: For all plumbing, fire-protection, HVAC and electrical work, the Contractor shall prepare a complete set of inked or typewritten control valve and circuit location diagrams, charts and lists identifying and locating all such items, and shall place the charts, diagrams and lists under frame glass in designated equipment rooms. The Contractor shall also furnish one-line diagrams, as well as such color-coding of piping, wiring and other necessary identifications as specified or required. This information is to be framed under glass and displayed where directed.

4.7.6.5 Coordination Drawings: The Contractor shall create and update a complete, composite set of Coordination Drawings. The purpose of these drawings is to identify coordination and interference problems prior to installation. Coordination Drawings are required for all equipment rooms, above ceiling spaces, shared chases, and other areas where the Work of two or more trades is to be installed. The drawings shall be drawn to a scale not smaller than 1/4"=1'-0" (30"x42" sheet size) and shall show clearly in both plan and elevation that all Work can be installed without interference. At a minimum these drawings shall indicate:

- a. The interrelationship of equipment and systems;
- b. Required installation sequences;

- c. Equipment foundations and pads, equipment, piping, conduits, racks, ductwork, insulation, panels, control centers, sprinkler and fire protection systems etc. and required clearances.

The Contractor shall prepare the coordination drawings based on the submitted shop drawings and Contract Documents. The Contractor shall prepare, submit and receive approvals for the Coordination Drawings before any sleeves or inserts are set, any floor openings are core drilled, or any equipment, equipment foundations, or related work is installed. The cost of preparing approved Coordination Drawings shall be included in the Contractor's price. DPMC may require the Contractor to identify Coordination Drawings as an item within the Schedule of Values, and incorporate them into in the Project schedule.

4.8 AS-BUILT DRAWINGS

4.8.1 The Contractor and each Subcontractor shall maintain on the Project Site at all times one set of drawings to be marked "AS-BUILT." The DPMC has the right to rely on accuracy of the "as-built" drawings provided by the Contractor. During the course of the Project, the Contractor shall mark these drawings with colored pencils to reflect any changes, as well as the dimension and the location of all pipe runs, conduits, traps, sprinkler and fire protection lines, footing depths or any other information not already shown on the drawings or differing therefrom. All buried utilities outside the building shall be located by a survey performed by a licensed surveyor who shall certify as to its accuracy. These marked-up drawings and surveys shall remain current and shall be made available to the DPMC or Architect/Engineer at all times during the progress of the Work.

4.8.2 In instances where shop drawings and/or erection drawings, of a scale larger than the Contract Drawings, are prepared by the Contractor, such drawings may be acceptable "as-built" drawings provided they are updated. A master sheet of the same dimensions as the Contract Drawings shall be prepared by the Contractor that shall indicate, sheet by sheet, a cross-reference to all shop drawings pertaining to that drawing.

4.8.3 The Contractor shall submit the "as-built" documents to the Architect/Engineer with a certification as to the accuracy of the information thereon at the time of Contract completion and before final payment will be made to the Contractor. After acceptance by the Architect/Engineer, the Contractor will furnish two sets of all shop drawings used for "as-built" documentation.

4.8.4 All "as-built" drawings as submitted by Contractors shall be dated and labeled "AS-BUILT" above the title block. This information shall be checked, edited and certified by the Architect/Engineer, who will then transpose such information from the Contractor's "as-built" drawings to the original drawings. Where shop drawings have been used by the Contractor for "as-built" documentation, the master sheet providing cross reference information, as described in section 4.8.2, shall be included in the set of "as-built" drawings furnished to DPMC.

4.9 EXCAVATIONS, CUTTING AND PATCHING

4.9.1 Soil borings, test pits or other subsurface information may be secured by an independent Contractor retained by the State prior to design and construction of the Project and, if obtained, may be included in the Contract Documents for the Contractor's use. The Contractor assumes full responsibility for interpretation of said information.

4.9.2 The Contractor shall be responsible for furnishing and setting of sleeves, built-in items, anchors, inserts, and other necessary materials for its work and for all cutting, fitting, closing in, patching, finishing, or adjusting of its work in new and/or existing construction, as required for the completed installation.

4.9.3 Approval in writing from the DPMC and the Architect/Engineer must first be obtained by the Contractor before cutting or boring through any roof, floor beams, floor construction or structural members.

4.10 TESTING

4.10.1 The Contractor shall notify the DPMC in writing of all work required to be inspected or tested. The notice shall be provided no later than five working days prior to the scheduled inspection or test. The Contractor shall bear all costs of such inspections or tests, except for Code inspections as stated in section 4.3 of this document.

4.10.2 When mechanical, electrical or other equipment is installed, it shall be the responsibility of the installing Contractor to maintain, warrant and operate it for such period of time as required by the Contract Documents or as necessary for the proper inspection and testing of the equipment and for adequately instructing the State's operating personnel. All costs associated with the maintenance, warranty, operations, inspection and testing of equipment, as well as instructing State personnel, shall be borne by the Contractor installing the equipment. All tests shall be conducted in the presence of, and upon timely notice to, the DPMC, prior to acceptance of the equipment.

4.10.3 DPMC shall have the authority to direct in writing that special or additional inspections or tests be performed. The Contractor shall comply and give notice as detailed above.

4.10.4 In the event such special or additional inspections or testing reveal a failure of the Work to comply with the terms and conditions of the Contract, the Contractor shall bear all costs thereof, including all costs incurred by the State made necessary by such failures.

4.10.5 The Contractor shall utilize inspection or testing from those firms/entities pre-qualified by DPMC. Failure to use a firm/entity pre-qualified by DPMC shall be grounds for rejection of the inspection or test as non-conforming.

4.10.6 All submittals of inspections, test reports or requests for approval shall be accompanied by a certification signed by the Contractor, attesting to: the Contractor's knowledge of the submittal; acceptance of its findings; acknowledgment that material testing meets the required standards; and a certification of the report's representation of

the facts. Failure to provide the written certification shall be grounds for rejection of the submittal.

4.10.7 The Contractor shall ensure that a copy of the inspection report is transmitted directly to the Architect/Engineer and the DPMC. The Contractor shall ensure that it includes in all of its subcontracts and purchase orders for inspection and testing, the requirement for the inspection or testing firm/entity to submit a copy of the report directly to the DPMC representative. The Contractor shall ensure that all such reports are submitted within fourteen (14) calendar days of the test or inspection.

4.10.8 In addition to tests performed by the Contractor, the State reserves the right to engage an independent testing agency or firm to perform testing inspections. The Contractor shall provide full access, provide samples, and cooperate fully with this testing agency.

4.10.9 Testing requirements for real property installed equipment (RPIE) to be furnished by the Contractor, when such testing is required by Code, Contract, or the manufacturer, shall be performed by a testing laboratory pre-qualified by DPMC, or in the absence of such, by the manufacturer or its authorized representative. The Contractor shall provide five working days' notice to the DPMC representative, to allow sufficient opportunity to witness the test.

4.10.10 The DPMC may order that any part of the Work be re-examined by the DPMC, and if so ordered, the Contractor shall open or uncover such work for re-inspection by the DPMC. If such work is found to be in accordance with the Contract, the DPMC shall pay the cost of re-inspection; however, if such work is not found to be in accordance with the Contract, the Contractor shall be responsible for the cost of re-inspection and replacement of any defective or non-conforming work.

4.11 EQUIPMENT AND MATERIALS

4.11.1 The Contractor warrants that all materials and equipment furnished under the Contract will be new, unless otherwise specified, and that all work will be of good quality, free from faults, defects, and installed in conformance with the Contract Documents. All work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective and rejected by the DPMC or the Architect/Engineer. If required by the Architect/Engineer or the DPMC, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. This warranty shall be in addition to but not in lieu of any other warranty or guarantee provided for in the Contract.

4.11.2 The Contractor shall submit to the Architect/Engineer an original and six copies of the request for approval of materials on the form provided by DPMC for approval. Each item of material listed shall be marked "As Specified", "Substitution" or "Unspecified" as appropriate.

4.11.3 The Contractor shall furnish and deliver the necessary equipment and materials in ample quantities and as frequently as required to avoid delay in the progress of the Work and shall store them so as not to cause interference with the orderly progress of the Project.

4.11.4 The Contractor shall furnish and pay for all necessary transportation, storage, scaffolding, centering, forms, water, labor, tools, light and power and mechanical appliances and all other means, materials and supplies for properly executing the Work under this Contract, unless expressly specified otherwise in the Contract Documents. The Contractor shall have its representatives at the Site to accept delivered materials. State agencies employees and/or representatives will not accept materials, nor will State agency employees and/or representatives be responsible for damage, theft, or disappearance of the Contractor's materials, equipment, tools, or other property.

4.11.5 Products manufactured in the United States shall be used in this work, whenever available. Wherever practicable, preference shall be given at all times to material and equipment manufactured or produced in the State of New Jersey, where such preference is reasonable and will best serve the interest of the State.

4.11.6 No materials, equipment, or supplies for the Work shall be purchased by the Contractor subject to any lien or encumbrance or other agreement by which an interest is retained by the seller. This clause shall be a condition included in all agreements between the Contractor and its Subcontractors. The Contractor warrants, by signing its invoice, that it has good and sufficient title to all such material, equipment and supplies used by it in the Work, free from all liens, claims or encumbrances.

4.12 TEMPORARY FACILITIES

The Contractor shall be responsible for providing for its own storage areas, employee vehicular parking and staging areas, excavation borrow/spoils designated areas, commercial canteen areas, and all other areas necessary for use by the Contractor. The Contractor shall locate these areas to suit Project requirements, subject to DPMC approval.

4.12.1 Field Offices - The Contractor will provide and maintain during the contract duration an on-Site suitable weather-tight insulated field office conveniently located, and shall maintain therein a complete set of Contract Documents including plans, specifications, CPM network diagrams, Change Orders, logs and other details and Project correspondence. Subject to the DPMC's written approval and at a date designated by DPMC, the field office may be removed upon enclosure of the building and space may be allocated for field offices within the building. The contents and operations will be transferred to the interior of the Project building by the Contractor, and said office(s) shall be maintained by the Contractor until final acceptance or until the DPMC approves its removal. The Contractor will be responsible to obtain and pay for all permits required for the Contractor's field offices.

4.12.2 Telephones - The Contractor shall provide its own telephones. The State will be responsible only for the cost of calls made by State employees. if there is a documented cost for same.

4.12.3 Storage - The Contractor will provide and maintain, for its own use suitable and safe temporary storage, tool shops, and employees' sheds for proper protection, storage work and shelter. The Contractor shall maintain these structures properly and remove the structures at the completion of work. The Contractor shall be responsible to maintain

these facilities and the areas around the facilities in a clear and clean manner. The Contractor shall be responsible for correcting defects and damage caused by such use. Rooms in buildings at the Project Site may be used as shops and storerooms, conditioned upon written approval from DPMC.

4.12.4 Toilet Facilities

- a. The Contractor shall provide and pay for suitable temporary toilets at an approved location on the Site and prior to the start of any field work. The toilet facilities shall comply with federal, State and local laws and regulations. The Contractor will be responsible for maintenance, removal and relocation as described hereinafter.
 - b. The Contractor shall provide a temporary toilet and/or indoor toilet connected to water and sewer to accommodate the meeting room and the Architect/Engineer's office, as well as the DPMC office.
- c. Toilets shall be serviced by a qualified and experienced firm authorized to maintain services.
- d. Each portable toilet facility shall be maintained in a neat and clean condition and serviced at least twice a week, including the removal of waste matter, sterilizing, recharging tank, refilling tissue holders, and thoroughly cleaning and scrubbing entire interior.
- e. Toilet facilities in a multiple-story building shall be located on no less than every other floor, unless otherwise directed in writing.
- f. Toilet service shall be relocated inside the building and connected to water and sewer as the progress of the Work will allow.
- g. When temporary toilets are connected to water and sewer lines, precautions shall be taken to prevent freezing.
- h. The Contractor shall remove the temporary toilet units from the Work Site at the completion of the Work, or when so directed by the DPMC or the Architect/Engineer.
- i. Workers are not to use the finished bathroom and toilet facilities in the Project buildings. Reasonable steps must be taken by the Contractor to enforce this rule.

4.12.5 Access, Roads and Walks

- a. The Contractor shall be responsible for providing and maintaining unobstructed traffic lanes on the designated construction access routes shown on the Contract Drawings or as reasonably required so as to perform the Work. The Contractor shall provide and maintain all reasonably required safety devices. The Contractor shall provide any necessary additional materials, grading and compaction, and shall remove snow and debris as necessary to provide and maintain the access roadbed and pedestrian ways in serviceable condition.
- b. The Contractor shall be responsible for constructing and maintaining all roadways, drives and parking areas within or proximate to the Site free and clear

of debris, gravel, mud, snow, ice, or any other Site materials, by ensuring that all reasonably necessary measures are taken to prevent such materials from being deposited on such surfaces. This includes, as may be appropriate, the cleaning of vehicle wheels and/or other necessary maintenance, prior to exit from the Construction Site. Should such surface require cleaning, the Contractor will clean these surfaces without additional cost to the State. The Contractor will be held accountable for any citations, fines, or penalties imposed on the State for failing to comply with local rules and regulations related to Site and off-Site maintenance.

c. The Contractor shall not commence final construction of permanent driveways, parking areas or walks without the written approval of the DPMC. The Contractor shall provide additional materials and labor for maintaining and reworking the sub-grade prior to completion of the Work, to ensure improvements conform fully to the specifications.

d. The Contractor shall obtain written permission from the State for the use of any existing driveways or parking areas not specifically designated for such use in the Contract Documents. If permission is granted, the Contractor shall maintain such driveways and areas in good condition during the construction period, and at the completion of the Project, shall leave them in the same or better condition as at the start of the Work. Conditions before use shall be carefully photographed and documented by the Contractor.

4.12.6 Light and Power

a. The Contractor shall extend electrical service to the building or buildings at locations approved by the DPMC. Temporary electrical service shall be independent of the existing permanent service. Initial temporary service shall be three phase or single phase as indicated in the Contract Documents. The Contractor is responsible to investigate and verify the appropriateness and availability of electrical service with the local utility company prior to the bid date. The Contractor's bid shall be deemed to include all costs associated with providing this power. Temporary light and power installations, wiring, and miscellaneous electrical hardware must meet the electrical Code and will be inspected by NJUCC officials. The Contractor shall provide the necessary distributing facilities and a meter, and shall pay the cost of running temporary services from the nearest utility company power pole. All costs shall be included in the Contractor's bid.

b. In the event that a water well is the source of water supply for the Project, the extension of electrical service shall include the necessary wiring of sufficient capacity to the location of the well for the operation of the well pump. Where service of a type other than herein mentioned is required, the Contractor requiring it shall install and pay all costs of such special service. The size and incoming service and main distribution switch and panel shall be sized as any service by NEC requirements.

c. The Contractor shall provide all electrical service for the operation of elevator equipment during construction.

d. The Contractor shall pay for the cost of all electric energy used on distribution lines installed.

e. The Contractor shall provide and pay for all maintenance, servicing, operation and supervision of the service and distribution facilities.

f. If the Contractor fails to carry out its responsibility in the supplying uninterrupted light and power as set forth herein, the Contractor shall be held responsible for such failure, and the DPMC shall have the right to take such action as is deemed proper for the protection and conduct of the Work. Any costs associated with DPMC obtaining or supplying light and power shall deducted from any payment due to the Contractor.

g. The Contractor shall comply with the requirements of the Federal Occupational Safety and Health Act of 1970 with regard to temporary light and power.

4.12.7 Temporary Enclosures

Whenever necessary in order to maintain proper temperatures for the execution or protection of the Work, the Contractor shall furnish and maintain temporary enclosures for all openings in exterior walls that are not enclosed with finished materials. Temporary wood doors shall be provided at door openings.

4.12.8 Temporary Heating, Ventilation and Air Conditioning

a. Prior to Enclosure - Prior to the building being enclosed by walls and roof, if the outside temperatures falls below 45 degrees Fahrenheit ("F") at any time during the day or night, and heat is required for work in progress or for its protection or curing, the Contractor shall furnish, at its expense, acceptable means to provide sufficient temporary heat to maintain a temperature required by the Work being performed but in no case less than 45 degrees F.

b. Generally Enclosed

(1) For the purposes of establishing the beginning of the Contractor's obligation to provide temporary heat, a building or major unit thereof shall be considered generally enclosed when (a) the exterior walls have been erected, (b) a temporary roof or permanent roof is installed and in a watertight condition, and (c) temporary or permanent doors are hung and window openings are closed with either permanent or temporary weather-tight enclosures. A major unit of buildings as referred to herein shall be: (a) an entire separate structure, or (b) a fully enclosed wing which shall have a floor area equal to at least 50% (fifty percent) of the total floor area of the Project.

(2) As soon as the DPMC determines that the building, or a major unit thereof, is "generally enclosed" by walls and roof, and when the outside temperature falls below 55 degrees F. at any time during the day or night, the Contractor shall furnish sufficient heat by the use and maintenance of LP gas heaters or other acceptable means to maintain a temperature of not less than 55 degrees F. within the enclosed area of the building at all

times, and shall remove such heaters when no longer required. The Contractor will be held responsible for providing temporary heat and for all damages resulting from freeze-ups, for the duration of the Project from the time the building is generally enclosed to final acceptance and occupancy. The Contractor shall remove soot, smudges, and other deposits from walls, ceilings, and all exposed surfaces which are the result of the use of heating equipment, including the permanent heating system, during the period of its use for supplying heat. The Contractor shall not do any finish work until the areas are properly cleaned. The Contractor shall provide or arrange, at its own expense, supervision of the heating equipment at all times prior to providing heat, using the permanent heating system. This obligation shall commence immediately after the acknowledged permanent enclosure of the building or buildings, as confirmed by the DPMC. The Contractor shall furnish and pay for all fuel for heat required during the period when the building is generally or permanently enclosed.

(3) The Contractor shall not assume that the permanent heating system or any part thereof will be available for furnishing of temporary heat during the period for which temporary heat is required. The Contractor's base bid price shall therefore include the cost of all equipment necessary for providing temporary heat as required by the Contract Documents. The Contractor may use the permanent heating system, with written approval from DPMC. Such use however does not cause to commence the equipment's warranties and guarantees. The equipment's warranties and guarantees shall not commence to run until the State takes beneficial use of the Project and facility for the purposes intended.

(4) All heating equipment shall be NFPA-approved and connected to approved flues to the atmosphere. Heaters shall be approved by a recognized testing laboratory and must be equipped with a positive shut-off safety valve.

(5) Storage of gas cylinders within the building will not be permitted at any time.

(6) The Contractor shall provide fire extinguishers on each floor where heaters are used, and the areas must be adequately ventilated.

c. Permanent Enclosure

(1) When the building enclosure has been confirmed by the Architect/Engineer has been completed in accordance with the Contract Documents, and to the satisfaction of DPMC, it shall be considered permanently enclosed. The Architect/Engineer will also confirm in the job meeting minutes that the building, or a major unit thereof, is permanently enclosed.

(3) The Contractor shall install adequate controls to make such temporary connection as required for the operation of the HVAC system.

Should the heating system be designed for the tie-in to existing steam lines for resource of heat, the State will provide steam for temporary heat through the Project permanent heating system, at no cost to the Contractor, after the tie-in is completed by the Contractor.

(4) When the building enclosure has been confirmed by the A/E as completed, the Contractor may request permission to operate the permanent HVAC system to meet its temporary HVAC obligation. The Contractor shall maintain a minimum temperature of 55 degrees F., or a higher temperature, not to exceed 75 degrees F., as may be directed by the Contract Documents for the proper conduct and protection of the Work. The Contractor shall do so until such time as its work is completed and accepted and the Contractor is relieved of this requirement in writing by the DPMC. The Contractor shall pay for and be responsible for the maintenance in accordance with the manufacturer's recommendations, operation and supervision of the HVAC system, including the cost of all water, electricity, and fuel, until the State assumes beneficial occupancy/use of the Project.

4.12.10 Temporary Water

a. The Contractor shall provide, protect and maintain an adequate valved water supply. If the source of water supply is a well, provisions covering the supply water will include the installation of necessary power-driven pumping facilities. The well shall be protected against contamination. The water supply shall be tested periodically by the Contractor, and if necessary, shall be chlorinated and filtered. All costs of providing water will be paid for by the Contractor.

b. The Contractor is responsible to protect all temporary and permanent water lines from damage or freezing. Should water connections be made to an existing line, the Contractor shall provide a positive shut-off valve at its own cost and expense.

4.12.11 Standby Personnel

If, pursuant to trade agreement to which the Contractor is a party, the Contractor is obligated, to employ standby personnel then the Contractor shall determine and include all such costs thereof in its bid proposal. The Contractor shall not, at any time, make a claim to the State for costs relating to standby maintenance or standby supervision for electric motor-driven or other equipment.

4.12.12 Dust Control

a. The Contractor shall provide and maintain necessary temporary dust-proof partitions around areas of Work in any existing building or in new building areas as directed by the Architect/Engineer or the DPMC.

b. The Contractor shall provide and maintain Site dust control of Projects with on-Site construction as directed by the Architect/Engineer or the DPMC.

4.13 STORAGE AND SITE MAINTENANCE

4.13.1 The Contractor shall confine its apparatus, the storage of its equipment, tools and materials, and its operations and workers to areas permitted by law, ordinances, permits, and Contract as set forth in the Contract Documents, the rules and regulations of the State, or as ordered by the DPMC. The Contractor shall not unreasonably encumber the Site or the premises with materials, tools and equipment.

4.13.2 The Contractor shall, at all times during the progress of the Work keep the premises and the job Site free from the accumulation of all refuse, rubbish, scrap materials and debris caused by its operations and/or the actions of its employees, Subcontractors and/or workers, to ensure that, at all times, the premises and Site shall present a neat, orderly and workmanlike appearance. This is to be accomplished as frequently as is necessary by the removal of such refuse, rubbish, scrap materials and debris from the Site and the State's premises. Loading, cartage, hauling and dumping of same will be at the Contractor's expense.

4.13.3 At the completion of the Work, the Contractor shall remove all of its tools, construction equipment, machinery, temporary staging, false work, mock-ups, form work, shoring, bracing, protective enclosures, scaffolding, stairs, chutes, ramps, runways, hoisting equipment, elevators, derricks, cranes, and any other materials and equipment brought onto the Project Site.

4.13.4 Should the Contractor not promptly and properly discharge its obligation relating to Site maintenance and/or final clean up, the State shall have the right to employ others and to charge the resulting cost to the Contractor after first having given the Contractor a three-working day written notice of such intent.

4.13.5 The Contractor's responsibilities for final clean up shall include:

- a. Removal of all debris and rubbish resulting from or relating to the Contractor's work. Rubbish shall not be thrown from building openings above the ground floor unless contained within chutes.
- b. Removal of stains from glass and mirrors. Glass shall be washed and polished inside and outside.
- c. Removal of marks, stains, fingerprints, soil, dust or dirt from painted, decorated or stained woodwork, plaster or plasterboard, metal acoustic tile and equipment surfaces.
- d. Removal of spots, paint and soil from resilient, glazed and unglazed masonry and ceramic flooring and wall work.
- e. Removal of temporary floor protections; and cleaning, washing or otherwise treating and/or polishing, as directed, all finished floors.
- f. Cleaning of exterior and interior metal surfaces, including doors, window frames and hardware, of oil stains, dust, dirt, paint, etc. Polishing and removal of fingerprints or blemishes from such surfaces shall be completed, as applicable.

- g. Restoration of all landscaping, roadways and walkways to preexisting condition. Damage to trees and plantings shall be repaired in the next planting season, and such shall be guaranteed for one year from the date of repair and/or replanting.

4.13.6 All construction equipment, materials and/or supplies of any kind, character or description, regardless of value, which remain on the job Site for more than 30 (thirty) calendar days from the date of the Certificate of Final Acceptance, shall become the property of the State. Such construction equipment, materials and/or supplies will be disposed of in any manner the State shall deem reasonable and proper. The cost of this disposal will be deducted from any sums due the Contractor. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the State.

4.14 CUT-OVERS AND INTERRUPTIONS

All cut-overs of mechanical and electrical services to existing buildings shall be approved, scheduled and coordinated in advance with the DPMC's representative and performed at a time convenient to the occupants of said buildings so as not to unreasonably interfere with its operations.

4.15 PROTECTION/SAFETY

4.15.1 Safety Precautions and Programs – The Contractor shall be responsible for initiating, maintaining and supervising all required safety precautions and programs in connection with the Work. The Contractor shall designate a responsible member of its organization at the Site whose duty shall be the prevention of accidents. This person shall be competent to review, implement and coordinate the safety programs being performed as required by Occupational Safety and Health Administration (OSHA) or any other agency having authority over safety on a State Construction Site.

4.15.2 Protection of Persons

- a. The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury or loss to:
 - (1) Every employee on the Site and all other persons who may be affected thereby;
 - (2) All the Work and all materials and equipment to be incorporated therein, whether in storage on or off the Site, under the care, custody or control of the Contractor, or any of its Subcontractor(s) or lower tier sub-Subcontractor(s); and
 - (3) Other property at the Site or adjacent thereto (whether owned by the State or not), including but not limited to trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

b. The Contractor shall give all notices and comply with all applicable laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the safety of persons or property or their protection from damage, injury or loss.

c. The Contractor shall erect and maintain, as required by existing conditions and progress of the Work, all reasonable safeguards for safety and protection, including but not limited to rails, night-lights, aircraft warning lights, the posting of danger signs and other warnings against hazards, promulgating safety regulations, notifying Owners and users of adjacent utilities and other means of protection against accidental injury or damage to persons and property.

d. The Contractor shall not load or permit any part of the Work to be loaded so as to endanger the safety of the project, its employees, or any other person on the project Site.

e. The Contractor shall promptly remedy all damage or loss to any property caused in whole or in part by the Contractor, any of its Subcontractors, lower tier Subcontractors, or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable and for which the Contractor is responsible. These obligations are in addition to those stated elsewhere herein.

4.15.3 Protection of Property

The Contractor shall have full responsibility to install, protect, and maintain all materials and supplies in proper condition whether in storage or off the site and to immediately repair and/or replace any such damage until Final Acceptance. The Contractor shall maintain an inventory of all materials and supplies for the Work at the Site, that are delivered to the site, or delivered to approved off-site storage facilities. The State shall not be liable for any damage, theft or negligent injury to the Contractor's property.

4.15.4 Hazardous Materials

a. When the use or storage of explosives or other hazardous materials or equipment is necessary for the execution of the Work, the Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel.

b. The Contractor shall maintain all records, reports and files of the general storage and handling of hazardous materials as required by any and all federal, State and/or local regulatory agencies.

4.16.5 Emergencies

In any emergency affecting the safety of persons or property, the Contractor shall act with diligence to prevent threatening injury, damage or loss. In such case, the Contractor shall immediately, but in no case, not more than 24-hours following the emergency, notify the DPMC and the Architect/Engineer of the action taken.

4.16 UNCOVERING AND CORRECTION OF WORK

4.16.1 Uncovering of Work

- a. The Contractor is obligated to provide reasonable notice to the DPMC and/or the Architect/Engineer of all work scheduled to be covered, to permit DPMC and the Architect/Engineer the opportunity to inspect the Work prior to actual covering. If any portion of the Work is covered prior to inspection by the DPMC or the Architect/Engineer, it shall be uncovered for observation. Uncovering and replacement of the covering shall be at the Contractor's expense.
- b. The DPMC and/or the Architect/Engineer may request any work be uncovered by the Contractor for inspection. If such work is found to be in accordance with the Contract Documents, the cost of uncovering and replacement shall, by appropriate Change Order, be reimbursed to the Contractor. If such work is found not to be in accordance with the Contract Documents, the Contractor shall pay all associated costs.

4.16.2 Correction of Work

- a. The Contractor shall promptly correct all work rejected by the DPMC or the Architect/Engineer as defective or failing to conform to the Contract Documents, whether observed before or after final acceptance and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such rejected work, including the costs of all consultant services including but not limited to the Architect/Engineer's additional services.
- b. The Contractor shall remove from the site, at its own expense, all portions of the Work which are defective or non-conforming and which have not been corrected, unless removal is waived by the DPMC.
- c. If the Contractor fails to correct defective or non-conforming work in a reasonable time fixed by written notice from DPMC, then DPMC may make arrangements for such correction by others and charge the cost of so doing to the Contractor.
- d. If the Contractor does not proceed with the removal and correction of such defective or non-conforming work within a reasonable time, fixed by written notice from the DPMC or the Architect/Engineer, any materials or equipment shall become the property of the State and the DPMC may remove and dispose the non-conforming work in any manner to best meet the interest of the State. If such material is sold and the proceeds of the sale do not cover all costs which the Contractor should have borne and any additional cost incurred by the State in the uncovering, removal, disposal and correction of non-conforming work, the difference shall be charged to the Contractor and an appropriate credit Change Order shall be issued. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the State.
- e. The Contractor shall be responsible for the cost of making good all work destroyed or damaged by such correction or removal.

- f. Notwithstanding other obligations within the Contract Documents, nothing contained herein shall be construed to establish a time or date limitation upon which the DPMC must discover non-conforming work. .

4.16.3 Acceptance of Non-Conforming Work

The DPMC may determine that the best interests of the State will be served by accepting defective or non-conforming work instead of requiring its removal and correction. In such instance, the DPMC may, by any means available, exact an appropriate reduction in the Contract sum. Such adjustment shall be effected regardless of final payment having previously been made, and the Contractor and/or its surety shall be responsible for promptly remitting any funds due the State as a result thereof.

4.17 LAYOUT AND DIMENSIONAL CONTROL

4.17.1 The Contractor shall be responsible for locating and laying out the building and all of its parts on the site, in strict accordance with the Contract Documents, and shall accurately establish and maintain dimensional control. The Contractor shall employ and pay for the services of a competent and licensed New Jersey engineer or land surveyor who shall be pre-qualified by DPMC to perform all layout work, and to test the level of excavations, footing base plates, columns, walls and floor and roof lines, and furnish to the Architect/Engineer, as the Work progresses, certifications that each of such levels is as required by the drawings. The plumb lines of walls, shall be tested and certified by the surveyor as the Work progresses.

4.17.2 The Contractor's engineer/surveyor, in the course of layout work either on the site or within any building, shall establish all points, lines, elevations, grades and bench marks for proper control and execution of the Work. The Contractor's engineer/surveyor shall establish a single permanent benchmark as set forth in the Contract Documents to which all three coordinates of dimensional control shall be referenced. The Contractor's engineer/surveyor shall verify all Owner-furnished survey data including but not limited to topographical and utility location points, lines, elevations, grades and benchmarks, and buildings. Should any discrepancies be found between information given on the Contract Documents and the actual site or field conditions, the Contractor shall notify DPMC and the Architect/Engineer in writing of such discrepancy, and shall not proceed with any work affected until receipt of written instructions from the DPMC.

4.18 PROJECT SIGN

The Contractor shall erect and maintain one sign at the Project Site, as set forth in the Contract Documents and located as directed by the Architect/Engineer. Painting shall be done by a professional sign painter, with two coats of exterior paint, colors, letter face and layout as shown. No other sign will be permitted at the site. Upon completion of the Project, and when directed by the Architect/Engineer or the DPMC, the Contractor shall remove the sign.

4.19 SECURITY

4.19.1 The Contractor shall provide all locks, doors and security construction and personnel as required to secure the Project building throughout the period of construction.

4.19.2 The Contractor shall be responsible for the security of any temporary structures located on the premises outside of the building and/or any stored materials.

4.20 DPMC FIELD OFFICE

4.20.1 The Contractor will provide on-site, suitable, separate, weather-tight, insulated (floor, walls, ceilings) field office facilities for the use of DPMC personnel, as more fully described in the Contract Documents. At a minimum, the Contractor is to supply this field office with toilet facilities, heating and air conditioning, tables and chairs, and phone and data communication lines. At a time determined by the DPMC or the Architect/Engineer, the Contractor shall remove field facilities upon enclosure of the Project building and shall relocate the contents and operations of the field office to the interior of the Project building until completion of the Project.

4.20.2 The Contractor shall be responsible for the maintenance of both offices and the meeting room, including the cost of heating, air conditioning, electric current, and janitorial service.

4.21 PHOTOGRAPHS

4.21.1 The Contractor shall submit monthly progress photographs in duplicate to the DPMC, giving six (6) views of the Work with each application for payment until the Project is completed,.

4.21.2 The photographs shall be 8" by 10" shall bear the date and time of the exposure, the DPMC Project number and title, the names of the Contractor and the name of the Architect/Engineer. All photographs shall also be submitted in digital format.

4.22 REPAIR OF FINISHED SURFACES, APPLIED FINISHES, GLASS

4.22.1 The Contractor accepts sole responsibility for repair of uncontrolled dislodging, cracking, delaminating or peeling of finished surfaces such as concrete, pre-cast concrete, cast and natural stone, unit masonry, millwork, plaster, glass and applied finishes such as compound, paint, and special coatings, within the Contract Work and the limits of specified guarantee periods, regardless of the cause.

4.22.2 The Contractor shall be responsible for replacement of all broken glass, regardless of the cause. The Contractor shall replace all broken, scratched or otherwise damaged glass before the completion and acceptance of the Work. If breakage is caused by the Owner, the Contractor will be reimbursed for the replacement costs. The Contractor shall wash all glass on both sides at completion, or when directed, removing all paint spots, stains, plaster, and other materials.

ARTICLE 5 - SUBCONTRACTORS

5.1 SUBCONTRACTORS AND MATERIAL SUPPLIER APPROVALS

5.1.1 Upon their execution, but not less than fourteen (14) calendar days prior to Subcontractor mobilization on the site, and/or Subcontractor billing, the Contractor shall forward to the Architect/Engineer on the form provided by the DPMC the names of all its Subcontractors and suppliers, of such others as the DPMC may direct, proposed to perform the principal parts of the Work. The Contractor shall forward the appropriate DPMC form to the Architect/Engineer for approval. Department of Labor Contractor Registration and New Jersey Business Registration Certificate are required for all Subcontractors.

5.1.2 If the DPMC has objection to any proposed or approved Subcontractor and/or material supplier, the Contractor shall substitute another Subcontractor and/or material supplier acceptable to DPMC. Under no circumstances shall the State be obligated for additional cost due to such substitution.

5.1.3 After the acceptance of bids, the Contractor shall make no substitution of any Subcontractor person or firm previously selected and approved, without prior written approval from the Architect/Engineer and DPMC. A Contractor seeking to substitute a Subcontractor person or firm shall provide written request for substitution no less than fourteen (14) calendar days prior to the execution of Work by the Subcontractor or material supplier.

5.1.4 Approval of a Subcontractor or material supplier by the DPMC and Architect/Engineer shall not relieve the Contractor of the responsibility of complying with all provisions of the Contract Documents. The approval of a Subcontractor or material supplier does not imply approval of any construction, material, equipment or supplies.

5.2 CONTRACTOR-SUBCONTRACTOR RELATIONSHIP

5.2.1 The Contractor acknowledges its full responsibility to the State for the acts and omissions of its Subcontractors and lower tier subcontractors, and of persons and firms either directly or indirectly employed by them, equally to the extent that the Contractor is responsible for the acts and omissions of persons and firms directly or indirectly employed by it. The Contractor acknowledges that it remains fully responsible for the proper performance of its Contract regardless of whether work is performed by the Contractor's own forces or by Subcontractors engaged by the Contractor.

5.2.2 Nothing contained in the Contract Documents shall create any contractual relationship between any Subcontractor and the State. Further, no Subcontractor or material supplier shall be deemed an intended third party beneficiary under this Contract.

5.2.3 The Contractor and all Subcontractors agree that, in the employment of both skilled and unskilled labor, preference shall be given to residents of the State of New Jersey, if such labor force is available.

5.2.4 The Contractor shall require, in its agreements with Subcontractors and as a condition of agreement, that each Subcontractor require in its agreement(s) with lower tier Subcontractors and Suppliers, that the Subcontractor understands that there is no contractual obligation of any kind between the State and Subcontractor and the Subcontractor's sole recourse lies with the Contractor and/or the surety, and not with the State, that each Subcontractor and lower tier Subcontractor, bound by the terms of the Contract Documents for this Contract, and assume toward the Contractor all the obligations and responsibilities which the Contractor assumes, pursuant to the Contract Documents.

ARTICLE 6 - CONSTRUCTION PROGRESS SCHEDULE

6.1 GENERAL

The State may contract for the services of a Critical Path Method (CPM) scheduling consultant for Project planning, scheduling and cost control. If such has been arranged, then section 6.2 shall apply to the Contract between the State and the Contractor. In the absence of a statement in the bid documents that a CPM consultant has been retained by the State, then section 6.3 shall apply.

6.2 CONSTRUCTION PROGRESS SCHEDULE (CRITICAL PATH METHOD -- CPM CONSULTANT RETAINED BY THE STATE)

6.2.1 Critical Path Method

- a. The Project will be monitored by a detailed critical path method scheduling system. This system shall be the basis for the evaluation of the Contractor's performance and for progress payments to the Contractor.
- b. The Contractor shall provide all the information necessary for the CPM consultant employed by DPMC to develop a CPM network plan demonstrating complete fulfillment of all construction Contract requirements and, as necessary, for the CPM consultant to maintain an accurate CPM schedule throughout the Project. The Contractor, in consultation with the CPM consultant, will establish construction logic and activity time duration consistent with Contract documents and Project requirements. The CPM consultant will establish the level of detail to be reflected on the CPM schedule. The Contractor shall utilize the schedule in planning, coordinating and performing the Work, including all activities of Subcontractors, equipment vendors and material suppliers.
- c. The Contractor agrees that the CPM consultant's Project network schedule is the designated plan for completion of all work in the allotted time, and the Contractor will assume full responsibility for the execution of the Work as shown. The Contractor shall indicate formal acceptance of the schedule by signing the final initial (baseline) network diagrams and computer schedule listing.
- d. The Contractor shall furnish sufficient labor and construction equipment to ensure the execution of the Work in accordance with the approved CPM progress schedule. If, in the opinion of the DPMC, a Contractor falls behind the CPM progress schedule, the Contractor shall take any and all such steps as may be necessary to bring its work into compliance with the CPM progress schedule. The DPMC may require the Contractor to increase the number of shifts, days of work and/or the amount of construction labor, plant and equipment, all without additional cost to the State.
- e. The Contractor shall make no claim for, and have no right to, additional payment or extension of time for completion of the Work, or any other concession because of any misinterpretation or misunderstanding on the Contractor's part of the CPM progress schedule, the Contractor's failure to attend the pre-bid

conference, or because of any failure on the Contractor's part to become fully acquainted with all conditions relating to the CPM progress schedule and the manner in which it will be used on the Project, or because of any Subcontractor's failure to properly participate in the development of a CPM progress schedule or to perform the Contract in accordance with the CPM progress schedule.

6.2.2 Initial Submittal

a. To the extent necessary for the CPM consultant to reflect in the network diagrams the plan for completion of this Contract, the Contractor shall meet with and assist the CPM consultant and furnish, within ten (10) calendar days after award of this Contract, all necessary information for the preparation of the CPM progress schedule. This information shall include, but not necessarily be limited to, a logical sequencing of work operations, activity time estimates, intended crew flow, activity costs and estimated manpower requirements for each activity.

(1) The network diagram shall show the sequence and interdependence of activities required for the Project. In preparing the network diagram, the Contractor shall assist the CPM consultant by breaking up the Work into activities of a duration of no longer than ten (10) working days each, except as to non-construction activities (such as procurement of materials, delivery of equipment and concrete curing) and any other activities for which the CPM consultant may approve the showing of longer duration. The diagram shall show not only the activities for actual construction but also such activities as the Contractor's submittal of shop drawings, templates and equipment, material fabrication, delivery of equipment and material, substantial completion, final completion, punch list and closeout, and the delivery of Owner-furnished equipment, if applicable. The Contractor shall provide activity durations to the CPM consultant for each activity on the diagram.

(2) If requested by the CPM consultant, the Contractor shall furnish any information needed to justify the reasonableness of activity time duration. Such information shall include, but not be limited to, estimated activity manpower, unit quantities, and production rates.

(3) Failure by either the Contractor or the CPM consultant to include any element of work required for the performance of the Contract shall not excuse the Contractor from completing all work required within any applicable date, notwithstanding DPMC approval of the network diagrams.

(4) The CPM consultant will establish the level of detail to be reflected in the CPM system.

(5) Seasonal weather conditions shall be considered in the planning and scheduling of all work influenced by high or low ambient temperatures for the completion of all Contract work within the allotted Contract duration. In addition, appropriate allowances shall be made for anticipated time losses due to normal rain and snow conditions based on

the previous five year average for that geographical area, by statistically expanding the estimated time duration for weather-sensitive activities, to ensure that the required completion date is achieved.

b. The Contractor shall be prepared to meet as many times as necessary with the CPM consultant to develop the information required for the timely development of the progress CPM schedule.

c. The Contractor shall furnish a breakdown of its total Contract price by assigning dollar values to each applicable network activity, coded for the Contractor and each Subcontractor, which cumulatively equals the total Contract amount. Upon acceptance by DPMC, the values will be used as a basis for determining progress payments. Progress payments to the Contractor shall be dependent upon final acceptance by DPMC of the cost-loaded progress CPM schedule.

d. Accompanying the network diagram and computer scheduling listing, the CPM consultant will furnish a computer-generated cost requisition listing, which will provide a separate tabulation of each activity shown on the CPM schedule in order of bid item or trade responsibility code as agreed to by DPMC. This listing will show, for each activity, the Contractor and each Subcontractor, the estimated dollar value of Work in place for totally or partially completed activities, including subtotals by bid items and grand totals for the entire Project. The cost requisition listing will also contain monthly activities reflecting the cost of Project overhead and administrative expenses, and activities reflecting the monthly cost of administering Project General Conditions.

6.2.3 Review and Approval:

a. After receipt of the initial network diagram, computer-produced schedule and cost requisition listing, the DPMC representative shall meet with the Contractor and CPM consultant for joint review, correction, or adjustment of the proposed plan and progress CPM schedule to evaluate the cost values assigned to each activity. Within ten (10) calendar days after the joint review, the CPM consultant will revise the network diagram and/or computer-produced schedule in accordance with agreements reached during the joint review, and shall submit two (2) copies each of the revised network diagram, computer-produced schedule and cost requisition listing to DPMC. The revised schedule documents will be reviewed by DPMC and, if found to be as agreed upon, will be approved. A copy of each will be returned to the CPM consultant for distribution and the CPM consultant shall forward same to the Contractor by email and/or overnight mail. The Contractor shall review these documents and shall indicate acceptance by signing the schedule documents. If the Contractor objects to the schedule documents, the Contractor shall forward these objections in writing to DPMC within ten (10) calendar days of the date of receipt of same or be deemed to have accepted the schedule documents. Objections shall include the precise activities of the schedule to which the Contractor objects and identify the basis of the objection. The Contractor will then meet with the DPMC representative and the CPM consultant to review the Contractor's objections. The CPM consultant may

revise the network diagram and the computer-produced schedule in accordance with the agreements reached during this final review and shall submit two (2) copies each of the revised network diagram, computer-produced schedule and cost requisition listing to DPMC. The re-submission will be reviewed by DPMC and, if found to be as agreed upon, will be approved and a copy of each will be returned to the CPM consultant for distribution and the CPM consultant shall forward same to the Contractor by email and/or overnight mail. The Contractor shall review these schedule documents to ensure that that the documents reflect all changes agreed upon, accept and sign. The Contractor shall indicate its acceptance by signing the scheduling documents, computer-produced schedule and cost requisition. Approval will be without reservation, and the Contractor will be deemed to have accepted the schedule as adequate, proper and binding in all respects and shall not raise further objections to the schedule.

b. After the network diagrams and computer-produced schedule have been signed by the Contractor, the CPM consultant shall forward to the Contractor and DPMC one set of copies of the network diagrams and computer-produced schedule. The network diagram and the computer-produced schedule with approved signatures shall constitute the Project work schedule until subsequently revised in accordance with the requirements of this section.

6.2.4 Progress Reporting and Changes:

a. Once every month, or more often if required by DPMC, the Contractor shall meet with the CPM consultant and DPMC's representative(s) and provide the information necessary for the CPM consultant to prepare and submit to DPMC a revised (updated) network diagram and computer-generated schedule listing showing:

- (1) Approved changes in activity sequencing;
- (2) Changes in activity duration for activities not started or partially completed where agreed upon;
- (3) The effect on the network of any delays in any activities in progress, and/or the impact of known delays which are expected to affect future work;
- (4) The effect of Contractor modifications (activity duration, logic and cost estimates) to the network;
- (5) Changes to activity logic, where agreed upon, to reflect revision in the Contractor's work plan, i.e., changes in activity duration, cost estimates, and activity sequences for the purposes of regaining lost time or improving progress; and
- (6) Changes to milestones, due dates, and the overall Contract completion date which have been agreed upon by DPMC since the last revision of the CPM schedule.

b. The CPM schedule shall accurately reflect the manner in which the Contractor intends to proceed with the Project and shall incorporate the impact of

all delays, Change Orders and change events as soon as these factors can be defined. All changes made to the schedule shall be subject to approval by DPMC prior to inclusion in the CPM schedule. If the DPMC representative and the Contractor are unable to agree as to the amount of time to be allowed for Change Order work, or the manner in which the Work is to be reflected on the network diagram, the CPM consultant will reflect the logic and time duration furnished by the Contractor for the Change Order work pending final DPMC decision. If non-approved Contractor logic and time durations are used, the Contractor agrees that any time which is projected to be lost on the Project as a result of these schedule changes will be considered the responsibility of the Contractor until a final agreement has been made or a final decision rendered by DPMC regarding the manner in which the Change Order work is to be reflected on the schedule. When this final decision has been made by DPMC, the CPM consultant shall revise the CPM schedule in accordance with such decision and issue a final analysis of the effect of the change on the Project.

c. If the Contractor desires to revise the logic of the approved progress CPM schedule to reflect a sequence of construction that differs from that to which was previously agreed, the Contractor must first obtain the approval of DPMC.

(1) Once each month, at the same time the network is updated, the CPM consultant, the Contractor and the DPMC representative(s) shall jointly make entries on the preceding network diagram schedule to show actual progress, identify those activities started by date and those completed by date during the previous period, show the estimated time required to complete each activity started but not yet completed, show activity percent completed and/or dollars earned, and reflect any changes in the network diagram approved in accordance with the preceding paragraph. After completion of the joint review and DPMC's approval of all entries, the CPM consultant will submit updated network diagrams, an updated computer-produced calendar-dated schedule and cost requisition listing to DPMC.

(2) The resultant monthly CPM computer printout and network diagrams shall be recognized by the Contractor as its sole updated construction schedule to complete all remaining Contract work.

(3) In addition to the foregoing, once each month the Contractor will receive a narrative report prepared by the CPM consultant. The narrative report will include a description of the amount of progress made during the last month in terms of completed activities in the plan currently in effect, a description of problem areas, current and anticipated delaying factors and the estimated impacts the delays have on the performance of other activities and completion dates, and recommendations on corrective action for the Contractor. Within seven (7) calendar days after receipt of this report, the Contractor shall submit to DPMC a written explanation of corrective action taken or proposed. The DPMC, after reviewing the written submission, may take appropriate action.

6.2.5 Payments to Contractor

- a. The monthly submission of the computer-produced calendar-dated schedule shall be an integral part and basic element of the estimate upon which progress payments shall be made pursuant to the provisions of Article 9 of these General Conditions. The Contractor shall be entitled to progress payments only upon receipt by DPMC of an updated computer-produced calendar-dated schedule and cost requisition listing.
- b. Payments to the Contractor shall be based upon the results of the computer-generated cost requisition listing which shall be prepared in conjunction with each updating of the CPM system as described above. The Contractors shall provide sufficient documentation to confirm reported progress for any cost items appearing in the scheduling and requisition system.
- c. Payments to the Contractor shall be dependent upon the Contractor furnishing all of the information which, in the judgment of DPMC, is necessary to ascertain actual progress, and all the information and data necessary to prepare any necessary revisions to the computer-produced calendar-dated schedule, cost requisition listing and/or the network diagram. DPMC's determination that the Contractor has failed or refused to furnish the required information shall constitute a basis for withholding payments until the required information is furnished and the schedule and/or diagram is prepared or revised on the basis of such information.

6.2.6 Biweekly Progress Meetings

- a. Every two (2) weeks or as otherwise directed by DPMC, the Contractor shall attend a coordination and CPM scheduling meeting on the job site. At this meeting, the Contractor shall provide detailed information regarding the Work schedule to be performed during the upcoming two weeks to permit the CPM consultant to prepare schedules for the subsequent two week period. Biweekly scheduling by the Contractor shall be in accordance with the priorities and degree of concurrent work required by the official CPM schedule for the Project. The Contractor shall be prepared to explain any difference between the Contractor's biweekly schedules and the priorities required by the latest updating of the official CPM schedule.
- b. At the biweekly scheduling meeting, the CPM consultant shall review the schedule for the preceding two (2) weeks, and the Contractor shall report the progress actually achieved for each activity which was scheduled to be performed during the two weeks, including the actual dates on which the Work was performed. The Contractor agrees that this information shall constitute the official historical record of Project progress.
- c. At each biweekly scheduling meeting, the Contractor shall document any current delays to work operations. In addition, the Contractor shall provide any available information regarding any potential delays.
 - (1) Following the biweekly scheduling meeting, the CPM consultant will issue to the Contractor a two-week look-ahead schedule as developed

at the meeting that shall constitute the construction schedule for the coming two weeks. The CPM consultant will also issue a narrative biweekly progress analysis documenting progress achieved during the preceding two weeks and analyze delays reported to constitute current or anticipated impacts to timely construction.

(2) The Contractor shall be represented at the biweekly scheduling meeting by its superintendent, who shall have complete authority to provide the information required for the development of the next two (2) weeks schedule, which includes documentation of past progress and documentation of delays. The Contractor's representatives shall also be authorized to commit to the implementation of corrective action planned to overcome delaying conditions.

6.2.7 Responsibility for Completion

a. The Contractor agrees that, when it becomes apparent from the current project CPM schedule that any Contract completion date will not be met, the Contractor will take any or all of the following actions, as required, at no additional cost to the State:

- (1) Increase construction manpower.
- (2) Increase the number of working hours per shift, shifts per working days, working days per week, or the amount of construction equipment, or any combination of the above; and/or
- (3) Reschedule activities to achieve maximum practical concurrence.

6.2.8 Adjustment of Contract Completion Date

a. The Contract completion dates will not be adjusted except under the specific and limited conditions set forth in the Contract Documents.. In the event that the Contractor requests an extension of any Contract completion date, the Contractor shall furnish a justification of such extension and provide any and all supporting evidence that DPMC requires to evaluate the Contractor's request. The DPMC shall either approve, in whole or in part, or reject the Contractor's request and will advise the Contractor in writing of its decision. If the DPMC finds that the Contractor is entitled to any extension of any Contract completion date under the provisions of this Contract, the determination as to the total number of calendar days extension permitted shall be based upon the currently approved Project CPM schedule and on all data relevant to the extension request. Such data will be included in the next updating of the CPM schedule.

b. The Contractor acknowledges and agrees that the evaluation of Project delays and determinations regarding Project time extension will be based upon the Project CPM schedule and the following criteria:

- (1) Float time shown on the Project CPM schedule is not for the exclusive use of either the Contractor or DPMC. It is agreed that float time is available for use by all performing Work on the Project, including the Contractor, other contractors, subcontractor, lower tier subcontractors,

and suppliers to facilitate the effective use of available resources and to minimize the impact of problems of Change Orders which may arise during construction. The Contractor specifically agrees that float time may be used by DPMC or its representatives or consultants in conjunction with the review activities or to resolve Project problems. The Contractor agrees that there will be no basis for a Project time extension as a result of any Project problem, Change Order or delay which only results in the loss of available positive float on the Project CPM schedule. The Contractor further agrees that there will be no basis for a claim for cost escalation for any activity which is completed on or before its initially required late end date as shown on the initial approved Project CPM schedule, regardless of the justifiability or any delaying factors which might have resulted in the elimination of float which was originally available for the activity. If the Contractor refuses to perform work that is available to it, the DPMC may consider, the Contractor to be in breach of the Contract, regardless of the float shown to be available for the Work. In such instances, the DPMC may, without prejudice to any other right or remedy, declare the Contractor to be in default and terminate the employment of the Contractor pursuant to Article 12 of the General Conditions.

(2) The Contractor agrees that no time extension will be granted for time lost due to normal seasonal weather conditions. In order to qualify for consideration for a time extension due to adverse weather conditions, it must be shown by clear and convincing evidence that the weather conditions during a given quarterly period (summer, fall, winter, spring) were more severe than the previous five-year (5) average for the Project geographical area, and that these weather conditions critically impacted the final Project completion date by delaying the performance of work on the main Project critical path. If abnormal weather losses can be shown to have affected the Project critical path, a non-compensable time extension will be considered for that portion of the proven weather-related delays, which exceeded normal weather losses that should have been anticipated for the quarterly period in question.

(3) No time extensions will be considered for any weather conditions that do not affect work on the Project critical path as set forth on the current Project CPM schedule. The Contractor agrees that there will be no basis for a claim for any additional compensation resulting from any time extension issued for weather-related delays.

(4) In order for a given cause (i.e., delay, Change Order, etc.) to be considered as a basis for a total Project time extension, it must meet both of the following criteria:

- (a) It must be totally beyond the control of the Contractor and due to no direct or indirect fault of the Contractor; and
- (b) It must result in a direct delay to work on the main Project critical path.

(5) The Contractor acknowledges and agrees that actual delays to activities that, according to the Project CPM schedule, do not directly affect the main Project critical path and do not have any effect on the Contract completion date or dates, will not be the basis for a change therein.

(6) Concurrent delays are defined as two or more delays or areas of work slippage that are totally independent of one another and which, if considered individually, would each affect the final Project completion date according to the Project CPM schedule. Where the CPM consultant determines that concurrent delays exist, the Contractor acknowledges and agrees that the following criteria will be used to evaluate time extension:

- (a) If the current Project CPM schedule shows two (2) or more concurrent delays, with one analyzed to be the responsibility of DPMC and the other analyzed to be the responsibility of the Contractor, a non-compensable time extension will be considered only if the excusable delay affects the main Project critical path and this delay is shown to be a greater amount than the other concurrent delays when the impacts of the concurrent delays are independently considered. In this event, a compensable time extension will be considered only for that portion of time by which the excusable delay exceeds all concurrent non-DPMC caused delays. For example, if an excusable impact delays the Project by one-hundred (100) calendar days and concurrent contract-caused slippage independently delays the final completion date by ninety (90) calendar days, a time extension will only be considered for a maximum of ten (10) calendar days, provided the excusable delay is on the project critical path.
- (b) If the CPM schedule shows concurrent delays with some excusable delays and some the fault of the Contractor, and if the Contractor-caused delays are analyzed to be the main determining impact to the main Project critical path, then there will be no basis for a total Project time extension regardless of the nature of the concurrent excusable delays. A concurrent time extension may, however, be considered for that portion of the total Project slippage which is shown on the CPM schedule to be totally attributable to excusable delays.
- (c) If a time extension request is being made for concurrent delays which did not affect the Project critical path, this must be clearly stated in the Contractor's time extension request and all CPM activities which are claimed to have been affected by the cited delay must be specifically identified with all applicable impact dates.

6.3 CONSTRUCTION PROGRESS SCHEDULING PROVIDED BY THE CONTRACTOR

6.3.1 The Project shall be completed within the specified number of calendar days from the effective date of the Notice to Proceed.

6.3.2 The Contractor shall be responsible for preparing and furnishing to the DPMC through the Architect/Engineer before the first Contract requisition date, but in no event later than 30 (thirty) days after the effective date of the Notice to Proceed, a coordinated combined progress schedule that incorporates the progress schedules of the Contractors and all Subcontractors engaged on the Project. The schedule shall be in the form of a network diagram or other recognized graphic critical path progress schedule format that indicates, among other things, predecessor and successor activities, and major and intermediate milestones, in sufficient detail to satisfy the DPMC. (See also section 6.3.4 below.) The Contractor's initial invoice will not be processed by the DPMC until and unless such a single coordinated progress schedule has been submitted to and approved by the DPMC. Thereafter, the Contractor shall submit an updated coordinated progress schedule on a monthly basis. Receipt and approval of the updates will be a mandatory condition to payment.

6.3.3 Once each month, or more often if required by the DPMC, the Contractor shall meet with the Architect/Engineer and the DPMC representative to gather the information necessary for the Contractor's preparation of the revised/updated computer generated scheduling reports.

6.3.4 The progress schedule, based upon the logic and time estimates, shall indicate in suitable detail for display, all significant features of the Work of the Contractor and each Subcontractor, including but not limited to, the placing of orders, manufacturing durations, anticipated delivery dates for critical and long-lead items, submissions and approvals of shop drawings, construction activities, all work activities to be performed by the Contractor and its Subcontractors, the beginning and time duration thereof, and the dates of all milestones, substantial and final completion of the various elements of the Work, including punch list and close-out. Reports shall be in booklets, indexed and separated as categorized below. Each activity listed on the Schedule shall include, as a minimum, the following:

- a. The activity description;
- b. The trade (A/E, Owner, GC, Electrical, Plumbing, HVAC);
- c. The duration in calendar days;
- d. The Early Start date;
- e. The Late Start Date;
- f. The Early Finish date;
- g. The Late Finish date;
- h. The Total Float

6.3.5 The Contractor agrees that no time extension will be granted for time lost due to normal seasonal weather conditions. In order to qualify for consideration for a time extension due to adverse weather conditions, it must be shown by clear and convincing evidence that the weather conditions during a given quarterly period (summer, fall, winter, spring) were more severe than the previous five-year (5) average for the Project geographical area, and that these weather conditions critically impacted the final Project completion date by delaying the performance of work. If abnormal weather losses can be shown to have impacted the Project completion date, a non-compensable time extension will be considered for that portion of the proven weather-related delays, which exceeded normal weather losses that should have been anticipated for the quarterly period in question.

6.3.6 Immediately upon approval by DPMC, the Contractor shall prepare and distribute four copies of the progress schedule to the DPMC plus two copies to the Architect/Engineer. Each monthly updated coordinated schedule shall be signed and dated by the Contractor.

6.3.7 The Contractor shall furnish sufficient labor and construction plant and equipment to ensure the execution of the Work in accordance with the approved progress schedule. If any updated completion time or date for any activity does not conform to the durations or milestones shown in the approved progress schedule, the sequence of activities and/or the time for performance of activities shall be updated on the progress schedule to be approved by the DPMC and cured by the Contractor by any means, including performing concurrent operations, additional manpower, additional shifts, and overtime. No additional charges to the State will be allowed the Contractor for overtime, additional manpower, equipment, additional shifts, etc. (except as may be provided elsewhere in the Contract), if such expediting procedures or measures are necessary to meet the Contract completion date.

6.3.8 The progress schedule shall show:

- a. Recommended Changes in activity sequencing;
- b. Changes in activity duration for activities not started or partially completed, where agreed upon;
- c. The effect on the network of the modifications (activity duration, Predecessors and Successors);
- d. Changes for the purposes of regaining lost time or improving progress, and;
- e. Changes to milestones, due dates, and the overall Contract completion date, which have been agreed upon by the DPMC's project manager since the last revision of the progress schedule.

6.3.9 The progress schedule shall accurately reflect the manner in which the Contractor intends to proceed with the Project and shall immediately incorporate and reflect the impact of all delays and change orders. All changes made to the schedule shall be subject to approval by the DPMC.

6.3.10 The DPMC will not authorize or approve any claims for additional payment or extension of time for completion of the Work, or any other concession because of any alleged misinterpretation or misunderstanding on the Contractor's part of the Project schedule, the Contractor's failure to attend the pre-bid conference, because of any failure on the Contractor's part to become fully acquainted with all conditions relating to the Project schedule and the manner in which it will be used on the Project, or because of any other failure by the Contractor to properly participate in the development of a progress schedule or to perform the Contract in accordance with the progress schedule.

ARTICLE 7 - TIME OF COMPLETION

7.1 CONTRACT DURATION/NOTICE TO PROCEED

7.1.1 Contract duration shall commence on the effective date set forth on the written Notice to Proceed. The Notice to Proceed will be issued by the DPMC after the DPMC's receipt and acceptance of properly executed Contract Documents, including performance and payment bonds, proof of insurance and permit technical information submitted by the Contractor and/or Subcontractors. The Contractor shall not be entitled to delay, disruption, acceleration or any other claims arising from a deferred issuance of the Notice to Proceed.

7.1.2 The Contractor shall perform no work at the Contract Site prior to the issuance of the Notice to Proceed.

7.2 SUBSTANTIAL COMPLETION

7.2.1 At the request of the Contractor, the Architect/Engineer or the DPMC, the Contractor and the DPMC representative may make a joint inspection of the Work for the purpose of determining if the Work is substantially completed in accordance with the definition provided in Article 1. If DPMC, in its sole discretion, finds that the Work is substantially complete, then the DPMC will issue a written Notice of Substantial Completion for Beneficial Use. Such Notice shall in no way relieve the Contractor of any contractual obligation(s) or relieve the Contractor from responsibility to promptly complete all remaining Contract Work including, but not limited to, punch list items.

7.2.2 The standard guarantee period for equipment, workmanship and materials shall commence on the date DPMC issues the Notification of Substantial Completion for Beneficial Use, or from the time of completion and acceptance of equipment, work or materials in question, whichever is later.

7.2.3 In the event that the Project is completed in phases or stages, and/or in the event that the DPMC takes possession of any part of the Work pursuant to Section 7.4 of these General Conditions, no part of the Project shall be deemed substantially complete for purposes of the New Jersey Statute of Repose, N.J.S.A. 2A:14-1.1, prior to the issuance of a formal Notice of Substantial Completion for Beneficial Use for the all of the Work.

7.3 FINAL COMPLETION

7.3.1 Final completion of the Contract shall occur when:

- a. The DPMC and the Architect/Engineer have determined that the punch list has been completed;
- b. The Contractor has complied with the Contract Document's closeout requirements;
- c. The Contractor has submitted all Contract deliverables as required by the Contract Documents including but not limited to the following: "as-built"

documents, operating and maintenance manuals, attic stock, parts lists, repair source lists, training and certificates; and

d. The Contractor has submitted all warranties, guarantees and/or maintenance bonds required under the Contract.

7.4 PARTIAL OCCUPANCY FOR USE

7.4.1 Use and possession prior to completion: The DPMC shall have the right to take possession or use of any completed or partially completed part of the Project. Said possession or use shall not be deemed acceptance of the Work performed on the Project.

7.4.2 Prior to such possession or use, the DPMC shall furnish the Contractor with an itemized list of Work remaining to be performed or corrected on such portions of the Project that are to be possessed or used by the State. Failure by the DPMC to list any item of work shall not be deemed an acceptance of any Work under the Contract.

7.4.3 The Contractor shall not be entitled to recovery of money damages for any delays, disruptions or inefficiencies caused by such partial occupancy.

7.5 DELAY, DISRUPTION AND INTERFERENCE

7.5.1 Delay - Time Extension. If the Contractor's work is delayed, disrupted or interfered with by act, neglect or default of any party, including the State, the Architect/Engineer, or by strikes, lockouts, fire, unusual delay by common carriers, natural disasters, or by any cause for which the Contractor is not responsible; then for all such delays and suspensions, the Contractor shall be allowed one (1) calendar day addition to the time herein stated for each and every calendar day of such delay so caused in the completion of the Work as specified above, the same to be determined by the DPMC. No such extension shall be granted for any delay unless, within ten (10) calendar days after the beginning of such delay, a written request for additional time shall be filed with the DPMC.

7.5.2 Contractor's Damages for Delay, Disruption or Interference

The Contractor shall not be entitled to recovery of money damages from the DPMC caused by delay, disruption or interference with the Contractor's Work except as expressly provided under section 7.5.2 of these General Conditions paragraph. The Contractor expressly agrees that the Contractor's remedy for delay, disruption or interference shall be limited to an extension of time only and that there shall be no recovery of money damages by the Contractor for any delay, disruption or interference with the Contractor's work attributable to any cause whatsoever (other than the State's negligence, bad faith, active interference or other tortuous conduct). The Contractor expressly agrees that it shall not be entitled to recover damages due to delay, disruption or interference caused by any of the following:

- a. Delayed execution of the contract or any of the causes referenced in paragraph 7.5.2;
- b. Any act or omission by any party other than the State, including, but not limited to, the Architect-Engineer, any other Contractor or Subcontractor, any

CPM or other consultant retained by the State, any construction manager retained by the State, any agency or instrumentality of the federal government or of any local governmental entity or any utility (e.g., gas, electric, telephone, cable);

- c. Any act or omission of any agency or instrumentality of the State, other than the DPMC, including, without limitation, the Department of Environmental Protection and the Department of Community Affairs;
- d. Weather;
- e. Subsurface conditions of any type including, without limitation rock and underground utilities, whether or not such conditions were reasonably ascertainable to the Contractor at the time of bidding;
- f. Use of all or any portion the Project premises prior to completion of the Work to the extent that such use is permitted under the terms of the Contract;
- g. Delay in obtaining any permit or approval;
- h. Delay caused by the issuance of any court order, injunction or restraining order;
- i. Any delay which does not entitle the Contractor to an extension of the Contract Completion Time under Section 6.2.8 of these General Conditions; or
- j. Delay attributable to any other cause, other than a cause for which the State is legally restricted from enforcing a contractual "no damage for delay" clause under N.J.S.A. 2A:58B-3 or any other provision of law restricting or barring the enforcement of such clauses.

In interpreting this provision, the negligence or other wrongful conduct of others, including, without limitation, the Architect/Engineer, the CPM consultant, any construction management firm and any other firm or person retained by the State shall not be imputed to the State. Further, to the extent that the Contractor is entitled to recover monetary damages for delay under this Contract, such recovery shall be limited to actual direct costs incurred on account of the delay, and shall not include profit or other markup on such costs, home office overhead calculated under the Eichleay formula or any other kind of consequential or indirect cost or damage, including but not limited to any alleged cost or damage under the total cost method, the modified total cost method, or productivity factors (costs for inefficiency based on industry productivity factors such as those provided by the Mechanical Contractors Association of America (MCAA) Factors Affecting Labor Productivity).

7.5.3 In the event of the failure of the Contractor to complete its work within the time stated in its Contract, the Contractor shall be liable to the State in the sum as set forth as liquidated damages in the Contract, for each and every calendar day that the Contractor fails to attain contract completion of the work. This sum shall be treated as liquidated damages to compensate for the loss to the State of the use of premises in a completed state of construction, alteration or repair, and for added administrative and inspection costs to the State on account of the delay; provided, however, that the said liquidated damages shall be in addition to other compensatory or consequential losses or damages

that the State may incur by reason of such delay, such as, but not limited to, added costs of the Project and the cost of furnishing temporary services, if any. Any such sums for which the Contractor is liable may be deducted by the State from any moneys due or to become due to the Contractor.

7.5.4 It is hereby understood and mutually agreed by and between the Contractor and the State that the start date in the Notice to Proceed, the dates of all required intermediate milestones, and the times for substantial and final completion, as specified in the Contract Documents, are essential conditions of this Contract.

7.5.5 The Contractor agrees that said work shall be executed diligently, at such rate of progress as will ensure full completion of the Work within the time specified. It is expressly understood and agreed, by and between the Contractor and the State, that the time for the completion of the Work herein is a reasonable time, taking into consideration the average climactic range and usual industry conditions prevailing in this locality. If the said Contractor shall neglect, fail or refuse to complete the Work within the time herein specified, or any proper extension thereof granted by the DPMC, then the Contractor does hereby agree, as a part of the consideration for the awarding of its Contract, to pay the State the amount specified in section 7.5.3 above, as liquidated damages for loss of use of the Project as hereinafter set forth, for each and every calendar day that the Contractor may have exceeded the stipulated date in the Contract for substantially completing the Work.

7.5.6 It is further agreed that time is of the essence of each and every portion of this Contract and of the specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any Work, the new time limit fixed by such extension shall similarly be of the essence.

ARTICLE 8 - CLOSE-OUT

8.1 CLOSE-OUT PROCEDURES/FINAL PAYMENT

As part of the final completion procedures described in Article 7 and the requirements for payment as described in Article 9, the Contractor must complete all of the Close-out procedures as follows:

- a. Submit the “as-built” record documents as described in Article 4;
- b. Submit all operating and maintenance manuals, parts lists, repair source parts, and certificates as defined in 8.2 below;
- c. Provide the necessary training for operating systems and equipment as defined in 8.3 below; and
- d. Submit all guarantees as defined in 8.4 below.

8.2 OPERATIONS, EQUIPMENT AND MAINTENANCE MANUALS

8.2.1 The Contractor shall provide six (6) copies of all operating, equipment and maintenance manuals, and applicable warranties, as identified and described in the Contract Documents. The operating, equipment and maintenance manuals and warranties, including contact personnel, addresses and telephone numbers, must include a complete description of all systems and equipment and the method of operating and maintaining the equipment. These manuals must be submitted to the Architect/Engineer for review and approval at the earliest date possible following substantial completion, but in all cases prior to final acceptance. Included within the manuals shall be a list of names, addresses and telephone numbers of all the Subcontractors involved in the installations and of firms capable of performing services for each mechanical item.

8.2.2 As a pre-condition to the Final acceptance of a facility for beneficial use, the Contractor shall provide a "throw-away" copy of operations and maintenance manuals to allow the Using Agency's staff to operate the equipment prior to receiving the hard bound copies required by this Contract.

8.3 TRAINING

The Contractor shall provide formal instruction for DPMC-designated personnel, addressing the operation and maintenance of the facilities and all installed equipment for each operating system or major item of equipment or as otherwise specified. The operations and maintenance manuals shall be used as training materials. Unless otherwise accepted by the DPMC, training course format shall be split equally between classroom instruction and field exercise. All classroom instruction may be videotaped by the DPMC. Classroom instruction may be supported by professionally made videotapes. If used, a copy of each professional video that was utilized shall be provided to the DPMC at no cost for future training and reference.

8.4 GUARANTEE

8.4.1 The issuance of a final certificate for payment and/or partial or complete occupancy of the premises shall not be deemed an acceptance of Work not completed in accordance with the Contract Documents. The issuance of a final certificate for payment and/or partial or complete occupancy of the premises shall not relieve the Contractor or its surety of liability with respect to any express or implied warranties or responsibility for faulty materials or workmanship.

8.4.2 The Contractor shall guarantee and warrant, in writing, the Work performed and all materials furnished under this Contract against defects in materials and/or workmanship. The Contractor shall be responsible for the value or repair of any damage to other Work or to the building premises resulting from the performance of the Contract.

8.4.3 The Contractor is responsible for the above-stated obligations for a period of one (1) year from the date established in 7.2.2 above. All guarantees, including bonds and registrations, required by the Contract Documents shall be in writing and delivered to the DPMC with submission of the invoice for final payment.

8.4.4 The Contractor shall, at its own expense and without cost to the State, promptly after receipt of written notice thereof, make good any defects in materials or workmanship which may develop during stipulated guarantee periods, as well as any damage to other Work caused by such defects or by repairs. Any other defects in materials or workmanship not discovered during the guarantee period shall be repaired and/or replaced at the Contractor's expense, and such shall be completed within a reasonable time after written notice is given to the Contractor.

8.4.5 Pursuant to the Contract Documents, certain permanent equipment, including elevators and HVAC systems, will have to be activated during construction of the Project to support construction operations. . Despite any early activation during the construction of the Project, any and all equipment warranties must extend for the time periods required in the Contract Documents, starting at the date set forth in paragraph 7.2.2.

8.4.5 It is expressly acknowledged and agreed that the express and implied warranties and guarantees to which the State is entitled as well as all warranty and guarantee bonds issued by any surety, shall be in addition to and not in lieu of the State's right to seek recourse against the Contractor and the Contractor's surety for defective work.

ARTICLE 9 - PAYMENTS

9.1 INVOICES

9.1.1 Requests for payment under the Contract for materials delivered or services rendered require the proper completion and submittal of specific forms including, but not limited to, the following:

- a. DPMC Form 11/AR50-1 - DPMC Invoice;
- b. DPMC Form 11-2 - Monthly Estimate for Payment to Contractor;
- c. DPMC Form 11-2a - Certification of Prime Contractor;
- d. DPMC Form 11-2b – Certification of Subcontractor;
- e. Copies of Subcontractor(s) invoices;
- d. DPMC Form 11-3 - Prime Contractors Summary of Stored Materials;
- e. DPMC Form 11-3A - Agreement and Bill of Sale Certification for Stored Materials;
- f. Consent of Surety forms;
- g. Certified Payroll Records;
- h. Updated project schedule
- i. Any other information or documentation required by other provisions of the Contract documents.

9.1.3 The Contractor shall submit the completed request for payment on a monthly basis for all properly completed billable work to the DPMC Project representative and at the address identified at the pre-construction conference.

9.1.4 One (1) original and one (1) copy of the request for payment packets shall be prepared and submitted unless otherwise specified.

9.1.2 No request for payment shall be deemed to be formally submitted and received for payment until all dollar amounts and completion percentages for each line item in the invoice has been determined and agreed upon by the State and the Contractor.

9.1.5 For the purpose of the State's Prompt Payment Act (N.J.S.A. 2A:30A-1 et seq.):

- a. A proper invoice will be deemed to have been received by the owner when it is received by the person or entity designated by the State to review and sign the invoice on the State's behalf at the address designated in the pre-construction conference for receipt of invoices. Receipt of an invoice by such person or entity shall commence the running of the 20-day period for formal approval and certification as provided under N.J.S.A. 2A:30A-2(a);
- b. The "billing date", as the term is used in N.J.S.A. 2A:30A-2, shall be the earlier of the date upon which an invoice for payment is approved for payment or twenty (20) days after the invoice is received, unless within such 20-day period

the invoice is found to be incomplete or otherwise unacceptable and returned to the contractor, with a written explanation of deficiencies;

c. In the event that an invoice is found to be deficient and returned to the contractor, the “billing date” shall be calculated from the date that a corrected invoice is received.

d. Payment shall be considered to have been made on the date on which a check for such payment is dated;

e. Payment terms (e.g., “net 20”) offered by the contractor shall not govern the State’s obligation to make payment;

f. The following periods of time will not be included in the calculation of the due date of any contractor invoice:

(1) Any time elapsed between receipt of an improper invoice and its return to the contractor, not to exceed twenty (20) calendar days; or

(2) Any time elapsed between the State’s return of an improper invoice to the contractor and the State’s receipt of a corrected invoice.

9.1.6 The provisions of this Article 9 shall not govern the State’s payment obligations nor shall they supersede or modify any other contractual provision allowing the withholding of monies from the contractor to the extent that the contractor has not performed in accordance with the provisions of the contract. Nor shall this Article 9 govern the State’s payment obligations nor supersede or modify any other contractual provision governing contractor claims for additional compensation beyond the base contract price and approved change orders.

9.2 INTEREST

9.2.1 Interest shall be payable on amounts due the contractor if not paid within thirty (30) calendar days after the billing date specified in the above subparagraph 9.1.5(b), as provided under the State’s Prompt Payment of Contractors and Subcontractors Act (N.J.S.A. 2A:30A-01, et seq.) Interest on amounts due shall be payable to the contractor for the period beginning on the day after the required payment date and ending on the date on which the check for payment is drawn.

9.2.2 Interest may be paid by separate payment to the contractor, but shall be paid within thirty (30) calendar days of payment of the principal amount of the approved invoice.

9.2.3 Nothing in this Article 9 shall be construed as entitling the Contractor to payment of interest on any sum withheld by the State for any reason permitted under the contract or applicable law, or on any claim for additional compensation, over and above sums due under the base contract or approved change orders.

9.3 SCHEDULE OF VALUES AND FINAL PAYMENT

9.3.1 Unless otherwise directed, the Contractor shall furnish a schedule of amounts for Contract payments (Unit Schedule Breakdown,) of the total Contract price, showing the amount included therein for each principal category of the Work and for each Contractor

and Subcontractor, in such detail as requested, to provide a basis for determining progress payments. The schedule, as approved, shall be used only as a basis for the Contractor's estimates for progress payments, and approval by the DPMC does not constitute acceptance of the allocability and allowability of costs to a specific element of Work. The Contractor is cautioned that no payment requests shall be approved until the Unit Schedule Breakdown has been approved in writing by the DPMC.

9.3.2 The State will make progress payments monthly as the Work proceeds based upon the Unit Schedule Breakdown.

9.3.2 All material and Work paid pursuant to progress payments shall thereupon become the sole property of the State. This provision shall not be construed as relieving the Contractor from the sole responsibility for the protection of all material and Work upon which payments have been made for the restoration of any damaged work, or as waiving the right of the State to require the fulfillment of all of the terms and conditions of the Contract.

9.3.3 Following completion and acceptance of all work, the amount due the Contractor under this Contract shall be paid only upon satisfactory completion, by the Contractor, of all Contract close-out requirements, completion of a State audit on all Contract values and payments, and after the Contractor has furnished the State with a release of claims against the State, arising by virtue of this Contract, other than claims in stated amounts as may be specifically excepted by the Contractor from the release.

9.3.4 If for any reason the Contractor refuses final payment, the Project may be closed out by the State by the processing of a Final Contract Acceptance certification. The lack of such certificate shall not toll the limitations period applicable to Contractor claims against the State.

9.3.5 In addition to other warranties required by provisions of the Contract and specifications, the Contractor warrants that title to all Work, materials and equipment covered by an application for payment will pass to the State free and clear of all liens, claims, security interests or encumbrances, either upon incorporation into the construction or upon receipt of payment to the Contractor, whichever occurs first,. This provision shall not be construed as relieving the Contractor from sole responsibility for the care and protection of materials and work upon which payments have been made, or for the restoration of any damaged work, or as a waiver by the State of its rights to require fulfillment of all terms of the Contract.

9.3.6 By recommending approval of any invoice, the Architect/Engineer shall not be deemed to represent that it has made exhaustive or continuous on-Site inspections to check the quality or quantity of the Work, or that it has reviewed the construction means, methods, techniques, sequences or procedures, or that it has made any examination to ascertain how and for what purpose the Contractor has used the moneys previously paid. The payment of an invoice does not constitute an acceptance of the Work. The State reserves the right to further inspect the Work and to withhold retainage and any additional funds required to pay for any corrective action for non-conforming work.

9.3.7 If any corporation licensed to do business in New Jersey shall be or become delinquent in the payment of taxes, assessments or fees due the State, unless under an

active appeal process or any final judgment in the State's favor against the Contractor, the DPMC may, in accordance with N.J.S.A. 54:49-19 or other applicable law withhold moneys due the said corporation for the purpose of assuring the payment to the State of such taxes, assessments, fees or judgment.

9.4 CERTIFICATION OF PAYMENTS TO SUBCONTRACTOR

Pursuant to N.J.S.A. 52:32-40, 41 and N.J.S.A. 2A:44-148; the Contractor shall submit a Certification of Prime Contractors form and a Certification of Subcontractor form for each Subcontractor identified in the Unit Schedule Breakdown, as part of the submission for each invoiced progress payment.

9.5 STORED MATERIALS

9.5.1 Unless specifically allowed in the Contract Documents, all materials and equipment must be delivered and installed or stored on the Site prior to payment for such material or equipment.

9.5.2 The DPMC may at its discretion allow payment for equipment stored off Site provided that the following has occurred:

- a. The DPMC has approved the Contractor's written request;
- b. The equipment has been properly stored in an approved location;
- c. The Contractor has established the Owner's title to the specific equipment;
- d. The Contractor has provided sufficient proof of insurance for the materials, equipment and the storage facility;
- e. The Contractor has submitted a release of liens on said stored equipment;
- f. The Contractor has submitted a statement agreeing to assume all costs for storage of material and equipment off Site, including, if required by the DPMC, the cost of storing such material and equipment in a bonded warehouse; and
- g. The Contractor furnishes the "Prime Contractor's Summary of Stored Materials" and "Agreement and Bill of Sale Certification for Stored Materials," forms respectively.

9.6 ALLOWANCES

9.6.1 The Contractor shall include in its bid all allowances as may be set forth in the Contract Documents. The Contractor shall purchase the "allowed materials" as directed by the DPMC on the basis of the lowest acceptable quote from at least three competitive offers or as a negotiated cost subject to DPMC approval. If the actual cost of the "allowed materials" is more or less than the stipulated allowance, the Contract price may be adjusted accordingly. The adjustment in Contract price shall be made on the basis of the actual purchase cost without additional charges for overhead, profit, bond premium or any other incidental expenses. The cost of installation of the "allowed materials," unless

otherwise specified, is to be included as the responsibility of the Contractor in whose Contract the allowance is included, and the Contractor installing such "allowed materials" shall not be entitled to additional payment for such installation.

9.6.2 Unless otherwise provided in the Contract Documents:

- a. These allowances shall cover the Contractor's true costs, including credit for any trade discount, of the materials and equipment required by the allowance, delivered at the Site, including all applicable taxes;
- b. The Contractor's costs for unloading and handling, labor, installation costs, overhead, profit and other expenses reasonably required in connection with such allowance items shall be included in the Contract sum and not as part of the allowances.

9.7 RETAINAGE

9.7.1 In making progress payments for Contract work completed, the State will retain ten percent (10%) of the approved invoice amount until final acceptance and completion of all work covered by the Contract.

9.7.2 The Contractor may, after 50% (fifty percent) of the Contract work is in place, and if the Work is proceeding on schedule, apply for a reduction in the amount retained by the State for the duration of the Contract. Such application must be in writing and accompanied by documentation granting formal consent of surety to the reduction in retainage request. If the DPMC determines that the Contractor's performance has been satisfactory and that the reduction is warranted and appropriate, the State may, with the next progress payment, release any portion of the accumulated retainage in excess of five percent (5%) of the Work in place and retain an amount equal to five percent (5%) of the Work in place for the duration of the Contract. If progress of the Work is not maintained in accordance with the approved schedule, the DPMC may elect to re-institute retainage of ten percent (10%) of the Work in place for the duration of the Contract.

9.7.3 Withholding Payment for Non-Delivery of Data:

- a. If technical data such as "as-built" drawings, reports, spare parts lists, repair parts lists, or instruction books (including additional and maintenance manuals), or any part thereof, are not delivered within the time specified by this Contract or are deficient upon delivery, the DPMC has the discretion to withhold from each invoice a percentage (in addition to any other retainage required by the Contract) of the Contract price in accordance with the following table:

When total contract price is:	Percentage to be withheld is:
Less than \$250,000.	10%
\$250,000.01 through \$1,000,000	5.0%
Over \$1,000,000	2.0%

- b. The withholding of any sums pursuant to this article shall not be construed as, or constitute in any manner, a waiver by the State of the Contractor's obligation to furnish the data required under this Contract. In the event the

Contractor fails to furnish these items, the State shall have those rights and remedies provided by law and pursuant to this Contract, in addition to, and not in lieu of, the sums withheld in accordance with this article.

9.8 MISCELLANEOUS

9.8.1 Disputes regarding nonpayment of a Contractor's invoice under this Article 9 may be submitted to non-binding Alternative Dispute Resolution (ADR) upon mutual agreement of the State and the Contractor. In such event, the State and the Contractor shall share equally the fees and expenses of the selected mediator, arbitrator, umpire or other ADR neutral. Provided, however, that nothing herein shall be construed, in whole or in part, as a waiver, release or modification of the provisions of the New Jersey Contractual Act, N.J.S.A. 59:13-1, et seq., which governs claims against the DPMC.

9.8.2 A Contractor not paid sums due under an approved invoice within thirty (30) days of the billing date may suspend performance without penalty for breach of contract, but only after providing the State with seven (7) days written notice of non-payment, and only in the event that the State fails to furnish the Contractor, within that seven-day period, a written statement of the amount withheld and the reasons for the withholding. Nothing herein shall be construed to excuse the Contractor's nonperformance, or to limit the State's rights and remedies relating to such non-performance, with regard to any monies withheld from the Contractor upon the proper notice provided under this Article 9, or with regard to any Contractor claim disputed by the DPMC.

ARTICLE 10 - CHANGES IN THE WORK

10.1 CHANGES IN THE WORK

10.1.1 The DPMC may at any time, issue a written Change Order which shall direct a change in the Work within the general scope of the Contract, including, but not limited to, changes:

- a. In the plans and/or specifications;
- b. In the method or manner of performance of the Work;
- c. In the State-furnished facilities, equipment, materials, services, or site; or directing acceleration in the performance of the Work; and/or
- d. In the time for the completion of the Work.

10.1.2 Change Orders

10.1.2.1 The Contractor agrees to prepare and submit, within ten (10) calendar days of encountering any conditions it considers a change, or upon receiving official notice of a proposed change or written direction to proceed with a change, a current DPMC form entitled "Contractor Change Order Request," to the DPMC. The Contractor shall submit an original of the form. Failure to submit a timely form may be grounds for rejection of the request for Change Order, at the DPMC's discretion.

10.1.2.2 All requests for Contract time extensions must be submitted in accordance with the requirements set forth in Articles 6 and 7, accompanied by copies of the current approved progress schedule and copies of a proposed progress schedule detailing the incorporation of the changed work and the effects of such incorporation on progress. Failure to provide all required information shall be grounds for rejection of the request.

10.1.2.3 DPMC will only consider a contract duration extension Change Order request arising from changes in the Work, if that change is proven by the Contractor to have caused a delay in the completion of the Project. When the Contract duration is increased as a result of a change, the resulting change in Contract amount will include the costs of extended performance, computed in accordance with the terms of this Section, and no further consideration of such costs arising from the specific modification will be given.

10.1.2.4 Every Change Order request submitted by the Contractor shall furnish a price breakdown, which shall cover all work involved in the change whether such work was deleted, added or changed and shall be in sufficient detail to permit an analysis of all material, labor, equipment, subcontract, overhead costs and profit. Any amount proposed for subcontracts shall be supported by an equally detailed breakdown. In addition, if the request includes a time extension, a justification (see section 10.1.4.) shall also be furnished. The request, together with the price breakdown and time extension justification, shall be furnished by the date specified by the DPMC.

10.1.2.5 The following rates shall apply in computing overhead (indirect costs) and profit for Change Orders that do not exceed \$25,000. The percentages shall be applicable for deleted work as well as additional work. When a change consists of both added and

deleted work, the applicable percentages shall be applied to the net cost or credit. In any event, the percentages shall not exceed the following:

- a. Overhead will be the sum of:
 - (1) fifteen percent (15%) of direct labor costs. NOTE: For the purpose of this article, the term "direct labor" shall include all foremen (identified by name and not included in the Project as the full-time superintendent or full time foreman as required elsewhere in the contract documents), equipment operators and skilled, semi-skilled and common laborers directly assigned to the specified operation. The term "direct labor costs" shall consist of the Contract or actual payroll rate of wage per hour and fringe benefits paid for each and every hour that such employees are actually engaged in the performance of the Work.
 - (2) fifteen percent (15%) of direct material costs. NOTE: For the purpose of this article, the term "direct material costs" shall consist of the actual costs of the materials including applicable tax and transportation charges.
- b. For rented equipment, an hourly rental rate will be used which will be determined based upon the monthly rental rates in the current edition of the Rental Rate Blue Book for Construction Equipment (Rental Book) and dividing it by 176. An allowance will be made for operating costs for each and every hour the equipment is actually operating in accordance with the rates listed in the Rental Book. The Contractor will be allowed only 65% (sixty-five percent) of the rental rate on Contractor-owned equipment.
- c. Bond premiums and payroll taxes, if applicable, will be allowed at actual cost. The Contractor shall submit from the surety to DPMC a letter for the bond premiums.
- d. The Contractor's profit on Subcontractor's work will be six percent (6%) of the Subcontractor's costs. Subcontractor indirect costs will be computed in the same manner as for the Contractor. The Contractor agrees to incorporate this article in each of its subcontracts. NOTE: When more than one tier of Subcontractor exists, for the purpose of markups, they shall be treated as one Subcontractor.
- e. A profit of six percent (6%), where profit is allowable by the terms of the applicable Contract provision, shall be added to the Contractor's total cost. Indirect costs shall not be duplicated in direct costs.

10.1.2.6 For Change Orders in excess of \$25,000 the maximum allowable percentages of 15% overhead and 6% profit applies unless negotiated lower based upon the nature, extent and complexity of the Work involved.

10.1.2.7 The DPMC, in order to avoid delays in the progress of work or when in the best interests of the State, has the discretion to direct the Contractor, in writing, to proceed with work claimed by the Contractor to be extra work, and/or to accelerate its work without a prior agreement on entitlement or costs. Such direction shall be in the form of a Letter of Direction. The Contractor may submit a claim for evaluation by

DPMC, for costs or for time on account of such work and/or acceleration on the form entitled "Contractor Change Order Request," completed in sufficient detail and in accordance with this article within ten (10) calendar days after receipt of the Letter of Direction. Nothing in this article shall excuse the Contractor from proceeding with the Work identified in the Letter of Direction and all other Contract Work. Issuance of a Letter of Direction under this article shall not be intended nor construed as an admission or acknowledgment by the State that the Contractor is entitled to additional compensation and/or time on account of such Work and/or acceleration.

10.2 ACCELERATION

The DPMC may order and direct the Contractor to accelerate its Work at any location(s) by increasing its forces, working overtime and/or working on Saturdays, Sundays, and holidays. If acceleration is required by the DPMC, and not due to any delays on the part of the Contractor, the Contractor will be reimbursed for additional costs.

ARTICLE 11 - CLAIMS AND DISPUTES

11.1 CONTRACTOR CLAIMS

11.1.1 Any claims made by a Contractor against the DPMC for damages, extra costs or any other claim made pursuant to the contract are governed by and subject to the New Jersey Contractual Liability Act, N.J.S.A. 59:13-1 et seq., as well as all the provisions in this Contract.

11.1.2 Upon presentation by the Contractor of a request in writing, the DPMC may review any decision or determination of the State or the Architect/Engineer as to any claim, dispute or any other matter in question relating to the execution or progress of the Work or the interpretation of the Contract Documents. Consistent with the intent of this Contract, the DPMC may schedule a conference for the purpose of settling or resolving such claims, disputes or other matters. Where such a conference is conducted, the Contractor and/or the Architect/Engineer shall be afforded the opportunity to be heard on the matter in question. Following review of the Contractor's request, the DPMC and the Contractor may settle or resolve the disputed matter, provided however that any such negotiations, conferences, settlement or resolution shall be subject to all requirements imposed by law, including where applicable, the New Jersey Contractual Liability Act (N.J.S.A. 59:13-1 et seq.). The DPMC's participation in any effort to negotiate, settle or resolve any such claim or dispute with the Contractor shall not operate to toll or extend the time limitations for notice or suit under the New Jersey Contractual Liability Act.

11.2 MUTUAL RIGHTS AND RESPONSIBILITIES OF ALL CONTRACTORS AND THE ARCHITECT/ENGINEER

11.2.1 Any Contractor or the Architect/Engineer which by its own acts, errors or omissions, damages or unnecessarily delays the Work or otherwise causes damage to the State, any other Contractor or the Architect/Engineer, shall be directly responsible to the aggrieved party or parties, for all costs and expenses incurred due to any such delays and/or damages whether by settlement, compromise or arbitration or judgment.

11.2.2 Any Contractor damaged by the actions of another Contractor or Architect/Engineer shall have a direct right to recovery against the party causing such damages, but shall not have a right to recover such damages against the State.

11.2.3 In addition, the party responsible for causing such damages agrees to defend, indemnify and save harmless the State from all such claims and damages. Nothing contained in this paragraph shall be construed to relieve the responsible party from any liability or damage sustained on account of such acts, errors or omissions.

11.2.4 The State shall not be held vicariously liable to any Contractor for any damages or extra costs caused by any acts or omissions by another party including but not limited to actions of the Architect/Engineer as specified in the above paragraph. The Contractor's exclusive remedy shall be against the party directly responsible for causing such damages or extra costs.

ARTICLE 12 - TERMINATION/SUSPENSION

12.1 SUSPENSION OF THE WORK / STOP WORK

12.1.1 If the Contractor fails to correct defective work or persistently fails to carry out the Work in accordance with the Contract Documents, or if the DPMC determines that it is in the best interest of the Project to do so, the DPMC may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated and the DPMC provides written notice to the Contractor that the stopped Work may resume.

12.1.2 The DPMC shall have the right to defer the beginning or to suspend the whole or any part of the Work herein contracted to be done whenever, in the opinion of the DPMC, it may be necessary or expedient for the State to do so.

12.2 TERMINATION FOR CAUSE

12.2.1 If the Contractor persistently or repeatedly refuses or fails to supply enough properly skilled workers or proper materials so as to avoid or eliminate delays in the orderly progress of the Work in accordance with the approved schedule; or if the Contractor fails to make prompt payment to any Subcontractor or for materials or labor; or persistently disregards laws, ordinances, rules, regulations or orders of any public authority having jurisdiction; or if the Contractor is guilty of a material breach of a provision of the Contract Documents or otherwise fails to carry out the Work in accordance with the Contract Documents, then the DPMC may, without prejudice to any other right or remedy, and after giving the Contractor and its surety three (3) working days written Notice to forthwith address such breach and default with diligence and promptness, terminate the employment of the Contractor by the issuance of a written Notice to that effect to the Contractor and its surety, should the Contractor fail to comply with the demands of the original above mentioned Three Day Notice.

12.2.2 Upon such termination, the DPMC may take possession of the Site and of all the materials, equipment, and tools on the Site and of any materials stored off Site paid for by DPMC, and may finish the Work by whatever method the DPMC may deem expedient. In such case, the Contractor shall not be entitled to receive any further payment until the Work is finished.

12.2.3 In the event of termination for default, the surety shall either complete the principal's work or finance the completion of the Work. The surety shall not have the right to do nothing. In the event of the surety's breach of its obligations to the State, the surety shall be subject to all available damages under the law, including but not limited to debarment and the penalties imposed by New Jersey's Consumer Fraud Act.

12.2.4 Within seven (7) calendar days following receipt of Notice of Termination by the surety, the surety shall submit in writing its intention to satisfy its bond obligation to the State as obligee, and to explain its plan to complete the Work, tender a completing Contractor or finance the completion of the Work.

12.2.5 If the surety elects to take over the Work and complete same or to tender a completing Contractor, it must furnish notice of its intent to do so in writing over the

signature of an authorized representative and such notice shall be served upon the DPMC within seven (7) calendar days after service upon the surety of the Notice of Termination. This document shall identify the Contractor to perform this work.

12.2.6 If the surety elects to satisfy its bond obligation by financing the completion of the Work, in lieu of taking over same, the surety and State shall enter into an agreement, within thirty (30) days of the termination Notice, setting forth the details of the payments to be made by the surety. All current obligations for labor and materials incurred and outstanding by the defaulting Contractor on this Project shall be paid by the surety without delay, subject to allowance of reasonable time to verify such claims by the surety.

12.2.7 If the surety fails to satisfy its bond obligations within the time frames established above, the DPMC may undertake the completion of the Project in any manner deemed appropriate. In that circumstance, the surety shall not be relieved of any of its payment and performance bond obligations.

12.2.8 If the unpaid balance of the Contract sum exceeds the cost of finishing the Work (including but not limited to liquidated damages for delays and all other remaining damages sustained by the State originating from such breach of Contract), such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor and its surety shall be obligated to pay the difference to the DPMC promptly upon receipt of billing from the State, and this obligation shall survive the termination of the Contract.

12.3 OWNER'S RIGHT TO COMPLETE THE WORK

12.3.1 Alternatively, should the Contractor fail or refuse to correct its breach and default after receiving the required notice as provided under Section 12.2 hereof, the DPMC, in lieu of terminating the Contractor's employment, may provide for the correction and completion of all remaining Work by other means, and deduct all costs associated with such correction and completion from any undisbursed balance of funds (including earned retainage) remaining under the Contract. Such deduction may be documented by issuance of one or more deductive change orders. DPMC's correction or completion of Work under this paragraph shall not operate to waive, release or diminish the liability of the Contractor and its surety to the State for any breach or default by the Contractor.

12.4 TERMINATION FOR CONVENIENCE

12.4.1 The DPMC may, at any time, terminate the Contract in whole or in any part for the DPMC's convenience and without cause when the DPMC in its sole discretion views termination to be in the public interest.

12.4.2 Upon receipt of an order of Termination for Convenience, the Contractor shall not proceed with any item of work which is not specified in the Order of Termination. The Contractor shall complete all items of work specified in the termination order. Such work shall include punch list items and all work necessary to ensure the safety of the public, to properly secure existing work already constructed or partially constructed and to secure the Project Site. This work so ordered shall be performed in accordance with the Contract Documents, and may include items of work not in the original Contract. The Work performed shall be considered substantially complete upon completion and

acceptance of all items of work specified in the Order, except punch list items. After completion of the punch list items and all documents required by the Contract, the Contract shall terminate upon issuance of a Final Certificate and payment. The DPMC reserves the right to declare in default a Contractor who fails to carry out the conditions set forth in an Order of Termination for Convenience.

12.4.3 When the DPMC orders termination of the Contract for Convenience, all completed items of work as of that date will be paid for at the Contract prices.

12.4.3.1 Payment for partially completed work will be paid for at agreed prices.

12.4.3.2 Payment for new items, if any, will be made either at agreed prices or in accordance with Article 10.

12.4.3.3 Materials obtained by the Contractor for the Work but which have not been incorporated therein may, at the option of the State, be purchased from the Contractor at actual cost delivered to a prescribed location, or otherwise disposed of as mutually agreed.

12.4.4 Within sixty (60) days of the effective termination date, the Contractor shall submit claims for additional costs actually incurred, not covered above or elsewhere in the Contract. Such claims may include reasonable mobilization costs, overhead expenses attributable to the Work performed, Subcontractor costs not otherwise paid for, actual idle labor costs if Work is stopped in advance of the termination date. The DPMC will not compensate the Contractor for costs prohibited under provisions of the Contract and/or anticipated profits on work not performed.

12.4.5 If the DPMC terminates the Contractor for cause as provided under Article 12.2 of the General Conditions, and if a court of law subsequently determines such termination for cause to have been undertaken without lawful justification, then such termination shall be deemed a termination for convenience governed by this Article 12.4. In that event, recovery by the Contractor and/or the Contractor's surety shall be limited to those costs which are recoverable following a termination for convenience under this Article 12.4.

ARTICLE 13 – OTHER REQUIREMENTS

13.1 PREVAILING WAGE

13.1.1 The Contractor shall comply with the New Jersey Prevailing Wage Act Laws of 1963, Chapter 150, (N.J.S.A. 34:11-56.25 et seq.) and all amendments thereto, and this act is hereby made a part of every Contract entered into on behalf of the State of New Jersey through the DPMC, except those Contracts which are not within the contemplation of the Act. Provisions of the Act include the following stipulations and requirements:

a. All workers employed in the performance of every Contract in which the Contract sum is in excess of \$2,000 and to which the DPMC is a party shall be paid not less than the prevailing wage rate as designated by the Commissioner, Division of Labor or his or her duly authorized representative.

(1) The Contractor performing public work for the DPMC and which is subject to the provisions of the Prevailing Wage Act, shall post the prevailing wage rates for each craft and classification involved as determined by the Commissioner, Division of Labor. This posting shall include the effective date of any changes thereof, and shall be displayed in prominent and easily accessible places at the Site of the Work or at such place or places as are used by the Contractor/Subcontractor to pay workers' wages.

(2) At the time of the bid due date, the Bidder and any Subcontractors identified by the Bidder must be registered in accordance with “The Public Works Contractor Registration Act” (N.J.S.A. 34:11-56.48 et seq.) All questions regarding registration shall be addressed to:

Contractor Registration Unit
New Jersey Department of Labor
Division of Wage & Hour Compliance
P O Box 389
Trenton NJ 08625-0389
Telephone: 609-292-9464
FAX: 609-633-8591

b. In the event it is found that any worker, employed by any Contractor covered by any Contract in excess of \$2,000 for any public work to which the DPMC is a party, has been paid a rate of wages less than the prevailing wage required by such Contract, DPMC may terminate the Contractor's right to proceed with the Work, or such part of the Work as to which there has been failure to pay required wages, and may otherwise execute the Work to completion.

c. In the event that any Subcontractor retained by a Contractor on any Contract in excess of \$2,000 for any public work to which the DPMC is a party, has been paid a rate of wages less than the prevailing wage required by such Contract, DPMC may terminate the Contractor's right to proceed with the Work, or such part of the Work as to which there has been failure to pay required wages, and may

otherwise execute the Work to completion or may require that the Contractor immediately substitute a new Subcontractor at the costs set forth in the Contract.

d. Nothing contained in the Prevailing Wage Act shall prohibit the payment of more than the prevailing wage rate to any worker employed on a Project.

e. The Contractor shall, as a condition of subcontract with any tier Subcontractor, require compliance with this section as a condition of Subcontract.

f. The State may audit the Contractor's conformance with the Prevailing Wage Act. If the result of such audit determines that the Contractor has not complied with the Prevailing Wage Act then such Contractor shall be responsible for the cost of this audit.

13.2 PATENTS

13.2.1 The Contractor shall hold and save the State and its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for or on account of any patented or non-patented design, device, invention, process, article or appliance manufactured or used in the performance of the Contract, including its use by the State, unless otherwise specifically stipulated in the Contract Documents.

13.2.2 License and/or royalty fees for the use design, device, invention, process, article or appliance which is authorized by the State must be reasonable, and paid to the holder of the patent or his or her authorized licensee directly by the State and not by or through the Contractor.

13.2.3 If the Contractor uses any design, device, invention, process, article or appliance covered by letters, patent or copyright, it shall provide for such use by suitable agreement with the State of such patented or copyrighted design, device or material. It is mutually agreed and understood that, without exception, the Contract prices shall include all royalties or costs arising from the use of such design, device, invention, process, article or appliance in any way involved in the Work.

13.2.4 The Contractor and/or its surety shall indemnify and save harmless the State from any and all claims for infringement by reason of the use of such patented or copyrighted device, invention, process, article or appliance, or any trademark or copyright in connection with Work performed under this Contract, and shall defend and indemnify the State for any cost, expense or damage which it may be obliged to pay by reason of such infringement at any time during the execution of the Work or after the completion of the Work. This section shall survive the termination of the Contract.

13.3 RIGHT TO AUDIT

13.3.1 The State reserves the right to audit the records of the Contractor in connection with all matters related to its Contract. The Contractor agrees to maintain its records in accordance with "Generally Accepted Accounting Principles," for a period of not less than five (5) years after receipt of final payment. All charges must be supported by appropriate documentation, including, but not limited to canceled checks. All records

shall be made available to the New Jersey Office of the State Comptroller or other State audit agency upon request and at no cost to the State.

13.3.2 The Contractor shall maintain all documentation related to products, transactions or services under this contract for a period of five years from the date of final payment. Such records shall be made available to the New Jersey Office of the State Comptroller or other State audit agency upon request and at no cost to the State.

13.3.2 The Contractor shall develop, maintain and make available to the DPMC on request such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, Change Orders, all original estimates, takeoffs and other bidding documents, all Subcontractor and supplier Contracts and changes, all records showing all costs and liabilities incurred or to be incurred in connection with the Project (including all Subcontractor and supplier costs), all payment records and all records showing all costs incurred in labor and personnel of any kind, records and other data as the State may request concerning work performed or to be performed under this Contract.

13.3.3 The Contractor acknowledges and agrees that no claim for payment which is premised to any degree upon actual costs of the Contractor shall be recognized or payable by the State except and to the extent that such actual costs are substantiated by records required to be maintained under these provisions.

13.3.4 The Contractor acknowledges and agrees that its obligation to establish, maintain and make available records and the State's right to audit as delineated herein shall extend to actual costs incurred by Subcontractors in performing work required under the Contract Documents. The Contractor shall require in each subcontract that the Subcontractor establish, maintain and make available to the State all records as defined and delineated herein, relating to all work performed under the Subcontractor including work performed by a sub-Subcontractor.

13.4 INSURANCE

13.4.1 Insurance To Be Carried By The Contractor:

The Contractor shall obtain and maintain, at its expense and for the duration of the contract, minimum insurance coverage set forth below. By requiring such minimum insurance, the State of New Jersey shall not be deemed or construed to have assessed the risk that may be applicable to the Contractor under this contract. The Contractor shall assess its own risks and if it deems appropriate and/or prudent, maintain higher limits and/or broader coverage. The Contractor is not relieved of any liability or other obligations assumed or pursuant to the Contract by reason of its failure to obtain or maintain insurance in sufficient amounts, duration or types.

a Commercial General Liability:

(1) Commercial General Liability (CGL)-ISO occurrence form CG001 or a substitute form providing a minimum coverage of \$2,000,000 per occurrence for bodily injury liability and \$2,000,000 per occurrence for property damage liability and shall cover liability arising from:

- Premises/Operations

- Independent Contractors
 - Products/Completed Operations
 - Personal and Advertising Injury
 - Liability assumed under an insured contract (including defense cost assumed)
- (2) The State of New Jersey shall be included as an additional insured under the CGL using ISO additional insured endorsement CG 20 10 and CG 20 37 or a substitute providing equivalent coverage, which endorsement shall include coverage for the State of New Jersey arising out of the completed operations of the contractor, and which coverage shall be maintained in effect for the benefit of the State of New Jersey for a period of three (3) years following the completion of the work specified in section 7.3 of this contract. Additional Insured coverage as required in this subparagraph shall apply as primary insurance with respect to any other insurance or self-insurance programs afforded to the State of New Jersey.
 - (3) The CGL general aggregate shall apply separately to this project using ISO CG 2503 form – designated construction projects(s) General Aggregate Limit.
 - (4) There shall be no endorsement or modification of the CGL limiting the scope of coverage for liability arising from explosion, collapse or underground property damage.
 - (5) If not included in the policy form the CGL policy must be endorsed with a separation of insureds (severability of interests) endorsement.
 - (6) CGL policy must provide or be endorsed (ISO form CG 24 04) to provide for waiver of subrogation.

b Business Automobile Liability:

- (1) Contractor and subcontractors shall maintain business auto liability insurance and such insurance shall cover liability arising out of any auto (including owned, hired and non-owned autos).
- (2) The limits of liability shall be not less than \$1,000,000 per occurrence for both bodily injury and property damage liability.
- (3) Business Automobile coverage shall be written on ISO form CA 00 01 or a substitute form providing equivalent liability coverage. If necessary, the policy shall be endorsed to provide contractual liability coverage equivalent to that provided in the 1990 and later additions of CA 00 01.
- (4) If required by law, the business auto policy shall be endorsed to provide pollution liability coverage equivalent to that provided under the ISO pollution liability broadened coverage for covered autos form

CA 99 48 and the Motor Carrier Act endorsement (MCS 90) shall be attached.

- (5) Waiver of Subrogation -- Contractor waives all rights against the State of New Jersey for recovery of damages to the extent these damages are covered by the business auto liability insurance obtained by Contractor pursuant to Paragraph 2.0 of this Agreement.
- c Workers Compensation: Workers Compensation Insurance applicable to the laws of the State of New Jersey and other State or Federal jurisdiction is required to protect the employees of the Contractor or any Subcontractor who will be engaged in the performance of this Contract. This insurance shall include employers' liability protection with a limit of liability not less than \$500,000.
- d Umbrella Liability: Contractor must maintain an Umbrella Liability Policy excess of the Commercial General Liability, Automobile Liability and Employer Liability coverage.
 - (1) The coverages of the umbrella policy must be as broad as the primary policies covered by this policy and include a "drop-down" provision if the primary coverage becomes impaired or exhausted.

13.4.2 Insurance To Be Carried By The State of New Jersey:

- a Builders Risk Insurance: Unless otherwise provided in this agreement the State of New Jersey shall provide and maintain, in a company or companies lawfully authorized to do business in the jurisdiction which this project is located, Builders Risk Insurance in the amount of the initial contract amount as well as subsequent modifications for the entire project at the site on a replacement cost basis.
 - (1) The Builders Risk coverage shall be on an "All Risk of direct physical loss or damage" or equivalent policy form and include theft, earthquake, flood, temporary structures, demolition and increased cost of construction, architects fees and expenses . Also the insurance must include coverage for Equipment Breakdown Coverage (a.k.a. Boiler & Machinery) which shall cover insured Equipment during installation and testing. The Builders Risk insurance shall include the interest of the State of New Jersey, the general Contractor, subcontractors and sub-tier contractors in the project.
 - (2) The Builders Risk Policy shall cover all materials equipment and supplies, assemblies and furnishings intended for specific installation in the project while located at the site. The policy will cover portions of the work off site and portions of the work in transit subject to the policy sub-limits for these coverages.
 - (3) Waivers of Subrogation -- The State of New Jersey and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees and (2) the Architect/Engineer, Architect/Engineer's Consultants, and any of their

subcontractors, Sub-subcontractors, agents and employees for damages caused by fire or other causes of loss to the extent covered by the Builders Risk insurance or any other property insurance applicable to the work.

- (4) The Builders Risk policy will provide for a waiver of subrogation against all interested parties covered by the policy but only to the extent the loss is covered by the policy.
- (5) The above insurance shall apply only to the work described in this contract, and shall not apply to alterations, repairs, maintenance and installations of systems, equipment and other items of work which do not result in creating additional habitable space. This insurance shall not protect against damage or loss to any of the Contractor's or Subcontractor's tools, equipment, scaffolding, staging towers or forms and Contractor's materials stored on Site which are not part of the construction Project,. It is understood that the Contractor will, at its own expense, carry all insurance which may be required to provide the necessary protection against such loss or damage herein described which shall contain a waiver of any right of subrogation against the State of New Jersey.
- (6) Deductible Provisions -- The insurance protection described herein may contain a deductible clause. The State of New Jersey agrees to bear the cost of all deductibles of the Builders Risk Policy.
- (7) Loss Reporting and Loss Adjustment – The Contractor will receive a Loss Reporting Form whenever Builders’ Risk Insurance is written. This form includes appropriate loss reporting instructions. In the event of loss, the Contractor shall immediately notify the State of New Jersey, DPMC, in writing, and take any other appropriate steps as may be required under the standard builders' risk insurance policy in effect. Upon the occurrence of any loss or damage prior to the acceptance of the building by the State, the Contractor shall, at the State's option, replace and repair the damaged work as originally provided in the drawings and specifications at no additional compensation to that provided in the original Contract.
- (8) Status Trustee for Loss Adjustment -- All losses will be adjusted with, and payable to, the State of New Jersey, as trustee for the insured as their interests may appear. The Contractor shall be named jointly with the State in all policies of insurance, all of which shall be open to inspection by the State.
- (9) This provision shall not relieve the Contractor from its obligation to complete, according to plans and specifications, the Project covered by the Contract, and the Contractor and its surety shall be obligated to full performance of the Contractor's undertaking.

13.5 ASSIGNMENT OF ANTITRUST CLAIMS

13.5.1 The Contractor recognizes that in actual economic practice, overcharges resulting from antitrust violations are in fact usually borne by the ultimate purchaser. Therefore, and as consideration for executing this Contract, the Contractor, acting herein by and through its duly authorized agent, hereby conveys, sells, assigns, and transfers to the State of New Jersey, for itself and on behalf of its political subdivisions, instrumentalities, and public agencies, all right, title and interest to all claims and causes of action it may now or hereafter acquire under the antitrust laws of the United States or the State of New Jersey, relating to the particular goods or services purchased or acquired by the State of New Jersey or any of its political subdivisions or public agencies pursuant to this Contract.

13.5.2 In connection with this assignment, the following are the express obligations of the Contractor:

- a. The Contractor will take no action which will in any way diminish the value of the rights conveyed or assigned hereunder.
- b. The Contractor will advise the Attorney General of New Jersey and DPMC:
 - (1) in advance of its intention to commence any action on its own behalf regarding any such claim or cause(s) of action; and/or
 - (2) immediately upon becoming aware of the fact that an action has been commenced on its behalf by some other person(s) of the tendency of such action.
- c. The Contractor will notify the defendants in any antitrust suit of the fact of the within assignment at the earliest practicable opportunity after the Contractor has initiated an action on its own behalf or becomes aware that such an action has been filed on its behalf by another person. A copy of such Notice will be sent to the Attorney General of New Jersey and the DPMC.

13.5.3 It is understood and agreed that in the event any payment under any such claim or cause of action is made to the Contractor, it shall promptly pay over to the State of New Jersey the allotted share thereof, if any, assigned to the State hereunder.

END, GENERAL CONDITIONS

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Equipment purchase contract.
4. Access to site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and drawing conventions.
8. Allowances.

1.2 PROJECT INFORMATION

- ##### A. Project Identification: Interior and MEP Restoration of the Central Railroad of New Jersey Terminal Building.
1. Project Location: Jersey City, New Jersey.
- ##### B. Owner: New Jersey Division of Property Management and Construction.
- ##### C. Architect: STV Architects.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- ##### A. The Work of Project is defined by the Contract Documents.

1.4 EQUIPMENT PURCHASE CONTRACT

- ##### A. General: The State has awarded pre-purchase contracts with suppliers of material and equipment to be incorporated into the Work. The State will assign these purchase contracts to this Contractor. Include costs for receiving, handling, on-site storage if required, and installation of material and equipment in the Contract Sum, unless otherwise indicated.
1. Equipment is being pre-purchased by The State of New Jersey. The equipment order will be assigned to the construction trade contractor who will become responsible for all aspects of the equipment and installation the same as if he had originally ordered the equipment, with the Contractor and Supplier coordinating all aspects likewise.

- B. For a list of pre-purchased equipment, services and other details, refer to the attached bid package. This bid package is included for reference only.
- C. The Contractor shall verify all pre-purchased equipment and services and coordinate installation details and equipment supplied as required.

1.5 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by the State's right to perform work or to retain other contractors on portions of Project.
- B. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine construction operations to areas indicated on the drawings.
 - 2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to the State, the State's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.6 COORDINATION WITH OCCUPANTS

- A. Partial State Occupancy: The State may occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with the State during construction operations to minimize conflicts and facilitate State usage. Perform the Work so as not to interfere with The State's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from The State and authorities having jurisdiction.
 - 2. Provide not less than 72 hours' notice to The State of activities that will affect The State's operations.
- B. State Limited Occupancy of Completed Areas of Construction: The State reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with

completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for the entire project.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited State occupancy.
3. Before mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. The State will operate and maintain mechanical and electrical systems upon Final Acceptance of the entire project.
4. Upon approval of Final Acceptance, The State will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.7 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
 2. Coordinate with the State and obtain written approval for site access and work hours.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 8:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. If the Contractor feels that the contract duration requires multiple shifts, it shall be included in their base bid.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by The State or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 1. Notify The State not less than two days in advance of proposed utility interruptions.
 2. Obtain The State's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to State occupancy with The State.
 1. Notify The State not less than two days in advance of proposed disruptive operations.
 2. Obtain The State's written permission before proceeding with disruptive operations.
- E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.
- F. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
- 1.9 ALLOWANCES FOR PLUMBING AND FIRE-PROTECTION REPAIR WORK
- A. Cost to Contractor of specific products and materials per Section 012221 and Section 012222.
1. Allowance for repair of plumbing and fire protection equals \$150,000.00.
- 1.10 SPECIAL INSPECTION ALLOWANCE
- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results. The Contractor shall be responsible for all testing and special controlled inspections as detailed on Drawing G-002 and per IBC-NJ 2009. The cost will be dispersed through an allowance as designated in the Bid Form. Contractor shall be responsible for contracting with a N.J. State approved (classified) independent inspector to perform all listed UCC Code driven inspections listed on Drawing G-002. The cost of inspection shall be a direct cost back to the owner with back-up documentation provided. Funding is included in the base contract under allowance for independent testing for \$50,000.00.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012221 - UNIT PRICES FOR FIRE PROTECTION

PART 1- GENERAL

1.1 DESCRIPTION

- A. Provide unit prices for possible revisions and alternates in the work.
- B. State and hold firm for the duration of the project all unit prices as described herein.

1.2 DEFINITIONS

- A. Unit prices, unless otherwise noted, are to include incidental work included in connection with the particular type of work involved and are to include, but not necessarily be limited to, the following:
 - 1. Engineering, including calculations, detailing, coordination, and shop drawings.
 - 2. Material costs, including an allowance for pipe, connections, etc.
 - 3. Necessary accessories, e.g., hangers, inserts, clips, bolts, painting, labeling, testing, etc.
 - 4. Fabrication and shop costs.
 - 5. Shop and field labor, including supervision and engineering layout costs.
 - 6. Temporary utilities required, including safety precautions.
 - 7. Costs of standby trades during or beyond normal working hours.
 - 8. Transportation, hoisting, rigging, freight, taxes of any kind, fringe benefits, overhead and profit (excluding Insurance Cost).
 - 9. Tools and equipment.
 - 10. Testing, cleaning, balancing and controlled inspection.
- B. Architect/Engineer documents will be used as the basis for calculating changes to contract work.
- C. Submit unit prices based upon the specification standards and as noted herein. Unit prices shall apply to work when added and also to work when deleted, as indicated in the Bid Proposal Form, except where specifically modified below.
- D. In addition to your contract proposal, quote prices for the work described below.

PART 2 - PRODUCTS

2.1 PIPING

A.	Provide Schedule 40 black steel pipe and hangers.	\$_____/LF
B.	Provide Schedule 10 black steel pipe and hangers.	\$_____/LF
C.	Provide Schedule 40 galvanized steel pipe and hangers.	\$_____/LF
D.	Provide Schedule 10 galvanized steel pipe and hangers.	\$_____/LF
E.	Gate Valves (U.L. and F.M. Listed)	\$_____/UNIT
F.	Pressure Reducing Valves (PRV)	\$_____/UNIT
G.	Check Valves (U.L. and F.M. Listed)	\$_____/UNIT
H.	Butterfly Valves (U.L. and F.M. Listed) With Tamper Switch	\$_____/UNIT
I.	Waterflow Detectors	\$_____/UNIT
J.	Sprinkler Heads: Install with 10 feet of pipe and necessary elbows and hangers	\$_____/UNIT
K.	Sprinkler Rig: Consisting of valve and tamper switch, waterflow detector, pressure gauge, inspector test assembly.	\$_____/UNIT
L.	Dry Valves	\$_____/UNIT
M.	Core Drill: Core drill holes in slab. Cost includes firestopping and plugging as required.	\$_____/LF
N.	Additional cost for repair and replace above ceiling grid	\$_____/SQFT.
O.	Additional cost for repair and replace above gypsum board ceiling	\$_____/SQFT.
P.	Additional cost for repair and replace behind walls	\$_____/SQFT.
Q.	Additional cost for repair and replace at concrete slab	\$_____/SQFT.
R.	Additional cost for repair and replace at crawlspace	\$_____/SQFT.

PART 3- EXECUTION

3.1 NOT USED.

END OF SECTION

SECTION 012222 - UNIT PRICES FOR PLUMBING

PART 1- GENERAL

1.1 DESCRIPTION

- A. Provide unit prices for possible revisions and alternates in the work.
- B. State and hold firm for the duration of the project all unit prices as described herein.

1.2 DEFINITIONS

- A. Unit prices, unless otherwise noted, are to include incidental work included in connection with the particular type of work involved and are to include, but not necessarily be limited to, the following:
 - 1. Engineering, including calculations, detailing, coordination, and shop drawings.
 - 2. Material costs, including an allowance for pipe, connections, etc.
 - 3. Necessary accessories, e.g., hangers, inserts, clips, bolts, painting, labeling, testing, etc.
 - 4. Fabrication and shop costs.
 - 5. Shop and field labor, including supervision and engineering layout costs.
 - 6. Temporary utilities required, including safety precautions.
 - 7. Costs of standby trades during or beyond normal working hours.
 - 8. Transportation, hoisting, rigging, freight, taxes of any kind, fringe benefits, overhead and profit (excluding Insurance Cost).
 - 9. Tools and equipment.
 - 10. Testing, cleaning, balancing and controlled inspection.
- B. Architect/Engineer documents will be used as the basis for calculating changes to contract work.
- C. Submit unit prices based upon the specification standards and as noted herein. Unit prices shall apply equally to work when added and also to work when deleted, except where specifically modified below.

D. In addition to your contract proposal, quote prices for the work described below.

PART 2 - PRODUCTS

2.1 PIPING

- | | | |
|----|---|---------------|
| A. | Cast Iron pipe and hangers. | \$_____/LF |
| B. | Ductile Iron pipe and hangers. | \$_____/LF |
| C. | Copper pipe (type K) and hangers. | \$_____/LF |
| D. | Copper pipe (type L) and hangers. | \$_____/LF |
| E. | Schedule 40 Steel pipe with factory applied coating, wrapping and hangers. | \$_____/LF |
| F. | Gate Valves | \$_____/UNIT |
| G. | Ball Valves | \$_____/UNIT |
| H. | Cellular Glass Insulation thickness 1” | \$_____/LF |
| I. | Flexible Elastomeric Insulation thickness 1” | \$_____/LF |
| J. | Foamglas with Pittwrap and metal jacketing Insulation thickness 2” | \$_____/LF |
| K. | Core Drill: Core drill holes in slab. Cost includes firestopping and plugging as required. | \$_____/UNIT |
| L. | Additional cost to remove, repair and replace above acoustical suspended ceiling grid (cost to include removal and reinstallation or replacement of existing acoustical suspended ceiling). | \$_____/SQFT. |
| M. | Additional cost for repair and replace above gypsum board ceiling (cost to include removal and replacement of existing gypsum board ceiling). | \$_____/SQFT. |
| N. | Additional cost for repair and replace behind walls (cost to include wall removal and repairs, finishing and painting) | \$_____/SQFT. |
| O. | Additional cost for repair and replace at concrete slab (cost to include concrete slab demo, excavation, backfill and concrete slab repairs) | \$_____/SQFT. |
| P. | Additional cost for repair and replace in crawlspace | \$_____/SQFT. |

PART 3- EXECUTION

3.1 NOT USED.

END OF SECTION

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

- a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - j. Number and title of appropriate Specification Section.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Other necessary identification.
 4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.

5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
 - a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
 - 1) Project name.
 - 2) Date.
 - 3) Destination (To:).
 - 4) Source (From:).
 - 5) Name and address of Architect.
 - 6) Name of Construction Manager.
 - 7) Name of Contractor.
 - 8) Name of firm or entity that prepared submittal.
 - 9) Names of subcontractor, manufacturer, and supplier.
 - 10) Category and type of submittal.
 - 11) Submittal purpose and description.
 - 12) Specification Section number and title.
 - 13) Specification paragraph number or drawing designation and generic name for each of multiple items.
 - 14) Drawing number and detail references, as appropriate.
 - 15) Indication of full or partial submittal.
 - 16) Transmittal number, numbered consecutively.
 - 17) Submittal and transmittal distribution record.
 - 18) Remarks.
 - 19) Signature of transmitter.
 - E. Options: Identify options requiring selection by Architect.
 - F. Deviations: Identify deviations from the Contract Documents on submittals.
 - G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
 - H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
 - I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

1. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
2. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
 - a. Three paper copies of Product Data unless otherwise indicated. Architect will return two copies.

- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 - 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as The State's property, are the property of Contractor.
 - 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - 1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 1. Submit product schedule in the following format:
 - a. Three paper copies of product schedule or list unless otherwise indicated. Architect will return two copies.
- F. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."
- G. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- H. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- I. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and the States, and other information specified.
- J. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- K. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- L. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

- M. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- N. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- O. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- P. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- Q. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- R. Schedule of Tests and Inspections: Comply with requirements specified in Section 014000 "Quality Requirements."
- S. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- T. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- U. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- V. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- C. Informational Submittals: Architect will review each submittal and will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 013591 - HISTORIC TREATMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and all Supplementary Articles as contained in Division 1 are hereby included in this section to the same extent as though written out hereinafter. All work of this section shall be performed in accordance with the requirements of the Contract Documents.

1.2 SUMMARY

- A. The building is listed on the National Register of Historic Places.
- B. The Contractor shall take all necessary precautions, throughout all operations, to protect the building and site from damage. Provide all required protection of surfaces and finishes. Provide tarps, drop cloths, etc. as required to minimize the spread of dust beyond immediate work areas, and to protect other surfaces slated to be restored.

1.3 SUBMITTALS

- A. Document (with photography or similar means) original, existing roofing, siding, windows, doors, roof structure and all trim & decorative elements. Configurations and details to be replicated are to be fully documented, prior to demolition or removals. Submit documentation for each work area.

1.4 QUALITY ASSURANCE

- A. Verify all field conditions, dimensions and quantities.
- B. Document (with photography or similar means) original, existing roofing, siding, windows, doors, roof structure and all trim. Configurations and details to be replicated are to be fully documented, prior to demolition or removals.
- C. Proceed with exterior removals and replacement only when existing and forecasted weather conditions are favorable, and will allow sufficient time for work under any segment of the roofing to be completed under favorable weather conditions.

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- D. Take all necessary precautions, including the installation of temporary roofing membrane and night seals, to protect the building interior from damage. The installation of tarps will not be considered as a satisfactory method of providing roof protection. Any leaks that occur after construction work on a particular section of roof begins shall be attributed to the Contractor. It shall be the Contractor's responsibility to immediately repair and correct all such leaks. Damage resulting from such leaks shall be the responsibility of the Contractor.
- E. Most importantly, this is a restoration project, with selective replacement. Wherever possible, existing original architectural elements are to be carefully conserved, repaired, and restored.
- F. Those elements which the Contractor feels should be replaced with new material or fabrications will be marked in the field by the Contractor and then have the Architect verify as to the need for re^placement.
- G. All elements which are being replaced must replicate the original in shape, thickness, detail, species, configuration, material, and etc.
- H. All removals required to execute any element of work for this contract shall be included in the bid whether shown or not shown.

1.5 SPECIAL CONCERNS

- A. Work covered in these plans and specifications has been reviewed by New Jersey State Historic Preservation Office (SHPO), which requires construction to be performed in accordance with the Secretary of Interior's Standards for Historic Preservation Projects (Standards), as amended and as prescribed in the project plans and specifications.
- B. Work to remove existing and install new elements shall be done with attention to minimizing damage to existing surfaces. Careful coordination and meticulous installation practices are required to minimize the visual impact of new elements on the existing historic fabric of the CRRNJ Terminal.

END OF SECTION

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, The State, or authorities having jurisdiction are not limited by provisions of this Section.
 - 3. Specific test and inspection requirements are not specified in this Section.

1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

- G. Testing Agency: An entity engaged by the Contractor to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.4 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

1.5 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 5. Other required items indicated in individual Specification Sections.
- C. Permits, Licenses, and Certificates: For The State's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. **Installer Qualifications:** A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. **Specialists:** Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. **Testing Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. **Manufacturer's Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. **Preconstruction Testing:** Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - d. When testing is complete, remove test specimens an assemblies, mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service through the Contractor to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.7 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 2. Notify testing agencies as required and in advance of time when Work that requires testing or inspecting will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect through the Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.
1. AABC - Associated Air Balance Council; www.aabc.com.
 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 7. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
 8. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 9. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 10. AF&PA - American Forest & Paper Association; www.afandpa.org.
 11. AGA - American Gas Association; www.aga.org.
 12. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 13. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 14. AI - Asphalt Institute; www.asphaltinstitute.org.
 15. AIA - American Institute of Architects (The); www.aia.org.
 16. AISC - American Institute of Steel Construction; www.aisc.org.
 17. AISI - American Iron and Steel Institute; www.steel.org.
 18. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
 19. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 20. ANSI - American National Standards Institute; www.ansi.org.
 21. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
 22. APA - APA - The Engineered Wood Association; www.apawood.org.
 23. APA - Architectural Precast Association; www.archprecast.org.
 24. API - American Petroleum Institute; www.api.org.
 25. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
 26. ARI - American Refrigeration Institute; (See AHRI).
 27. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
 28. ASCE - American Society of Civil Engineers; www.asce.org.
 29. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
 30. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.

31. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
32. ASSE - American Society of Safety Engineers (The); www.asse.org.
33. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
34. ASTM - ASTM International; (American Society for Testing and Materials International); www.astm.org.
35. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
36. AWEA - American Wind Energy Association; www.awea.org.
37. AWI - Architectural Woodwork Institute; www.awinet.org.
38. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
39. AWPA - American Wood Protection Association; (Formerly: American Wood-Preservers' Association); www.awpa.com.
40. AWS - American Welding Society; www.aws.org.
41. AWWA - American Water Works Association; www.awwa.org.
42. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
43. BIA - Brick Industry Association (The); www.gobrick.com.
44. BICSI - BICSI, Inc.; www.bicsi.org.
45. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.com.
46. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
47. BOCA - BOCA; (Building Officials and Code Administrators International Inc.); (See ICC).
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bwfbadminton.org.
49. CDA - Copper Development Association; www.copper.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.
52. CFFA - Chemical Fabrics & Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.pbmdf.com.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).
69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; www.ec-central.org.
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECA).

73. EIA - Electronic Industries Alliance; (See TIA).
74. EIMA - EIFS Industry Members Association; www.eima.com.
75. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
76. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
77. ESTA - Entertainment Services and Technology Association; (See PLASA).
78. EVO - Efficiency Valuation Organization; www.evo-world.org.
79. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
80. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
81. FM Approvals - FM Approvals LLC; www.fmglobal.com.
82. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
83. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarooft.com.
84. FSA - Fluid Sealing Association; www.fluidsealing.com.
85. FSC - Forest Stewardship Council U.S.; www.fscus.org.
86. GA - Gypsum Association; www.gypsum.org.
87. GANA - Glass Association of North America; www.glasswebsite.com.
88. GS - Green Seal; www.greenseal.org.
89. HI - Hydraulic Institute; www.pumps.org.
90. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
91. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
92. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
93. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
94. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
95. IAS - International Approval Services; (See CSA).
96. ICBO - International Conference of Building Officials; (See ICC).
97. ICC - International Code Council; www.iccsafe.org.
98. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
99. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
100. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
101. IEC - International Electrotechnical Commission; www.iec.ch.
102. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
103. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
104. IESNA - Illuminating Engineering Society of North America; (See IES).
105. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
106. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
107. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
108. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
109. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
110. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
111. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
112. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
113. ISO - International Organization for Standardization; www.iso.org.
114. ISSFA - International Solid Surface Fabricators Association; (See ISFA).

115. ITU - International Telecommunication Union; www.itu.int/home.
116. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
117. LMA - Laminating Materials Association; (See CPA).
118. LPI - Lightning Protection Institute; www.lightning.org.
119. MBMA - Metal Building Manufacturers Association; www.mbma.com.
120. MCA - Metal Construction Association; www.metalconstruction.org.
121. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
122. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
123. MHIA - Material Handling Industry of America; www.mhia.org.
124. MIA - Marble Institute of America; www.marble-institute.com.
125. MMPA - Moulding & Millwork Producers Association; (Formerly: Wood Moulding & Millwork Producers Association); www.wmmpa.com.
126. MPI - Master Painters Institute; www.paintinfo.com.
127. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
128. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
129. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
130. NADCA - National Air Duct Cleaners Association; www.nadca.com.
131. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
132. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
133. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
134. NCMA - National Concrete Masonry Association; www.ncma.org.
135. NEBB - National Environmental Balancing Bureau; www.nebb.org.
136. NECA - National Electrical Contractors Association; www.necanet.org.
137. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
138. NEMA - National Electrical Manufacturers Association; www.nema.org.
139. NETA - InterNational Electrical Testing Association; www.netaworld.org.
140. NFHS - National Federation of State High School Associations; www.nfhs.org.
141. NFPA - NFPA; (National Fire Protection Association); www.nfpa.org.
142. NFPA - NFPA International; (See NFPA).
143. NFRC - National Fenestration Rating Council; www.nfrc.org.
144. NHLA - National Hardwood Lumber Association; www.nhla.com.
145. NLGA - National Lumber Grades Authority; www.nlga.org.
146. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
147. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
148. NRCA - National Roofing Contractors Association; www.nrca.net.
149. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
150. NSF - NSF International; (National Sanitation Foundation International); www.nsf.org.
151. NSPE - National Society of Professional Engineers; www.nspe.org.
152. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
153. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
154. NWFA - National Wood Flooring Association; www.nwfa.org.
155. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
156. PDI - Plumbing & Drainage Institute; www.pdionline.org.
157. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.

160. RIS - Redwood Inspection Service; www.redwoodinspection.com.
161. SAE - SAE International; (Society of Automotive Engineers); www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association; www.sefalabs.com.
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
167. SIA - Security Industry Association; www.siaonline.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.
169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.
175. SRCC - Solar Rating and Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
177. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
178. STI - Steel Tank Institute; www.steeltank.com.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; (Formerly: Tile Council of America); www.tileusa.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
184. TIA - Telecommunications Industry Association; (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
185. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
186. TMS - The Masonry Society; www.masonrysociety.org.
187. TPI - Truss Plate Institute; www.tpinst.org.
188. TPI - Turfgrass Producers International; www.turfgrassod.org.
189. TRI - Tile Roofing Institute; www.tilerroofing.org.
190. UBC - Uniform Building Code; (See ICC).
191. UL - Underwriters Laboratories Inc.; www.ul.com.
192. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
193. USAV - USA Volleyball; www.usavolleyball.org.
194. USGBC - U.S. Green Building Council; www.usgbc.org.
195. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
196. WASTEC - Waste Equipment Technology Association; www.wastec.org.
197. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
198. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
199. WDMA - Window & Door Manufacturers Association; www.wdma.com.
200. WI - Woodwork Institute; (Formerly: WIC - Woodwork Institute of California); www.wicnet.org.
201. WMMPA - Wood Moulding & Millwork Producers Association; (See MMPA).
202. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.

203. WPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; <http://dodssp.daps.dla.mil>.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; <http://eetd.lbl.gov>.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeia; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).

5. FS - Federal Specification; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
 6. MILSPEC - Military Specification and Standards; (See DOD).
 7. USAB - United States Access Board; www.access-board.gov.
 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.
1. CBHF - State of California; Department of Consumer Affairs; Bureau of Electronic Appliance and Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
 2. CCR - California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
 3. CDHS - California Department of Health Services; (See CDPH).
 4. CDPH - California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
 5. CPUC - California Public Utilities Commission; www.cpuc.ca.gov.
 6. SCAQMD - South Coast Air Quality Management District; www.aqmd.gov.
 7. TFS - Texas Forest Service; Forest Resource Development and Sustainable Forestry; <http://txforestservation.tamu.edu>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and all Supplementary Articles as contained in Division 1 are hereby included in this section to the same extent as though written out herein full. All work of this section shall be performed in accordance with the requirements of the Contract Documents.

1.2 SUMMARY

- A. The work of this section shall include all necessary labor, materials, tools, and appliances required to complete, in a first quality, workmanlike manner, and the following operations:
1. WORK ACCESS: Moveable lift work platforms, scaffolding and/or Industrial rope access as required to provide work access to the building and provide protection to adjacent areas and pedestrians, including:
 - a Moveable lift work platforms and scaffolding for work access.
 - b. Industrial rope access with integrated fall protection - SPRAT/IRATA certification required, must meet ASTM E2505-07 Standard Practice for Industrial Rope Access, ANSI 2359 Standards for Fall Arrest / Protection and comply with OSHA regulations.
 - c. Protection of the work areas, as required, to afford protection and safety for workmen and the general public.

NOTE: The scaffolding where utilized shall be lightweight, and assembled in a manner to prohibit any damage to the building and its surroundings.

2. TEMPORARY ELECTRIC POWER & LIGHTING: Contractor shall provide generator power adequate to provide power and light to all work areas and all work related activities.

PART 2 - PRODUCTS - Not applicable to this section.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide mobile scaffolds & work lift platforms at the exterior of the building as required, to execute the masonry pointing, repairs, restoration, roofing, cleaning, painting and all other related work as outlined by the plans and specifications. Utilize scaffolding, lifts, etc., only with prior approval of the owner for specific building access needs.

NOTE: The Terminal (buildings and grounds) may be occupied during the course of construction. It is the Contractor's responsibility to assure the protection and safe passage of the general public and Parks personnel when utilizing lifts or scaffolding.

- B. All platform scaffolds (if utilized) must have solid board backs and ends at least 24" high and solid board fronts at least 12" high to minimize the possibility of tools and materials from being dropped or kicked off of the scaffold.

- C. Scaffolding design and erection is the responsibility of the Contractor. The Contractor shall submit scaffolding plan and sequence to A/E and owner, for review.
- D. Industrial rope access with fully redundant integrated fall protection systems - Society of Professional Rope Access Technicians (SPRAT) and/or International Rope Access Trade Association (RATA) certification required. SPRAT Safe Practices for Rope Access Work Guidelines must be followed. IRA techniques must employ fully redundant systems based on the use of two independent ropes, each capable of sustaining OSHA-required ultimate loads far in excess of the specified 5000 pounds. The two rope system, including the selected anchors and hardware, must be engineered so that every component meets a safety factor of at least 10:1. Site specific engineering analysis and site specific safety plans are required.

3.2 PROTECTION

- A. Please be advised that special care and consideration is to be given to the building and its environment. The following steps must be taken so as to provide these minimum precautions against injury and property damage.
- B. The area below and surrounding any scaffold where the work is being done must be protected using barricade assemblies.
- C. Provisions for watchmen duties are the sole responsibility of the contractor, and shall be made as required to insure safety - especially during non-work hours.
- E. No work will be allowed to be conducted on weekends or holidays without written permission from the Owner.
- F. It is recommended that the base of fixed scaffold have plywood protection to prevent climbing.
- G. Building security during construction: Access to scaffolding and access to the building from scaffolding by intruders must be prevented, by appropriate means.

END OF SECTION

SECTION 015410 - BUILDING SECURITY AND CONTRACTOR USE OF THE PREMISES

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Coordination, site access, parking, deliveries and storage
- B. Availability and use of utilities
- C. Contractor work areas, working conditions, and equipment storage regulations
- D. Noise and odor restrictions, material approvals and working hours
- E. Security issues
- F. Protection of interior finishes

The following items describe the allowed use of the CRRNJ Terminal and grounds by the contractor, the availability and use of utilities, contractor equipment storage regulations, noise and odor restrictions, security issues, parking restrictions, material deliveries, working hours and protection of interior finishes. This list shall not be considered all-inclusive and may be extended by the Project Architect or DPMC. The content of this section shall not relieve the contractor from complying with the terms of the DPMC "Instructions to Bidders and General Conditions" and "Supplementary Instructions to Bidders and General Conditions" included in the project specifications.

PART 2 PRODUCTS- -Not Used

PART 3 EXECUTION

3.1 COORDINATION, SITE ACCESS, PARKING, DELIVERIES, AND STORAGE

- A. It should be noted that other projects may be in progress concurrently with this project within the CRRNJ Terminal area. Site access, deliveries, traffic control, parking, material storage and trailer locations must be coordinated with the DPMC Project Manager.
- B. The Parks personnel must have free and safe access to, from, around and within the Terminal at all times, unless specific arrangements are made with DPMC to close the terminal for a limited period of time during specific phases of work..
- C. The Contractor must coordinate in advance with the DPMC Project Manager regarding protection of facilities, equipment and people.

3.2 AVAILABILITY AND USE OF UTILITIES

- A. Electric and water are not currently available at the site.
- B. The Contractor is responsible for provision of adequate electric power and lighting to all work areas and as required to accomplish the work of this contract.
- C. The Contractor is responsible for provision of water to all work areas and as required to accomplish the work of this contract.

3.3 CONTRACTOR WORK AREAS, WORKING CONDITIONS AND EQUIPMENT STORAGE REGULATIONS

- A. The contractor shall not unreasonably encumber the facility with his equipment or work to be performed. The contractor shall be responsible for clean up every day and shall, at all times during the progress of the work, keep the site free from the accumulation of all rubbish and debris caused by its performance. The contractor shall remove all equipment, tools, debris and rubbish from or related to its work to the satisfaction of the DPMC Project Manager.
- B. The contractor shall adequately secure and protect its equipment, materials and vehicles. The State assumes no liability for any damage to, or theft of, the contractor's property.
- C. The State shall designate the use of a limited area outside of the building for storage and staging of construction materials, dumpsters, equipment, lockable portable toilets, vehicle parking, etc. The location of the area shall be submitted for approval. All shall be subject to approval by the Project Architect and DPMC Project Manager.
- D. The contractor is responsible for all safety precautions for all of its employees and property while performing its services.
- E. The contractor shall strictly limit its employees' use of areas of the facility grounds for lunch, smoking or rest time usage to only those areas designated by the DPMC Project Manager.
- F. The contractor shall, at all times, enforce strict discipline and good order among its employees and shall not employ any unfit person or any non-skilled person in the task assigned to him. The contractor shall supervise and direct the work using its best skill and attention.
- G. The contractor shall employ a competent, full-time supervisor to appropriately supervise the work and protect people and the facilities. The contractor must maintain a person on the site who represents the firm and can make immediate decisions when required at all times. The Contractor's full-time supervisor must be on site to supervise work at all times - no sub-contractors are to be on site or at work without the Contractor's supervisor present.
- H. The contractor agrees that upon request by the DPMC Project Manager, it will remove from services hereunder any of its employees who are incompetent, prone to tardiness, absenteeism or theft, are improper in conduct, or are not qualified or needed to perform the work assigned.
- I. The Project Architect in cooperation with the contractor and the DPMC Project Manager shall develop a "Project Directory" which identifies key designated representatives who may make decisions. Phone and cell phone numbers and pagers must be identified for immediate problem resolution.
- J. Construction dumpsters used by the contractor, shall be submitted for approval by DPMC Project Manager. Any dumpster shall be properly secured during the project and promptly

removed at the end of the project and emptied regularly so as not to allow trash or debris to be spewn about the grounds or to cause odors.

3.4 NOISE AND ODOR RESTRICTIONS, MATERIAL APPROVALS AND WORKING HOURS

- A. For the purposes of this project, regular working hours shall be from 8:00 am to 5:00 pm on weekdays. Upon Contractor request and with State approval these work hours may be extended to include early morning and / or after hours on weekdays, weekends and State holidays. Such Contractor requests shall be made at least twenty-fours in advance and shall be subject to approval by the Project Architect and DPMC Project Manager.
- B. Consideration shall be given by the contractor regarding odors, adhesives, noise, etc. If the odors or noise are such that they may disturb the Parks personnel and/or public in any way, then such work shall be performed at set times and while the building is not occupied. This determination shall be at the sole discretion of the DPMC Project Manager.
- C. The construction work is to be performed adjacent to other occupied buildings and areas which may be in full and continuous use during the course of the project. The contractor shall coordinate all operations with the DPMC Project Manager and Building Manager to minimize disturbances to the occupants of these buildings/areas. The playing of radios and other unnecessary noise will not be permitted.
- D. All material safety data sheets shall be submitted and approved by the DPMC Project Manager prior to use of the material. All MSDS information shall be kept in a binder on site.

3.5 SECURITY ISSUES

- A. The contractor is responsible for the security of the site and work area. All security fencing, precautions and methods must be approved by DPMC.

3.6 PROTECTION OF INTERIOR AND EXTERIOR FINISHES

- A. The contractor shall take extra care to avoid damage or soiling to any part of the facility. The contractor is responsible for all damages or destruction caused directly or indirectly by its performance to any part of the building or adjoining property. Any damage or destruction caused by the contractor or its employees shall be repaired as the Owner and DPMC Project Manager direct and to their satisfaction with all costs charged to the contractor. The costs may be deducted from any and all amounts due to the contractor.
- B. The contractor shall take all necessary steps to ensure adequate protection of all building furniture, equipment and building finishes, including but not limited to: floors, walls, windows, draperies, blinds, carpeting, doors, woodwork, etc. In this endeavor, all workers are to take precautions to protect rugs and floors. The contractor shall be charged for all remedial work to clean, repair and/or replace items damaged by the contractor to the satisfaction of the State.

- C. The contractor is responsible for the cost of cleanup of dust, dirt and stains caused by the work to the satisfaction of the Owner and the DPMC Project Manager. The contractor shall take all necessary precautions to keep dust, dirt and debris to a minimum within the construction area.

END OF SECTION

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Installation of the Work.
 - 3. Cutting and patching.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.

1.2 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location mechanical and electrical systems, and other construction affecting the Work.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements"

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting The State unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 5. Submit test/adjust/balance records.
 6. Submit changeover information related to The State's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise The State of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to The State. Advise The State's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct The State's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise The State of changeover in heat and other utilities.
 7. Participate with The State in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of

unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

- A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
 1. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 2. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 3. Submit pest-control final inspection report and warranty.
 4. Instruct The State's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings.
- B. Inspection: Submit a written request for final inspection to determine acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Submit list of incomplete items in the following format:
 - a. PDF electronic file. Architect will return annotated copy.

1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit The State's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 - 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - p. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 - 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
- C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.
- B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- C. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of The State.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.
- D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily

navigated file tree. Configure electronic manual to display bookmark panel on opening file.

G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of The State's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor is delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Normal shutdown instructions.

7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by The State's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.
- F. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

- B. Related Requirements:

1. See other Division 2 sections for requirements for identification and disposal of hazardous waste.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to The State.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to The State that may be uncovered during demolition remain the property of The State.

1. Carefully salvage in a manner to prevent damage and promptly return to The State.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property , for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure The State's on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of The State's continuing occupancy of portions of existing building and of The State's partial occupancy of completed Work.
- C. Inventory: Submit a list of items to be removed and salvaged and deliver to The State prior to start of demolition.
- D. Predemolition Photographs or Video: Submit before Work begins.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 FIELD CONDITIONS

- A. The State will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so The State's operations will not be disrupted.

- B. Conditions existing at time of inspection for bidding purpose will be maintained by The State as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
 - 3. The State will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by The State. The State does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
 - 2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
 - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
 - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. The State will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

- e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to The State.
- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and

- chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to the State.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain The State's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Disposal: Transport demolished materials off The State's property and legally dispose of them.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 024500 - REMOVAL, STOCKPILE AND DISPOSAL OF HISTORIC FILL MATERIAL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work shall include, but not be limited to, providing all labor, materials and equipment necessary to Stockpile and dispose of contaminated soil if discovered and as directed by the Engineer or the Engineer's representative.
- B. This section shall be used to address the Historic Fill Material (HFM) that may be impacted as part of the construction of the Mechanical Annex (Mechanical Building) and trenching required associated with this project. The State is aware that subsurface soils at the subject site contain HFM (soils contaminated with semi volatile organic compounds and metals) above residential standards. The State has a vehicle in place to address spoils associated with foundation and trenching work where the spoils are excavated and transported to a designated reception area of the Park (corner of Berma Road and McGovern Drive) indefinitely.
- C. The State has developed and implemented a Site Specific Health and Safety Plan (HSP) to address exposure to the HFM. This document is attached to these specifications as an Appendix. The contractor shall ensure compliance with this plan and develop his/her own HSP to comply with the OSHA standards. The contractors HSP shall be a required preconstruction submittal.

1.2 APPLICABLE CODES

- A. Services furnished shall be in accordance with the codes and standards listed below. In addition to these codes and standards, the Contractor shall comply with all applicable Federal, State and Local laws and regulations.
 - 1. OSHA - Occupational Safety and Health Act: 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response.
 - 2. New Jersey Department of Environmental Protection Waste Stream Requirements.

PART 2 - PRODUCTS

2.1 PLASTIC SHEETING

- A. Provide sheet polyethylene plastic with a minimum nominal thickness of 6 mils, to be utilized for the staging and covering of contaminated soils, as directed by the Engineer.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

- A. The Contractor's scope of work specified in this section shall be as follows; the sequence of steps shall be as follows unless otherwise directed by the Engineer:

1. If contaminated soil is encountered, the Contractor shall excavate, remove and stockpile the soil at the Owner's and Engineer's direction. The Engineer will provide the Contractor with a designated staging area for the soil or the material can be live loaded to the soil reception area of the park as noted in 1.1.B. of this Section. The contaminated soil will be placed on and covered with 6-mil sheet polyethylene plastic, to be supplied by the Contractor.
2. If there has been a discharge and the soil removal operations require de-watering, the Contractor shall de-water the excavation capturing the liquids for later disposal, at the Engineer's direction unless the Contractor feels there is an eminent threat to human health and or the environment, via Vac truck or the equivalent.
3. During all excavation activities, the contractor shall control dust emissions by ensuring no visible emissions. The contractor shall develop and implement a dust control plan as part of this work.
4. Transport and dispose of all stockpiled contaminated soil at the site, to the soil reception area of the park as noted in 1.1.B. of this Section. The Park Superintendent shall be informed each time a load of HFM is transported to the stockpile location and presented with a letter signed by the Contractor Superintendent that shall state the date of the transport, origin of the material and quantity transported. This letter shall be accompanied by a site plan depicting the soils origin.

3.2 QUALITY CONTROL/SUBMITTALS

The Engineer has been informed that materials to be excavated as part of this contract contain HFM and that the contractor shall provide the following preconstruction submittals prior to beginning any earth work.

1. A notarized statement that the contractor and all subcontractors have been provided with and have reviewed the Liberty State Park Health and Safety Plan Dated July 2012.
2. A site specific health and safety plan.
3. A soils management plan.
4. A dust control plan
5. List of employees scheduled to perform earth moving activities and proof of their training and medical surveillance.
6. An equipment decontamination plan.

3.3 EQUIPMENT DECONTAMINATION

- A. The Engineer will inspect all soil excavation and be responsible for tracking removal operations for the purposes of determining the total quantity of contaminated soil removed. The Engineer enforce equipment decontamination including but not limited to:
 1. Location of the decontamination area/pad
 2. The dimensions of the decontamination area
 3. Decontamination liquid control
 3. Decontamination waste material disposition

- B. Payment for the disposal of contaminated soil will be made as part of the contractor's lump sum fee. The contractor shall review and inspect the contract documents and understand the quantity of HFM and possible dewatering liquids to be impacted, excavated and transported as part of the contract under this section. There shall be no additional fees or unit prices associated with PPE, worker training, soils/liquids management, etc.

END OF SECTION 02450 - REMOVAL, STOCKPILE AND DISPOSAL OF CONTAMINATED SOIL

SECTION 02 60 00 – MISCELLANEOUS HAZARDOUS MATERIALS REMOVAL

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.
- B. Equality of material, article, assembly or system other than those named or described in this Section shall be determined in accordance with the provisions of the CONTRACT AND GENERAL CONDITIONS.

1.2 DESCRIPTION OF THE WORK

- A. Certain building/mechanical components in Terminal Building and adjacent Mechanical Annex located in Jersey City, New Jersey have been identified as requiring proper removal and disposal before any general demolition/renovation activities occur. This section specifies requirements for removing, handling, storing, transporting, and ultimate disposal of all light fixture ballasts, fluorescent lamps, lead building components, mercury containing thermostats/gauges, stored chemicals, chlorofluorocarbon (CFC's), machine/liberating oils, hydraulic oils transformer oils, glycol, conditioning chemicals, refrigeration lubricants, treated heating and cooling liquid, radiological waste, and smoke detectors. Some of these materials are found within mechanical equipment scheduled for demolition and others are self-contained.
- B. The above list of materials is not intended to be all-inclusive. The contractor is responsible to remove and dispose or recycle all materials impacted by the work as part of this project in accordance with all Federal, State and Local Waste Stream Requirements. The Contractor shall be required to carefully remove and properly recycle or dispose of these items in accordance with all applicable waste disposal requirements. Waste manifests associated with the final disposition of these materials shall be presented to Site Project Manager and the Owner prior to payment.
- C. The Contractor shall provide labor, materials, equipment and insurance to complete the work specified in this Section including, but not limited to, the removal and lawful disposal of hazardous materials, hazardous wastes, and special wastes. Work shall be performed in accordance with this specification, all referenced documents included as part of this specification, and with all Federal, State and local regulations. Wherever there is a conflict or overlap of requirements, the most stringent provisions will apply. Generally, the management of miscellaneous hazardous materials shall include, but not be limited to:
 - 1. Characterization (any testing that may be required by the off-site materials management facility), removal, and disposal of hazardous materials or potentially hazardous materials.

2. Characterization (any testing that may be required by the off-site materials management facility), removal, and disposal of contained gear oils, hydraulic oils and refrigeration liquids, glycol, conditioned heating and cooling liquids, etc. from various pieces of machinery and equipment, as part of the work.
3. Characterization (any testing that may be required by the off-site materials management facility), removal, and disposal of all containers, drums, and unknown materials generated as part of the work.
4. Characterization (any testing that may be required by the off-site materials management facility), removal, and disposal of loose paint chips and flaking and peeling paint from walls and floors throughout generated as part of the Contractors work.
5. File all necessary notices, obtain all permits and licenses, and pay all governmental taxes, fees, and other costs in connection with the work. Obtain all necessary approvals of all governmental departments having jurisdiction. The Contractor shall deliver a copy of all permits, approvals and notifications to the Site Project Manager at least 5 days before beginning the work.
6. Perform all sampling and testing required to properly profile the material for waste reuse, recycling or disposal. This shall also include all testing required by the recycling or disposal facility.
7. All costs for the testing shall be borne by the Contractor.
8. Comply with the Contractor's submitted Health and Safety Plan.

1.3 RELATED WORK

- A. Section 02 82 10 – HAZARDOUS MATERIAL ASBESTOS ABATEMENT – ROOFING.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. The list provided below is not intended to be all inclusive of each regulation prevailing over the work. The latest version of the document listed shall govern the work performed.

- A. Code of Federal Regulations (CFR)
 1. 29 CFR 1910, "Occupational Safety and Health Standards" (General Industry Standards)
 2. 29 CFR 1926, "Safety and Health Regulations for Construction" (Construction Industry Standards)
 3. 40 CFR 50, "National Primary and Secondary Ambient Air Quality Standards"

4. 40 CFR 60, "Standards of Performance for New Stationary Sources," Appendix B, "Test Methods"
 5. 40 CFR 117, "Determination of Reportable Quantities for Hazardous Substances"
 6. 40 CFR 122, "USEPA Administered Permit Program: The National Pollutant Discharge Elimination System"
 7. 40 CFR 172, "Hazardous Waste Transportation"
 8. 40 CFR 261, "Identification and Listing of Hazardous Waste"
 9. 40 CFR 262, "Standards Applicable to Generators of Hazardous Waste"
 10. 40 CFR 263, "Standards Applicable to Transporters of Hazardous Waste"
 11. 40 CFR 268, "Land Disposal Restrictions"
 12. 40 CFR 273, "Universal Waste Rule"
 13. 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan"
 14. 40 CFR 302, "Designation, Reportable Quantities, and Notification"
- B. Occupational Safety and Health Administration (OSHA) Booklet 3126 "Working with Lead in the Construction Industry"
- C. National Institute for Occupational Health and Safety (NIOSH)
1. NIOSH Method 7082, "Lead"
- D. American Society for Testing and Materials (ASTM)
1. ASTM D3335, "Test Method for Low Concentration for Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy"
- E. USEPA Publications
1. SW-846, "Test Methods for Evaluating Solid Waste – Physical/Chemical Methods"
 2. USEPA Method 3050, "Acid Digestion of Sediments, Sludges, and Soils"
- F. Steel Structures Painting Council (SSPC)

1. SSPC Guide 61 (CON) Guide for Containing Debris Generated During Paint Removal Operations
 2. SSPC Guide 71 (DIS) Guide for the Disposal of Lead Contaminated Surface Preparation Debris
- G. NJ Department of Environmental Protection
1. ENVIRONMENTAL REGULATION - SOLID AND HAZARDOUS WASTE MANAGEMENT PROGRAM; COMPLIANCE AND ENFORCEMENT - DIVISION OF COUNTY ENVIRONMENTAL AND WASTE ENFORCEMENT - Solid Waste Rules; Proposed Re-adoption without amendments: N.J.A.C. 7:26
- H. Other
1. 454 CMR 10-23, Division of Industrial Safety

1.5 DEFINITIONS

- A. Site Project Manager: A representative of the Property Owner (A/E) and/or a representative of USA Environmental Management, Inc.
- B. Engineer: Authorized representative of the Site Project Manager. Engineer shall be the Architect or Designer of Record for the project.
- C. CERCLA: Comprehensive Environmental Response, Compensation and Liability Act
- D. CFC: Chlorinated Fluorocarbons
- E. DOT: U.S. Department of Transportation
- F. HDPE: High Density Polyethylene
- G. HVAC: Heating, Ventilation, and Air-Conditioning
- H. NJ DEP: New Jersey Department of Environmental Protection
- I. OSHA: Occupational Safety and Health Administration
- J. PCB: Polychlorinated Biphenyls
- K. RCRA: Resource Control and Recovery Act
- L. RQ: Reportable Quantity
- M. TCLP: Toxicity Characteristic Leachate Procedure
- N. TSCA: Toxic Substance Control Act

- P. TSDf: Treatment, Storage, and Disposal Facility
- P. USEPA: United States Environmental Protection Agency

1.6 QUALITY ASSURANCE

- A. Examination of Existing Conditions: The Contractor shall examine the Contract Drawings, Contract Specifications and the equipment and materials to either be demolished or disposed of as part of this contract for hazardous waste identification, handling, removal, and disposal requirements and provisions for new work. There shall be no additional fees paid to the contractor for his/her failure to account for the provisions of this Section.
- B. Hazardous Waste Removal and Transportation Firm Qualifications: An experienced firm that has specialized in hazardous waste work similar in material and extent to that indicated for this Project. The Contractor shall provide for the proper transportation and disposition of all materials generated as part of the work. Transport and Disposal Facilities shall be permitted in accordance with NJ DEP requirements.
- C. Refrigerant Recovery Technician Qualifications: Certified by an USEPA-approved certification program. The Contractor shall provide for the proper transportation and disposition of all materials generated as part of the work. Transport and Disposal Facilities shall be permitted in accordance with NJ DEP requirements.
- D. Regulatory Requirements: Comply with governing USEPA and NJ DEP notification regulations before beginning removal of any hazardous waste materials. Comply with hauling and disposal regulations of authorities having jurisdiction. The Contractor shall provide for the proper transportation and disposition of all materials generated as part of the work. Transport and Disposal Facilities shall be permitted in accordance with NJ DEP requirements.

1.7 SCHEDULING AND SEQUENCING

- A. The Contractor and the Engineer shall develop a hazardous materials removal schedule at the Pre-Construction Conference. The Engineer may choose to alter the work sequence as they see fit.
- B. The Contractor shall update the schedule and submit any schedule changes for review by the Engineer at the weekly construction meetings.

1.8 PERMITTING

- A. The use and disposal of hazardous materials (broken fluorescent lamps, leaking or damaged batteries, mercury thermostats, and PCB ballasts) is highly regulated and compliance with all requirements set forth by authorities having jurisdiction is an essential condition of the Work. The Contractor shall be fully aware of all such requirements and ensure that all regulatory conditions are met, including those required of any Sub-contractors.

- B. The Contractor is responsible for ensuring that all personnel performing work under this section shall be properly trained in accordance with all Federal, state and local regulations. The Contractor is required to provide proof of training and licensing of any and all employees completing the work of this section at least 5 days prior to the start of Work.

1.9 LOCATION OF WORK

- A. Certain building/mechanical components in Terminal Building and adjacent Mechanical Annex located in Jersey City, New Jersey have been identified as requiring proper removal and disposal before any general demolition/renovation activities occur. This section specifies requirements for removing, handling, storing, transporting, and ultimate disposal of all hazardous materials that may be discovered as part of this undertaking including but not limited to light fixture ballasts, fluorescent lamps, lead building components, mercury containing thermostats/gauges, stored chemicals, chlorofluorocarbon (CFC's), machine/liberating oils, glycol, conditioned heating and cooling liquids, radiological devices, hydraulic oils, transformer oils, conditioning chemicals, refrigeration lubricants, and smoke detectors. Some of these materials are found within mechanical equipment scheduled for demolition and others are self-contained.
- B. The above list of materials is not intended to be all-inclusive. The contractor is responsible to remove and dispose or recycle all materials impacted by the work as part of this project in accordance with all Federal, State and Local Waste Stream Requirements. The Contractor shall be required to carefully remove and properly recycle or dispose of these items in accordance with all applicable waste disposal requirements. Waste manifests associated with the final disposition of these materials shall be presented to Site Project Manager and the Owner prior payment. The materials list is provided for general guidance and may not correspond exactly to the materials to be removed. The Contractor is responsible to investigate all items for the presence of all hazardous materials. The Contractor shall determine quantities of hazardous materials for bidding purposes.
- C. Handling, containerizing, packaging, re-handling, hauling and disposal of all items identified above are to be included in the lump sum bid item of the Contract.

1.10 SUBMITTALS

- A. The Contractor shall submit each item in this Article according to the Conditions of the Contract and Section 01 33 00 – SUBMITTALS, for information only, unless otherwise indicated.
- B. The Contractor shall submit a Waste Management Plan. Submit a job-specific plan within 20 calendar days after award of contract of the work procedures to be used in the removal, packaging, and storage of materials anticipated to be generated as part of the work. Include in the plan: Requirements for Personal Protective Equipment (PPE), spill cleanup procedures and equipment, eating, smoking and restroom procedures. The plan shall be approved and signed by a Certified Industrial Hygienist. Obtain approval of the plan by the Site Project Manager prior to the start of work under this section

- C. The Contractor shall provide copies of all worker certifications associated with OSHA 40-Hour Hazardous Waste Site Health and Safety Training in accordance with 29 CFR 1910.120.
- D. Submit a Waste Disposal Plan with 20 calendar days after award of contract. The Waste Disposal Plan shall comply with applicable requirements of Federal, State, and local waste regulations and address a. wastes to be generated, disposed of, and recycled. b. Names and qualifications of each Contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location. Furnish two copies of EPA and state waste permit applications and EPA identification numbers, as required c. Names and qualifications (experience and training) of personnel who will be working on-site with wastes. d. Spill prevention, containment, and cleanup contingency measures to be implemented. e. Work plan and schedule for waste removal, containment, storage, transportation, disposal and or recycling. Wastes shall be cleaned up and containerize daily.
- E. After completion of the hazardous materials removal, the Contractor shall provide a final report documenting removal, transportation and recycling, treatment, disposal, or incineration activities. The document shall include copies of manifests, shipping slips, permits, and licenses for this Project.

PART 2 – PRODUCTS

2.1 PROTECTIVE EQUIPMENT

- A. Provide health and safety equipment required to protect workers and to comply with the Health and Safety Plan and OSHA requirements.

2.2 DISPOSAL BAGS

- A. Disposal Bags: Provide 6 mil (0.15 mm) thick leak-tight polyethylene bags.

2.3 DRUMS

- A. DOT Hazardous Waste Disposal Drums: Provide DOT 17-H Open -Top Drums (55 gallon) in accordance with DOT regulations title 49 CFR Parts 173, 178, and 179.

2.4 LABELS

- A. DOT Hazardous Waste Labels: in accordance with DOT regulations, Title 49 CFR parts 173, 178, and 179.
- B. Universal Waste Labeling. USEPA 40 CFR 273.14

PART 3 – EXECUTION

3.1 GENERAL WORK AREA SET UP

- A. Signage: Prior to the preparation for work that will disturb hazardous materials; the Contractor shall place warning signs immediately outside all entrances and exits to the area.
- B. Access to Work Areas: The Contractor shall allow only authorized personnel into the work area. Barrier tape shall be used to limit access to the exterior work area.

3.2 GENERAL HAZARDOUS MATERIALS/HAZARDOUS WASTE MANAGEMENT

- A. Do not mix potentially hazardous waste streams. Where feasible, separate each type of hazardous waste from other types of hazardous wastes, from asbestos waste and from construction debris.
- B. Segregate, package, label, transport and dispose of Hazardous Materials/Hazardous Waste in accordance with DOT, USEPA, State and local regulations.
- C. The Engineer shall identify materials considered to be a listed or characteristic hazardous waste prior to initiating this project. A schedule of materials that must be managed as hazardous waste is attached as an Appendix to this specification.
- D. The following wastes are designated as Hazardous Wastes and are non-salvageable. This is not a comprehensive listing of hazardous wastes and the Contractor is directed to the NEW JERSEY ENVIRONMENTAL REGULATION - SOLID AND HAZARDOUS WASTE MANAGEMENT PROGRAM; COMPLIANCE AND ENFORCEMENT - DIVISION OF COUNTY ENVIRONMENTAL AND WASTE ENFORCEMENT - Solid Waste Rules; Proposed Re-adoption without amendments: N.J.A.C. 7:26.
 - 1. Waste Type A: PCB waste to include PCB-containing ballasts from fluorescent light fixtures.
 - 2. Waste Type B: lead base paint debris to include containers of paint, paint chips/debris and lead building components (drains).
 - 3. Waste Type C: HVAC and refrigerator refrigerant, glycol, conditioned liquids, etc..
- E. In the event of an apparent conflict between the requirements of these specifications and the requirements of the NEW JERSEY ENVIRONMENTAL REGULATION - SOLID AND HAZARDOUS WASTE MANAGEMENT PROGRAM: COMPLIANCE AND ENFORCEMENT - DIVISION OF COUNTY ENVIRONMENTAL AND WASTE ENFORCEMENT - Solid Waste Rules; Proposed Re-adoption without amendments: N.J.A.C. 7:26, the Contractor shall bring the apparent conflict to the attention of the Site Project Manager for resolution. The Contractor shall not seek to review the apparent conflict with other parties prior to resolution with the Site Project Manager.

3.3 HAZARDOUS MATERIALS/HAZARDOUS WASTE PACKAGING AND LABELING

- A. Package each segregated Hazardous Waste Type A, B, and C, in separate specified containers as follows. IMPORTANT: Do Not Mix Waste Streams
 - 1. Waste Type A to be packaged in DOT 17-H open-top drums. Fill to capacity only with Waste Type A. Install gasket on lid, apply lock ring, and seal. Apply Hazardous Waste Label to drum side. Enter DOT Shipping Data as follows: RQ Waste Polychlorinated Biphenyls, 9, UN-2315, PG-II, (M001). Adjacent to each label, enter the date indicating when waste was first placed in each drum.
 - 2. Waste Type B to be packaged in DOT 17-H Open-Top Drums. Fill to capacity only with Waste Type B. Install gasket on lid, apply lock ring, and seal. Apply Hazardous Waste Label to drum side. Enter DOT Shipping Data as follows: RQ Hazardous Waste Solid, NOS, 9, NA3 077, PG-III, (~D009). Adjacent to each label, enter the date indicating when waste was first placed in each drum.
 - 3. Waste Type C to be packaged in DOT 17-H open-top drums. Fill to capacity only with Waste Type C. Install gasket on lid, apply lock ring, and seal. Apply Hazardous Waste Label to drum side. Enter DOT Shipping Data as follows: RQ Hazardous Waste Solid, NOS, 9, NA3077, PG-III, (D009). Adjacent to each label, enter the date indicating when waste was first placed in each drum.
- B. Maintain all containers in a continuously sealed condition after they have been filled. Do not reopen sealed containers or place additional waste in previously sealed containers. Storage of containers must be in a secure location.

3.4 HANDLING AND DISPOSAL OF BATTERIES, LEAD COMPONENTS, FLUORESCENT LAMPS & MERCURY THERMOSTATS

- A. The Contractor is responsible for removing all fluorescent lamps from fixtures, intact, prior to demolition. Fluorescent lamps shall be recycled and managed in accordance with the Universal Waste Management Standards (310 CMR 30.1034). If fluorescent lamps become broken or damaged during removal and/or handling, broken lamps shall be managed as hazardous waste as specified below.
- B. The Contractor is responsible for recycling and managing intact, non-leaking batteries (lead-acid, nickel cadmium, and lithium) in accordance with the Universal Waste Management Standards (310 CMR 30.1034). If batteries are, or become damaged or are leaking during removal and/or handling, such batteries shall be managed as hazardous waste as specified below.
- C. The Contractor shall manage intact fluorescent lamps and intact batteries in the following manner:
 - 1. Do not break or crush spent lamps or batteries or damage them in any way.
 - 2. Store intact lamps and batteries in a secure area(s) protected from physical damage. Storage area(s) should be identified within an easily read sign stating “Universal Waste Area - Spent Fluorescent Lamps” or “Universal Waste Area – Batteries” as appropriate.

3. Store lamps and batteries in packaging or containers that are designed to minimize breakage/damage during both storage and shipping. Label containers as “Universal Waste – Spent Fluorescent Lamps” or “Universal Waste – Batteries” as appropriate and mark each container with the date on which you first began storing the waste.
 4. Use a Bill of Lading that contains the following information when shipping to the recycler: name and address of generator, transporter, and recycler; number of lamps shipped; date of shipment and date of receipt by recycler; and, dated signature of recycler. Deliver a copy of the Bill of Lading to the Site Project Manager within 5 days of shipment of the materials.
- D. Broken fluorescent lamps shall be placed in sealed, vapor-tight containers/drums that are compatible with the waste being stored for disposal as mercury-containing hazardous waste. The waste shall be classified as RCRA characteristic hazardous waste and shall be labeled and stored in accordance with all applicable regulations.
- E. Leaking or damaged batteries shall be placed in appropriate non-metal containers/drums that are compatible with the waste being stored for disposal as hazardous waste and shall be labeled and stored in accordance with all applicable regulations.
- F. Mercury thermostats shall be placed in sealed, vapor-tight drums (55-gallons or less) for disposal as mercury-containing hazardous waste and shall be classified as RCRA characteristic hazardous waste (note, thermostats can be co-mingled with broken fluorescent lamps as appropriate).
- G. Lead Components (sink traps) shall be placed in a sealed drums (55-gallons or less) for disposal and/or recycling in accordance with Federal, State and local waste stream requirements.
- H. The Contractor shall deliver to the Site Project Manager information relating to the transportation and recycling or disposal of batteries, lead components, fluorescent lamps, and mercury thermostats before the start of the Work. This information shall include:
1. Name and address of fluorescent lamp recycler or dismantler that will accept fluorescent lamps, intact;
 2. Name and address of the battery recycler that will accept batteries, intact;
 3. Name and address of the RCRA TSDf that will accept leaking batteries, broken fluorescent lamps and mercury thermostats as hazardous waste;
 4. Copies of all authorization letters, licenses, and permits to operate for the facilities, to confirm that they are permitted to accept the batteries and fluorescent lamps; and,
 5. Name and address of hazardous waste transporter that will transport leaking batteries and/or broken fluorescent lamps to RCRA TSDf including USEPA

Identification Number and proof of permit, license, or authorization to transport hazardous waste in all affected areas.

3.5 HANDLING AND DISPOSAL OF BALLASTS

- A. Prior to removal of any ballasts, the Contractor shall uncover and inspect the label on the ballast. All ballasts designated as 'No PCBs' shall be marked with green paint; all other ballasts shall be assumed to contain PCBs and shall be marked with red paint. Similar color-coding shall be used for the receiving drums.
- B. Removal shall be performed using approved methods and tools that will minimize damage to the fluorescent lamp and ensure a quick, neat removal with the ballast intact and undamaged.
- C. Once removed, the ballasts shall be placed in a corresponding color-coded 55-gallon drum.
- D. Once filled, the 55-gallon drums shall be closed and properly labeled for temporary storage, transport, and disposal in accordance with all applicable regulations.
- E. The Contractor shall submit to the Site Project Manager written confirmation from the disposal facility stating which type of ballasts the facility will accept. The letter shall also state that the facility agrees to submit to the Contractor, by fax, within 48 hours of receipt of material, signed manifests and/or Bills of Lading.
- F. Drums containing PCB ballasts that are marked red, and other PCB contaminated materials shall be incinerated at a TSCA/RCRA and approved utilized incineration facility in accordance with Federal, State and local waste stream requirements. Contractor shall submit documentation verifying removal, transportation, and disposal at the approved facilities.
- G. Drums containing "no PCB" fluids, ballasts and capacities that are marked green shall be disposed of at a legally permitted disposal facility. Contractor shall submit documentation verifying removal, transportation, and disposal at the approved disposal facility.
- H. Upon completion of the destruction of PCB ballasts, the Contractor shall deliver to the Project Manager:
 - 1. Written certification from the incineration facility that the items were delivered to, accepted, and destroyed by the facility. Certificate shall be signed by the person authorized by the facility to accept PCB items for disposal.
 - 2. Copies of all manifests.
 - 3. Certificates of Destruction of Materials.

3.6 HAZARDOUS MATERIALS/CONTAINERIZED WASTE

- A. All hazardous materials shall be characterized and disposed of in accordance with applicable federal, state, and local regulations. Hazardous waste manifests shall be completed for all off-site waste management.
- B. Workers who handle hazardous materials shall be licensed and trained in safe and proper hazardous materials handling procedures. At a minimum, this shall include OSHA 40-Hour Hazardous Waste Site Health and Safety Training in accordance with 29 CFR 1910.120.
- C. Any hazardous materials containers in poor condition shall be removed as soon as possible.
- D. Handling Hazardous Waste
 - 1. The Contractor shall place waste in DOT approved containers and label the containers for transport to a licensed disposal site.
 - 2. The Contractor shall use an authorized hazardous waste transporter to haul waste to an approved hazardous waste facility.
 - 3. The Contractor is responsible to prepare, maintain and track all record keeping, chain-of-custody and reporting requirements including a copy of the hazardous waste manifest.
 - 4. The Contractor shall accurately measure and weigh the volume of each container or load of waste removed from the site. Submit records of waste volumes to the Site Project Manager and the Engineer.
 - 5. The Contractor shall not place paint debris on the unprotected ground and paint debris shall be shielded to prevent dispersion of the debris by wind or precipitation.
 - 6. The Contractor shall provide legal transportation of the waste to the recycling, disposal, treatment, or incineration facility, and complete or obtain all required licenses, manifests, receiving facility waste profiles, or other forms. Copies of all forms or licenses, and the signed original of the Waste Manifest for each waste load, shall be given to the Engineer and Site Project Manager.
- E. The Contractors Project Manager shall provide appropriate notifications to regulatory agencies if there is a release to the environment exceeding the CERCLA/NJ DEP reporting requirements (e.g. lead - 1 pound).
- F. Any evidence of improper storage shall be cause for immediate shutdown of the project until corrective action is taken.

3.7 LEAD-BASED PAINT

- A. Lead-based paint may be present on many surfaces throughout the building. The Contractor shall assume that all painted surfaces contain lead-based paint. Any of the

Contractor activities that may generate leaded dust or impact a leaded surface shall be responsible for regulating his/her work area so that dust migration is contained properly within the regulated area. Once the work is complete, the Contractor shall be responsible for the proper clean up and disposal of leaded dust and materials.

- B. All lead based paint work must be reflected in the lump sum bid of this contract and be performed in accordance with the USEPA/OSHA lead in construction standard.
- C. In areas where lead based paint is co-mingled with ceiling and wall plaster materials, Contractor shall characterize and dispose of co-mingled materials in accordance with applicable waste stream requirements or as hazardous waste.
- D. The Contractor shall make every effort to segregate lead-based paint and asbestos debris. In areas where lead based paint is co-mingled with asbestos debris, the Contractor shall remove paint chips from asbestos debris to the extent feasible, and dispose the material as asbestos waste. Paint chips shall be tested and disposed as a solid or hazardous waste, dependent upon the test results. The Contractor shall provide the Site Project Manager with any and all waste classification and analytical test results.
- E. All painted or coated building components shall be disposed of off site, including brick and concrete as solid waste debris, unless determined to be a hazardous waste as described below.
- F. All visible paint and painted debris shall be removed from the ground within and surrounding the work site prior to building demolition. All material shall be properly disposed of off-site.
- G. Lead-containing material, including painted or coated building debris (i.e. windows, doors, sashes, etc.) that exceeds the TCLP criteria shall be disposed in accordance with applicable NEW JERSEY ENVIRONMENTAL REGULATION - SOLID AND HAZARDOUS WASTE MANAGEMENT PROGRAM; COMPLIANCE AND ENFORCEMENT - DIVISION OF COUNTY ENVIRONMENTAL AND WASTE ENFORCEMENT - Solid Waste Rules; Proposed Re-adoption without amendments: N.J.A.C. 7:26. The off-site management of lead-containing material shall be at a NJ DEP-approved facility.

3.8 MACHINERY FLUIDS AND POWER PLANT SYSTEMS FLUIDS

- A. Drain all equipment containing hydraulic fluids, lubricating oils, glycol, conditioned liquids, fuel oil, antifreeze, and all other types of fluids. Decontaminate all systems, including piping, by means of steam cleaning or triple rinsing, or both, with a compatible fluid to remove all visible contamination.
- B. Collect and drum all fluids, including decontamination fluids drained from the above described equipment.
- C. Label drums for transport and disposal.

- D. After removal of all hazardous components, dispose of remaining equipment carcasses and piping in accordance with applicable regulations. The Contractor shall submit documentation verifying removal, transportation, and disposal at the approved disposal facility.
- E. The Client shall not pay for disposal until complete documentation of the proper recycling, reclamation, treatment or disposal is received by the Site Project Manager.

3.9 WHITE GOODS AND OTHER ITEMS

- A. Remove and properly dispose of all environmentally hazardous items and systems components installed in white good item before proper disposal of the unit. This work includes, but is not limited to:
 - 1. Water coolers.
 - 2. Air conditioners.
 - 3. Refrigerators.
- B. White good items which do not contain environmentally hazardous materials, and white good item carcasses from which the Contractor has removed environmentally hazardous materials prior to removal from the building, shall be removed, transported and disposed of at an approved facility.
- C. The Client shall not pay for disposal until complete documentation of the proper recycling, reclamation, treatment or disposal is received by the Site Project Manager.

3.10 REMOVAL OF TRANSFORMERS

- A. All transformers shall be handled with appropriate personal protective equipment. Unless otherwise noted, the Contractor, shall assume that all unmarked transformers contain oil with >50 ppm PCBs.
- B. Prepare each transformer to be electrically disconnected in compliance with the National Electrical Safety Code, the National Electric Code, and OSHA regulations.
- C. Transformers labeled “dry-type” shall be handled and disposed of as white goods, in compliance with the NEW JERSEY ENVIRONMENTAL REGULATION - SOLID AND HAZARDOUS WASTE MANAGEMENT PROGRAM; COMPLIANCE AND ENFORCEMENT - DIVISION OF COUNTY ENVIRONMENTAL AND WASTE ENFORCEMENT - Solid Waste Rules; Proposed Re-adoption without amendments: N.J.A.C. 7:26.
- D. Transformers identified as not containing PCBs or labeled “No PCBs” shall be drained, if necessary, and shall be marked with green paint. The fluid shall be placed in properly sealed drums and painted green, and shall be sampled and analyzed by the Contractor, as required, for transportation and disposal purposes.

- E. Each transformer not positively identified as containing “No PCBs” shall be sampled and tested in place to determine the concentration of PCBs prior to any removal activities, as required for transportation and disposal/incineration purposes.
- F. Before sampling and testing transformers, the Contractor shall take the following preparatory and precautionary measures. These measures shall remain in effect for the duration of the transformer sampling and removal process.
 - 1. Cover and seal all drains, manholes, and other openings that may lead to waterways in such a manner to prevent any migration of the contaminants.
 - 2. Provide temporary containment designed to contain the entire contents of the fluid to be removed. This containment shall encompass the transformer and any areas designated for temporary storage. In addition, absorbents in the amounts adequate to absorb a spill from one complete equipment failure shall be placed within the containment area.
 - 3. Provide adequate spill cleanup equipment within the containment area.
- G. The laboratory proposed by the Contractor shall be certified for such analyses by the NJ DEP and the NJ School Development Authority, and shall be capable of demonstrating skill and experience in similar projects. The laboratory shall forward copies of all reports and technical correspondence directly to the Site Project Manager and Engineer. All reports shall completely and positively identify each transformer sampled.
- H. Following the disconnection of the electrical power source, pump PCB fluids in place from the equipment into specified containers before moving to minimize the accidental release of fluids. The PCB-filled type of electrical equipment is not intended for use as transport vessels and, therefore, must be drained of fluids before removal and transport. Following draining and drumming of fluids, transformers shall be move from the existing location to the loading area where they will be loaded onto a truck and transported to the disposal facilities. Each drum shall be properly labeled and sealed.
- I. Any transformers identified shall be marked with paint as follows:
 - 1. Green: No PCBs.
 - 2. Red: Containing PCBs.
- J. Transformers shall then be ready to be moved and transported to the applicable disposal facility.
- K. Unless otherwise indicated on the plans, all transformers shall be removed and disposed of by the Contractor in accordance with the applicable laws and regulations. The Contractor shall assume that all transformers identified contain oil with concentrations of PCBs greater than 50 ppm, unless otherwise noted.

3.11 FIRE EXTINGUISHERS

- A. Fire extinguishers may contain corrosive agents (monoammonium phosphate, ammonium phosphate) and may be reactive in water.
- B. De-pressurize prior to disposal.
- C. Fire extinguishers and their contents shall be landfilled in accordance with Federal, State and local waste stream requirements. Do not discharge to the ground or to surface water. Do not cross contaminant with other fire extinguisher agents.
- D. Submit proof of disposal to the Site Project Manager and Engineer.

3.12 TEMPORARY STORAGE

- A. Partially filled containers of hazardous waste may be stored at the work site for intermittent packaging provided that:
 - 1. Each container is properly labeled when it is first placed in service;
 - 2. Each container remains closed at all times except when compatible waste types are added; and
 - 3. When moved from site to site, each container remains within the geographic boundaries of the facility without moving or crossing public access highways.
- B. All items classes of waste identified as part of this section, once removed, shall be stored on-site in accordance with all applicable regulations for no more than 30 Days. At the conclusion of each day's work, drums containing hazardous waste (broken fluorescent lamps, leaking or damaged batteries, mercury thermostats, and PCB ballasts) shall be securely stored in regulatory-compliant locations (i.e., properly marked/signed, proper secondary containment, etc.) under lock and key.
- C. Hazardous waste shall be stored and loaded from secure areas that are impervious and contained. At a minimum, the area shall be lined with 6-mil HDPE overlaid with absorbent paper.

3.13 TRANSPORTATION OF HAZARDOUS WASTES

- A. The Contractor shall continuously maintain custody of all hazardous waste materials generated at the work site. Provide security, short-term storage, transportation and disposition until custody is transferred to an approved properly permitted treatment, storage, disposal or site or recycling center. Document continuous chain-of custody of all wastes generated.
- B. Do not remove, or cause to be removed, hazardous waste from Client's property without a legally executed Uniform Hazardous Waste manifest.
- C. All haulers shall be properly licensed to transport hazardous waste (broken fluorescent lamps, leaking or damaged batteries, mercury thermostats, and PCB ballasts) in New Jersey and all other states traversed in transporting the ballasts to approved disposal

sites. Haulers shall be under the direct control of the Contractor at all times. Any spills during transport shall remain the responsibility of the Contractor. Any damage of costs incurred as a result of a spill and the required cleanup process shall be borne by the Contractor.

1. Vehicles used for the transportation of PCB items and asbestos shall be plainly marked as required by DOT and state regulations.
 2. All drums and equipment carcasses shall be secured to the transport vehicle to prevent movement during transport.
- D. The Contractor shall be responsible for preparing all manifests and other required shipping documents and for acquiring the necessary signatures for transport. At completion of hauling and disposal of each load submit copy of waste manifest, chain of custody form, and landfill/incineration receipt to the Project Manager and Engineer.

3.14 DISPOSAL OF HAZARDOUS WASTE

- A. The Contractor is responsible for completing all disposal documents, which may include, but are not limited to, waste profiles, hazardous waste manifests and land ban restriction forms. The Owner shall be designated as the Generator on all documents and shall sign the documents as such. Note that the Owner may or may not possess USEPA ID numbers; the Contractor shall complete and apply for Generator ID Numbers or the appropriate USEPA # and Generator Status as may be required for this undertaking. Copies of all disposal documents shall be delivered to the Site Project Manager for review at least 5 days prior to shipment. Coordination for the Site Project Manager/Generator's signature on hazardous waste disposal documents shall be made through the Site Project Manager.
- B. For hazardous waste which is shipped off-site using a hazardous waste manifest, the Contractor shall provide the bottom three copies of the manifest to the Site Project Manager at the time of shipment for distribution to the appropriate agencies.

3.15 DISCOVERY OF HAZARDOUS MATERIALS

- A. If hazardous materials, such as chemicals, or other hazardous materials are discovered during the course of the work other than those identified in the Plans and Specifications, the Contractor shall cease work in affected area only and immediately notify the Engineer and Site Project Manager of such discovery. Do not proceed with work in such areas until instructions are issued by the Engineer. Continue work in other areas.
- B. If unmarked containers are discovered during the course of the work other than those identified in the plans and Specifications cease work in the affected area only and immediately notify the Engineer and the Site Project Manager of such discovery. The Contractor shall not proceed with work in such areas until instructions are issued by the Engineer. Take immediate precautions to prohibit endangering the containers integrity. Work can continue in other areas.

END OF SECTION 02 60 00

SECTION 02 82 10 – HAZARDOUS MATERIAL ASBESTOS ABATEMENT – ROOFING

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A Work consists of the removal of exterior asbestos-containing roof field, roof flashing and associated residue. In addition, work consists of the removal of interior counter flashing and associated residue. Locations of confirmed asbestos-containing materials (ACM) are indicated on the Contract Drawings. All asbestos-containing materials shall be removed according to this specification.
- B The exterior scope of removal shall include all ACM, residue and persistent materials to accommodate installation of the new roofing system. The interior scope of removal shall render the substrates impacted with ACM, free of all counter flashing and associated residue. If present, all residues shall be removed from any porous substrate material (concrete, stone, etc.), via methods utilized to maintain the non-friable nature of the asphaltic materials (i.e. grinding shall not be allowed). Flashing/tar residue on metal surfaces shall be removed by dissolution of the residue, or disposal of the substrate element as asbestos-containing waste if that element were to be removed as part of the roof renovations. Residue and stained substrate elements may be left in place only where they will not interfere with the installation of the new roofing system.
- C The Contractor shall be responsible for all cleaning and asbestos decontamination required to complete the specified abatement as well as any cleaning and asbestos decontamination that may be required due to the abatement activities.
- D Contractor shall remove:
- Exterior:
1. All field, flashing and residue from East & West Side Concourse Roofs (Roof 1),
 2. All flashing and residue from 2nd Floor North Raised Roof (Roof 2),
 3. All flashing and residue from North Roof Former Skylight Cap(s) (Roof 3), and
 4. All field, flashing and residue from Mechanical Shed Roof (Roof 4).
- Interior:
1. All counter flashing and associated residue from Mechanical Room (105), Storage Room (106) and Storage Room (106A)
- E No attempt has been made to quantify the exact amount of ACM in the above mentioned locations. The Contractor is expected to have acquainted itself with the building involved, and to have investigated the location and amount of all identified materials. Information regarding quantification anywhere in the Contract Documents shall not in any way be construed or applied so as to limit the Contractor's obligation to remove and dispose of, or otherwise treat as specified, all ACM so identified, nor to form the basis of any change of the Contract Sum or Time. See Drawing HA.1 and HA.2 for the locations of materials to be abated as part of this section.

- F The Contractor shall be responsible for overall coordination of the Asbestos Abatement Work with the general demolition work.
- G The Contractor shall complete the Asbestos Abatement Work according to a schedule to accommodate the demolition schedule, removing ACM to accommodate daily activities.

1.2 DEFINITIONS

- A. The Asbestos Abatement Work shall be defined as that work which encompasses the specified removal of asbestos-containing materials, all preparatory and cleaning activities associated with or otherwise motivated by the removal activities, and the handling, transportation and disposal of asbestos-containing and asbestos-contaminated materials. The term "work" may be utilized herein, and throughout Section 02 82 13 to refer to Asbestos Abatement Work.

1.3 OWNER'S RIGHT TO CARRY OUT ASBESTOS ABATEMENT WORK

- A. If the Contractor and/or Sub-Contractor neglects to carry out the activities related to the Asbestos Abatement Work, which would cause endangerment to public health, the Owner may, with 24 hour notice to the Contractor act to correct such deficiencies.
- B. In the above cases an appropriate Change Order or Construction Change Directive shall be issued deducting from payments then or thereafter due to the Contractor the cost of correcting such deficiencies, including compensation for the Architect's/Asbestos Abatement Consultant's additional services and expenses made necessary by such default, neglect, or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

1.4 DOCUMENTATION

- A. Whether or not specifically required by Code, the Contractor shall submit notification in accordance with the following:
 - 1. A generator of asbestos or asbestos-containing waste shall submit a written notification of intent, in accordance with (2) and (3) below to dispose of such wastes at least 10 days prior to disposal.
 - 2. The written notification required by (1) above shall include:
 - a. Name, address, and telephone number of the generator.
 - b. Quantity and nature of waste to be disposed.
 - c. Name, address, New Jersey Department of Environmental Protection registration number of the transporter.
 - d. Name and address of the sanitary landfill at which disposal will occur.
 - e. Date and time of disposal.
 - f. A copy of any written notification required by 40 CFR 61.145 to 61.155.
 - 3. The written notification required by (1) above shall be submitted to:
New Jersey Department of Environmental Protection and Energy
Division of Solid Waste Management
Enforcement Element
840 Bear Tavern Road, P.O. Box 414 Trenton, NJ 08625

4. The Department may allow less than 10 days prior notification, where emergency circumstances require.
- B. Construction Permit
1. The Contractor shall be responsible for obtaining a construction permit in accordance with N.J.A.C. 5:23-2.
- C. Regulatory Compliance
1. The Contractor shall furnish documentation to the building Owner or his designated representative that the firm and its employees are familiar with the following regulations of the United States Department of Labor, Occupational Safety and Health Administration (OSHA) and the United States Environmental Protection Agency (EPA) relating to the application, removal, disposal, and treatment of asbestos:
 - a. OSHA regulations, namely: 29 CFR 1910.1001, 29 CFR 1926.58 and 29 CFR 191.134, Respiratory Protection and 29 CFR 1910.20, Access to Employee Exposure and Medical Records.
 - b. EPA regulations, namely: Subparts A and M of 40 CFR Part 61, National Emissions Standards for Hazardous Air Pollutants.
 2. One copy of each of the regulations cited in Article 1.4.C.1 shall be available in the Contractor's business office and one copy of each shall be maintained in view at the job site, available to both the public and the Contractor's employees.
 3. The Contractor shall display at the job site, copies of documents required in Articles 1.4.A and 1.4.B.
 4. The Contractor shall be responsible for controlling access at the work site and shall maintain a daily log of personnel conducting asbestos removal activities. A list of worker names shall be posted with their start and stop times for each day. Copies of the daily log shall be given to the Project Monitor at the end of the project.
 5. The Contractor shall strictly adhere to all precautions necessary for the safety and health of workers in accordance with provisions of OSHA Standards 29 CFR Part 1926, Construction Standards, and 29 CFR 1910, General Industry Standards. The applicable parts of NIOSH Health Hazard Evaluation Report Number HETA 84-321-1590 shall be adhered to.
- D. Preconstruction Submittals
1. The Contractor is required to submit the following documentation prior to starting the asbestos removal project:
 - a. A written copy of the letter of notification required in Article 1.4.A. and the construction permit, if applicable.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REMOVAL OF ASBESTOS-CONTAINING ROOFING MATERIALS

- A. Pursuant to specific exclusion made by the New Jersey Administrative Code promulgated pursuant to the New Jersey Asbestos Control and Licensing Act, the removal of asbestos-containing roofing materials specified may be completed by a competent party other than a licensed asbestos abatement contractor (see N.J.A.C. 12:120-1.4(b) (5) and N.J.A.C. 8:60-1.5 (b) (5)). Therefore, the Contractor, if a roofing contractor, or other competent party may complete the roofing material removal.
- B. Roofing material removal shall be completed pursuant to N.J.A.C. 5:23-8.20 (c) and applicable OSHA Construction Standards.
- C. The Owner reserves the right to conduct monitoring of the roofing material removal activities, holding the Subcontractor and Contractor responsible for cleaning activities resulting from improper handling of debris and waste and/or the receipt of unacceptable air sampling results, in accordance with the contingency plan criteria promulgated by the New Jersey Asbestos Hazard Abatement Subcode (N.J.A.C. 5:23-8) for an “asbestos hazard abatement project”. The Owner’s sampling may include progress sampling and/or clearance air sampling both inside the building and outside of the building at the work site perimeter.
- D. The Contractor shall be responsible for controlling access into the secured area to properly trained and protected personnel only.
- E. The asbestos-containing materials shall be removed by two person teams. The first worker shall continually mist the material with amended water; the second shall remove the materials from their existing substrate.

3.2 DISPOSAL OF ASBESTOS-CONTAINING ROOFING MATERIALS

- A. All asbestos waste materials shall be subject to approval of the registered landfill, placed in a waste container lined with two (2) layers of six (6) mil polyethylene sheeting. If the waste container is not enclosed prior to transportation, the top of the waste container shall be sealed with two (2) layers of six (6) mil polyethylene sheeting.
- B. Prior to disposal, the notification in Article 3.2.A. must be submitted.
- C. Asbestos waste which is properly packaged is classified as Waste Identification #27 non-hazardous industrial waste, and can be disposed of at a landfill which is registered by the New Jersey Department of Environmental Protection in conformance with the following:
 - 1. The landfill used must be registered by the New Jersey Department of Environmental Protection to accept Waste ID #27.
 - 2. The specific landfill facility chosen must be the one designated by the New Jersey Department of Environmental Protection as the recipient facility for the community in which the removal project is located. To determine which facility to use for a particular project, contact the Division of Solid Waste Management at (609)-530-8896, or consult the New Jersey Waste Flow Regulations (N.J.A.C. 7:26-2).
 - 3. The waste hauler must possess a valid solid waste transporter registration issued by the New Jersey Department of Environmental Protection. A licensed solid

waste transporter shall be a commercial collector/hauler or shall be the Contractor if they are so registered.

- D. The Contractor shall supply to the Owner the original "Generator's Copy" of the Waste Manifest within five (5) business days of receipt of the loads at the designated landfill.

3.3 GENERAL WORK PROCEDURES

- A. Removal of roofing materials should be done at a time of minimum building occupancy. If this is not feasible, all doors and windows should be kept closed during tear-off and clean up operations. Fresh air intakes for heating, ventilation and air conditioning systems will be ducted, re-routed and filtered as required to provide fresh air free of asbestos contamination.
- B. Critical barriers, consisting of a minimum of 2 layers of fire retardant, 6 mil polyethylene sheeting as tested by ASTM standard E-84, shall be installed on all openings of the roof. The polyethylene barriers shall be replaced or repaired if torn or damaged.
- C. The waste container shall be properly lined with two (2) layers of 6 mil polyethylene sheeting before any asbestos removal takes place.
- D. The non-friable asbestos-containing material removed shall not be dropped more than ten (10) feet. If the height of the roof is greater than ten (10) feet the Contractor shall either lower the material from the roof or use an enclosed chute directly into the waste container. These arrangements should be put into place before any asbestos removal takes place.
- E. The asbestos waste must be placed directly into the removal container. The storage of asbestos waste, unless in an authorized container, will not be permitted.
- F. To help minimize airborne levels of asbestos fibers, the roofing materials should be misted with water or other appropriate wetting agent before tear off. Damage caused by water over-spraying shall be the responsibility of the Contractor.
- G. Any power tools used to drill, cut into, or otherwise disturb asbestos material shall be equipped with HEPA-filtered local exhaust ventilation.

END OF SECTION 02 82 10

SECTION 02 83 00 – LEAD-BASED PAINT RELATED WORK

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Introduction

1. The Central Rail Road of New Jersey Terminal was constructed prior to the 1978 and preceded the Lead-Based Paint Ban. The State assumes that presence of lead-based paint associated with this undertaking is evident. The State does not wish to perform a formal lead paint abatement action. The State does require that the renovation Contractor to protect human health and the environment during their operations as they relate to lead impacts associated with the renovation activities as follows:

Any exterior and interior painted surfaces that will be impacted by the planned work may contain lead. *As such, the Contractor shall provide a site specific Lead Safety Plan to address: (1) worker protection as required by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), “Lead in Construction” standard (20 CFR 1926.62) and (2) worksite contamination, clean-up and waste disposal as regulated by the New Jersey Department of Environmental Protection and the New Jersey Department of Health and Senior Services.*

B. Lead-Based Paint

1. Any exterior and interior painted surfaces that will be impacted by the planned renovation work may contain lead and is covered in this Section.
2. Work under this Section shall be performed by or under the direction of the architect/engineer providing work under other Sections.
3. The Contractor shall provide a site specific Lead Safety Plan to address:
 - a. Worker protection as required by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), “Lead in Construction” standard (20 CFR 1926.62), and
 - b. Worksite contamination, clean-up and waste disposal as regulated by the New Jersey Department of Environmental Protection and the New Jersey Department of Health and Senior Services.
4. If any painted surface is to be drilled, sanded, cut or ground, the Contractor shall provide exposure monitoring for workers as required by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) for those persons whose trade will disturb painted surfaces as a result of demolition activities, paint refinishing, construction and re-construction.

1.2 RELATED DOCUMENTS

- A. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), “Lead in Construction” standard (20 CFR 1926.62) included by reference.
- B. U.S. Environmental Protection Agency (USEPA) Lead Renovation, Repair and Painting Rule.

1.3 SUBMITTALS

- A. Name, experience and training of the person to be designated the competent person, and who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization to take prompt corrective measures to eliminate them.
- B. Results of airborne exposure monitoring.
- C. A copy of the medical examination results including medical and work history as required under 20 CFR 1926.62.
- D. Test results for the TCLP test on paint debris.
- E. Site Specific Lead Safety Plan

PART 2 - PRODUCTS

(None listed)

PART 3 – EXECUTION

3.1 PERFORMING WORK ACTIVITIES THAT IMPACT PAINT

- A. Isolate the work area with either OSHA-approved barrier tape or signs.
- B. Place a 6-mil polyethylene drop cloth below the impact point.
- C. All employees working in the vicinity of the area shall wear the proper personal protection equipment in accordance with OSHA regulations.
- D. A local exhaust shield and a HEPA-filtered vacuum cleaner shall be attached to any equipment utilized for drilling, cutting, sanding, etc.
- E. Visible debris shall be cleaned up immediately with a HEPA vacuum or using a wet-wipe technique utilizing a trisodium phosphate (TSP) solution.
 - 1. Re-clean areas as necessary to satisfy HUD clearance criteria.

3.2 DISPOSAL

A. Lead

1. The Contractor shall determine if any waste generated by the work is regulated as hazardous waste. The Contractor shall utilize the Toxicity Characteristic Leachate Procedure (TCLP) test, Test Method 1311 in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, USEPA publications SW-846, as incorporated by reference in 40 CFR 260.11, and as referenced in the State of New Jersey regulations for the materials in question. Test results for the TCLP test for lead shall be less than 5.0 mg/L, as per USEPA HW#D008, or the material is required to be treated as hazardous waste. Hazardous waste transporters shall possess a hazardous waste hauler license. Hazardous materials shall only be transported to a NJDEP Licensed Facility.

PART 4 – ADDITIONAL INFORMATION

4.1 LEAD-BASED PAINT HISTORY

- A. In the State of New Jersey, the Department of Community Affairs, regulates lead abatement activities. In the regulatory context, lead abatement activities involve those events where a known lead health hazard is being addressed; or, where an outside contractor is being used to provide services where the Contractor performs the work as a certified lead abatement contractor. *The State code is not intended to regulate renovation or maintenance activities which are required in a structure simply because lead-based paint is present and may be disturbed as a result of these activities.*
- B. Removal of identified LBP items should be performed to minimize the generation of dust. Additionally, special precautions and work procedures should be implemented in an effort to minimize the creation and distribution of lead dust during renovation work. Under no circumstances should lead containing components be cut with torches, ground, dry sanded or welded. These activities will result in the release of potentially dangerous lead fumes and dust.
- C. Any exterior and interior painted surfaces that will be impacted by the planned renovation work may contain lead. As such, the Contractor shall provide a site specific Lead Safety Plan to address: (1) worker protection as required by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), “Lead in Construction” standard (20 CFR 1926.62) and (2) worksite contamination, clean-up and waste disposal as regulated by the New Jersey Department of Environmental Protection and the New Jersey Department of Health and Senior Services.
- D. Renovation, Repair and Painting Rule (RRP) – The USEPA RRP law went into effect in April 22, 2010. Many common renovation activities (sanding, cutting and demolition) can create hazardous lead dust and chips that can be harmful to adults and particularly children. To protect against this risk, the USEPA has issued the referenced Rule requiring the use of lead-safe work practices and other actions aimed at preventing lead poisoning. Under the rule anyone performing renovation, repair and painting projects that disturb lead-based paint in homes, child care facilities and schools built prior to 1978 must be certified and must follow specific work practices to prevent lead contamination.

- D. If any painted surface is to be drilled, sanded, cut or ground, the Contractor shall provide exposure monitoring for workers as required by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) for those persons whose trade will disturb painted surfaces as a result of demolition activities, paint refinishing, construction and re-construction.
- E. The Contractor shall determine if any waste generated by the work is regulated as hazardous waste. The Contractor shall utilize the Toxicity Characteristic Leachate Procedure (TCLP) test, Test Method 1311 in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, USEPA publications SW-846, as incorporated by reference in 40 CFR 260.11, and as referenced in the State of New Jersey regulations for the materials in question. Test results for the TCLP test for lead shall be less than 5.0 mg/L, as per USEPA HW#D008, or the material is required to be treated as hazardous waste. Hazardous waste transporters shall possess a hazardous waste hauler license. Documentation of disposal shall be provided to the Owner prior to approval of final payment.

PART 5 – OWNER DIRECTED TESTING AND ANALYSIS

5.1 OWNER TESTING OPTIONS

- A. Testing for lead can be conducted by the Owner at any time during the Contractor's activities and may include, but not be limited to, air, wipe (dust), soil and paint chip sampling and analysis. Samples obtained will be compared to the most stringent Federal, State and Local standards as applicable.
- B. The Contractor shall be responsible for any and all testing and analysis as indicated in the standards noted in this Section. The Owner may, at its digression, mirror testing and analysis being conducted by the Contractor.
- C. If lead contamination is discovered related to the Contractor's activities, the Contractor shall rectify the contamination issue by cleaning the area until satisfactory lead wipe (dust) and/or soil results are achieved (per HUD and N.J.A.C. 5:17 clearance criteria) at no additional cost to the Owner. The Contractor shall be responsible for the costs associated with the cleaning in addition to the costs associated with the Owner's Representative.

5.2 SURFACE WIPE SAMPLING COMPLIANCE

- A. Post Renovation Clearance Wipe Sampling
 - 1. At the Owner's discretion, the Owner's Representative may conduct post clearance wipe sampling in accordance with NIOSH Method 9100. All laboratories which analyze samples shall be recognized under the USEPA National Lead Laboratory Accreditation Program (NLLAP).
 - 2. Acceptable clearance post renovation wipe sampling results shall be less than the following lead dust levels, as established by HUD guidelines and adopted by New Jersey Administrative Code (N.J.A.C. 5:17):

- a. $40 \mu\text{g}/\text{ft}^2$ = Clearance for Floors
 - b. $250 \mu\text{g}/\text{ft}^2$ = Clearance for Window Sills
 - c. $400 \mu\text{g}/\text{ft}^2$ = Clearance for Window Wells/Troughs
3. Contractor shall re-clean areas that do not meet the clearance criteria as outlined in this Section until acceptable clearance post renovation wipe sampling results are achieved as indicated in 5.2, A. 2. above.

END OF SECTION 02 83 00

SECTION 02 85 01 – MOLD REMEDIATION

PART 1 – GENERAL

1.1 REFERENCES

- A. These Specifications are based on industry standards and practices, including applicable Federal, State and Local regulations and requirements. The Contractor has the responsibility of being fully informed of the requirements of the various Agency Regulations and shall satisfy completely these Specifications and all referenced regulations as may be amended by said Agencies during the course of this work. The Contractor shall comply with all Federal Regulations (i.e., the United States Department of Labor, Occupational Safety and Health Administration (OSHA) regulations including but not limited to:
1. Respiratory Protection, Title 29, Part 1910, Section 134 of the Code of Federal Regulations.
 2. Construction Industry, Title 29, Part 1926, of the Code of Federal Regulations.
 3. Hazard Communication, Title 29, Part 1910, Section 1200 of the Code of Federal Regulations.
 4. Specifications for Accident Prevention Signs and Tags, Title 29, Part 1910, Section 145 of the Code of Federal Regulations.
 5. The Contractor shall comply with all State regulations.
 6. Local Requirements: Abide by all local requirements which govern demolition work or hauling and disposal of waste materials.
 7. Incorporated by Reference is the New York City Department of Health's Guidelines on Assessment and Remediation of Fungi Indoors.

1.2 CONTRACTOR REQUIREMENTS AND QUALIFICATIONS

- A. Bidders or sub-contractors must be prequalified by the State of New Jersey, Department of the Treasury, Division of Property Management and Construction for C103 Microbial Remediation.
- B. The Contractor shall furnish evidence that each worker and supervisor has been given medical examinations and respiratory fit tests within the previous twelve months in accordance with United States Department of Labor, Occupational Safety and Health Administration (OSHA) 29 CFR 1910 and 29 CFR 1926 requirements.
- C. The Contractor shall be responsible for securing the work area(s) at the end of the shift, and all on-site waste containers/dumpsters. In addition, failure to comply with all site health and safety requirements, these Technical Specifications, and all applicable local,

State and Federal regulations will require issuance of a Stop Work order by the Project Consultant.

- D. Prior to commencement of work, the Contractor shall inspect areas in which work is to be performed. Prepare a listing of damage to structure, surfaces, equipment or of surrounding properties which could be misconstrued as damage resulting from the work. Photograph or videotape existing conditions as necessary to document conditions. Submit a copy of these photos or tapes to the Project Consultant prior to starting work.
- E. All electrical connections, except to outlets and extension cords, will require the Contractor to utilize a licensed Electrician.

1.3 SUBMITTALS

- A. Submit materials specified and/or proposed to the project for Consultant approval prior to installation. Submit all owner required submissions as per bid documents and specifications.
 - 1. Material Safety Data Sheets: Submit the Material Safety Data Sheets, or equivalent, in accordance with the OSHA Hazard Communication Standard (29 CFR Part 1910.1200) for those materials that will be utilized on the site by the Contractor.
 - 2. Inspection documentation, as indicated in Article 1.2 D.
 - 3. The Contractor shall submit documentation on each individual that may be entering the work area on their behalf, to verify that they have received pulmonary function testing (PFT) and respiratory fit testing.
 - 4. Map or sketch delineating the extent of the Contractor's work site, location of staging area, waste exit ports, waste container and decontamination unit if differing from Plan, Specifications, sketch and illustrations.
 - 5. Description of emergency procedures to be followed in the case of injury. Presentation shall include evacuation procedure, and source of medical assistance, including telephone numbers of first aid squad, police, fire, etc.

NOTE: Required emergency procedures shall take priority over all other requirements of this specification.
 - 6. List of workers to be on site.
 - 7. Description of the decontamination system and clean change area to be implemented for employee usage.

1.4 DEFINITIONS

- A. The following words, terms and abbreviations, when used in this section, shall have the following meanings unless the context clearly indicates otherwise.

1. Abatement – The process or procedure for removing, sanitizing and controlling the biological release and/or dispersion of infectious agents.
2. Adequately Wetted – Sufficiently wet, mixed, or coated with a solution of a biocide to prevent biologic dust dispersion during the movement of contaminated items and debris.
3. Air Filtration Device (AFD) – A local exhaust HEPA equipped air filtration device capable of maintaining a negative pressure inside the work area and a constant air flow from adjacent areas into the work area exhausting clean filtered air outside the work zone.
4. Air Testing – The process of measuring inside biological contamination and outside ambient conditions.
5. Authorized Personnel – Building Owner or representative, and all other personnel who are authorized officials of any regulating agency, be it State, Local, Federal or Private entity who possess legal authority for enforcement or inspection of the specified work.
6. Barrier – Any surface which seals off the work area to inhibit the movement of infectious biological agents and contamination.
7. Breathing Zone – A zone forward of the shoulders and head with a radius of approximately 6 to 9 inches, which is the approximate area from which an individual would obtain their air for breathing purposes.
8. CIH IH – Certified Industrial Hygienist or an Industrial Hygienist, certified by the American Board of Industrial Hygiene.
9. Clearance Criteria – Where required, air testing clearance criteria shall be established that no single individual species shall exceed 500 colony forming units (CFU's) per cubic meter.
10. Construction – For the purpose of this project - Construction includes all specified requirements (i.e., mold remediation, all work specified, etc.)
11. Construction Barrier – Used for construction separation only. This does not prevent movement of infectious biological contaminants. Construction barriers shall be constructed of 2 inch plywood and 2" x 4" studding spaced no greater than 24" o/c. Doorways (minimum), 3 ft. x 6 ft., shall be installed where required for ingress and egress. A lock shall be installed to secure the area when the Contractor is not on site.
12. Contracting Authority – The State of New Jersey, Department of the Treasury, Division of Property Management & Construction.
13. Contractor – The Contractor(s) who has demonstrated proficiency in the

- construction, clean-up of regulated chemical or physical substances, proficient in environmental remediation and the clean-up of contaminated debris and/or infectious biological agents.
14. Construction Monitor – USAEMI on-site representative experienced in construction related activities.
 15. Critical Barrier – Two (2) layers of six (6) mil polyethylene sheeting adhered in such a fashion that each layer is individually visible, and completely seals off the work area to prevent the distribution of infectious biological agents into the surrounding areas that are not part of the work zone.
 16. Decontamination Unit – A serial arrangement of rooms or spaces for the purpose of separating the work area from the building environment. This unit provides for entering the work site, returning to the clean environment, cleaning of persons, equipment and movement of properly contained waste material.
 17. Disposal Bag – A minimum six (6) mil thick leak tight plastic bag used for packaging and transporting debris and biological waste from the work zone to a disposal site. Where required, these bags shall have affixed appropriate warning labels and site specific waste generator labels.
 18. Facility – Any institutional, commercial or industrial structure, installation or building.
 19. Facility Component – Any building component, such as, but not limited to: structural steel, steel decking, ceiling grid, block and brick, floors, walls, ceilings, bar joists, light fixtures, ceiling hangers, studs, plates, insulation and all other vertical and horizontal surfaces.
 20. Fixed Object – Mechanical equipment, electrical equipment, fire detection systems, alarms, and all other fixed equipment, furniture, fixtures or other items which cannot be removed from the work area.
 21. HEPA – High Efficiency Particulate Absolute filtration efficiency of 99.97% down to 0.3 microns. Filtration provided on specialized vacuums and air filtration devices to trap particles and infectious agents.
 22. HVAC – Heating, Ventilation and Air Conditioning system.
 23. Moveable Object – Equipment, furniture or other items in the work area which can be removed from the work area.
 24. Negative Pressure Ventilation System – A system established for the work zone utilizing HEPA filtration capable of maintaining a negative pressure inside the work area and which creates a constant air flow from adjacent areas into the work area and exhausts clean filtered air outside the work zone. Maintain a minimum of one (1) complete air change every 15 minutes and 0.02 inches of water column pressure differential from the surrounding area.

25. Owner – State of New Jersey, Department of Environmental Protection
 26. Project Consultant – USA Environmental Management, Inc. (USAEMI)
 27. Respirator – Device designed to protect the wearer from the inhalation of harmful respirable dust, fumes, mists and infectious biological agents.
 28. Separation Barrier – Used for isolating contaminated work areas from non-contaminated occupied areas. Separation barriers shall be constructed of one-half (½) plywood and two (2) inch by four (4) inch studding spaced no greater than 16" on-center with two (2) layers of six (6) mil fire resistant polyethylene installed on both sides. A minimum three (3) feet by six (6) feet emergency escape kick-out panel shall be cut and secured into place with duct tape where required for emergency egress. This exit shall be clearly marked from the work area side and indicated on the emergency route document posted at the entrance to the work area.
 29. Staging Area – Site where Contractor maintains waste transfer airlock, where containerized waste has been placed, an outside site of material storage, equipment storage, construction trailer, etc. These areas are off limits to unauthorized personnel and shall be clearly and visibly marked.
 30. Structural Member – Any load supporting member of a facility, such as, but not limited to: beams, decking, load supporting walls or any non-load supporting member, such as: ceilings, non-load supporting walls.
 31. Visible Emissions – Emissions containing particulate materials that are visually detectable without the aid of instruments.
 32. Waste Transfer Airlock – A system airlock constructed in such a manner as to prevent the free flow of air to areas outside of the work area and utilized for transferring containerized waste from inside to outside the work area. The system shall be checked prior to use for negative air flow.
 33. Water Column (w.c.) – Means a unit of measurement for pressure differential expressed in inches of water column. Maintain 0.02 inches of w.c.
 34. Wet Biocide Cleaning – The process of eliminating biological contamination from building surfaces and objects by using cloths, mops, or other cleaning devices which have been dampened with a biocide.
 35. Work Area – The area where the related work or biological decontamination operations are performed which is defined and or isolated to prevent the spread of biological agents.
- B. Abbreviations for organizations and regulating authorities which may appear in this document:

1. ACGIH, American Conference of Governmental Industrial Hygienists
1330 Kemper Meadow Drive
Cincinnati, Ohio 45240-1634
2. AIHA, American Industrial Hygiene Association
2700 Prosperity Avenue
Suite 250
Fairfax, Virginia 22031
3. ANSI, American National Standards Institute
1430 Broadway
New York, New York 10018
4. ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, Pennsylvania 19103
5. CFR, Code of Federal Regulations
Government Printing Office
Washington, DC 20402
6. USEPA, United States Environmental Protection Agency
401 M Street SW
Washington, DC 20460
6. NIOSH, National Institute for Occupational Safety and Health
Building J.N.E. Room 3007
Atlanta, Georgia 30333
7. OSHA, Occupational Safety and Health Administration
200 Constitution Avenue
Washington, DC 20210
8. USAEMI, USA Environmental Management, Inc.
344 West State Street
Trenton, New Jersey 08618

PART 2 – PRODUCTS

2.1 DISINFECTANTS, BIOCIDES, SANITIZING SOLUTIONS AND FUNGICIDAL AGENTS

- A. Shall be approved by EPA for the use as detailed in the Specifications and used in accordance with the manufacturer's specifications.
- B. Reagents:

1. Disinfectant: Fosters First Defense 40-80, Fiberlock Shockwave or approved equivalent.
2. Anti-Microbial Coating: Fosters 40-20, Fiberlock IAQ 6000/6100 or approved equivalent.

PART 3 - SCOPE OF WORK

3.1 SUMMARY OF WORK

- A. This section covers the furnishing of all labor, materials, facilities, equipment, services, permits and agreements necessary to perform the work required for mold remediation in accordance with these Technical Specifications, United States Environmental Protection Agency (USEPA) and OSHA regulations, NIOSH recommendations, State of New Jersey regulations and other applicable federal, state and local government regulations. Wherever there is a conflict or overlap of the above references the most stringent provisions shall apply. It shall be the Contractor's responsibility to verify exact quantities and locations of all impacted materials scheduled for abatement as noted on Drawing HA.1. The quantities shown are for informational purposes only. It is USA Environmental Management, Inc., understanding that the Contractor has verified the materials and quantities to be removed under this scope of work and has priced the work accordingly.
- B. These Specifications are based on current, applicable Federal, State and Local Regulations. The Contractor has the responsibility of informing themselves fully of the requirements of the applicable Regulations and shall satisfy completely these Specifications and all referenced Regulations as may be amended by Federal, State and Local Agencies during the course of this work.

3.2 DESCRIPTION OF WORK

- A. All work shall be conducted within the Central Railroad of New Jersey, Terminal Building, Jersey City, New Jersey, as specified in the General Provisions of the Contract, including General and Supplementary Conditions, and other Specifications.
- B. The Contractor shall furnish all labor, supervision, materials, services, insurance, and equipment necessary for the work described as follows and as indicated on the Contract Drawings:
 1. Remove all mold impacted drywall, ceiling tile, wall insulation and insulation (pipe, batt, etc),
 2. Disinfect all surfaces, including, but not limited to, exposed cavities, above drop ceilings, walls, decorative/historic lighting to remain, floors, ceilings, wood components, stained glass, stained glass support system, stained glass surround, crown molding (doors, trim, molding, etc.), and
 3. Apply an anti-microbial coating / encapsulant to all remediated exposed wall and

ceiling cavities at such a level that it can be discerned easily by visual inspection.
Do not encapsulate exposed finished surfaces

4. Have the work area(s) inspected and approved by the Owners representative or the Owner prior to installing replacement materials (i.e. drywall, insulation, pipe insulation, ceiling tiles, etc.)

C. Microbial Remediation Work Sequencing:

1. Coordinate all work with Project Consultant and allow for inspections. Remove the decorative and commemorative plaques throughout the work area, clean these materials and store for reinstallation at the completion of the project. Please keep in mind that the lighting shall be retained, re-ballasted and re-tubed as part of this project; as part of this remedial work, protect all lighting in place.
2. Shut down all air handling and electric systems servicing the work areas. All work involving the shutting down of air handling systems and electrical systems shall be coordinated with the Owner.
3. Provide area containment and engineering controls, as specified.
4. Remove and dispose of contaminated building materials.
5. Properly containerize and dispose of all debris as indicated in these Technical Specifications.
6. Disinfect all impacted exposed surfaces.
7. Encapsulate abated and/or treated surfaces with an anti-microbial encapsulant as indicated in these Technical Specifications.
8. Remove area containment and engineering controls upon satisfactory inspection and testing.
9. Install new finishes to replace the finishes abated including but not limited to drywall, ceiling tiled wall insulation, pipe insulation, etc.

D. Related requirements and conditions that are indicated on the Contract Documents include, but are not necessarily limited to, the following:

1. Applicable codes and regulations.
2. Notices and permits.
3. Existing site conditions and restrictions on use of the site.
4. Work performed prior to work under this Contract.

5. Alterations and coordination with existing work.
 6. Work to be performed concurrently by the Owner.
 7. Work to be performed concurrently by separate contractors.
 8. Work to be performed subsequent to work under this Contract.
 9. Requirements for Owner occupancy prior to substantial completion of the Contract Work.
- E. Engineering Controls and Work Area Containment:
1. All in field decisions with respect to compliance with these Specifications or applicable regulations shall be at the discretion of the site Project Consultant.
 2. The Contractor shall be responsible for the erection of a single layer polyethylene enclosure and critical barriers consisting of two (2) layers of fire retardant, six (6) mil polyethylene sheeting over all openings and access points from the exterior of the work area(s) and over all electrical panels within the work area. The Contractor shall provide all ladders, scaffolding and/or other necessary equipment for the installation of all engineering controls.
 3. The Contractor shall provide and install HEPA equipped air filtration device(s) (AFDs) within the work area to create a continuous negative pressure within the work area throughout abatement operations, in addition to the prevention smoke/fumes from exiting the work area. This may require more than one AFD depending on conditions. Exhaust for the AFDs shall be ducted to the outside of the building.
 4. Construction a two (2) stage remote decontamination unit.
 - a. Two (2) stage remote decontamination unit shall be constructed at a location to be determined by field conditions.
 - b. The clean change area shall be provided by the Contractor in accordance with OSHA Regulations.
 5. Contractor shall request an inspection, to be performed by the Project Consultant, of each work area.
 - a. The Project Consultant shall then inspect and approve the work area(s)
 - b. For approved work areas, the Contractor shall remove materials as specified.
 - c. The Project Consultant shall then inspect and approve the work where no visual mold is detected. Where visible mold is detected the Contractor shall disinfect surfaces and provide an application of an anti-microbial surface coating.
 - i. Disinfectant: Fosters First Defense 40-80, Fiberlock Shockwave

- or approved equivalent.
 - ii. Anti Microbial Coating: Fosters 40-20, Fiberlock IAQ 6000/6100 or approved equivalent.
 - 6. Take down enclosures and remove engineering controls specified.
 - 7. Dispose of all construction waste and/or contaminated bagged debris.
- F. Hazard Communication, Medical Clearance and Work Area Safety:
 - 1. The Contractor shall be responsible for providing hazard communication to their supervisor and crew on the potential health risks associated with fungal exposure and of the proper work procedures which must be followed.
 - 2. Where in the performance of the work, workers, supervisory personnel, sub-contractors, or consultants may encounter, disturb, or otherwise function in the immediate vicinity of contaminated items and materials, all personnel shall take appropriate continuous measures as necessary to protect all building occupants from exposure to biological agents. Such measures shall include the procedures and methods described herein and shall be in compliance with all applicable regulations of Federal, State and Local agencies.
- G. General:
 - 1. The Contractor shall coordinate the location of all waste vehicles with the Owner. The Owner shall approve all locations of waste vehicles prior to the waste vehicle's arrival.
 - 2. The Contractor shall limit his/her use of the premises to the work indicated, so as to allow for Owner continuous usage as required.
 - 3. Use of the Site: Confine operations at the site to the areas permitted under the Contract and as directed by the facility. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in the project. Facility security regulations affecting the Contractor shall be strictly adhered to.
 - 4. Keep existing driveways and entrances serving the premises clear and available to the Owner and their employees at all times. Do not use these areas for parking or storage of materials.
 - 5. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to Owner approved areas or areas indicated. If additional storage is necessary, obtain and pay for such storage off site.
 - 6. Lock automotive type vehicles, such as passenger cars, trucks and other mechanized or motorized construction equipment, when parked and unattended, so as to prevent unauthorized use. Do not leave such vehicles or equipment

unattended with the motor running or the ignition key in place or accessible to unauthorized persons.

7. Contractor's Use of the Existing Building: Maintain existing building in a safe manner throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.
8. Keep public areas such as hallways, stairs and toilet rooms free from accumulation of waste, rubbish or construction debris.
9. Smoking or open fires will not be permitted within the building enclosure or on the premises.
10. Cooperate fully with the Owner or his representative during construction operations to minimize conflicts and to facilitate Owner usage. Perform the work so as not to interfere with the Owner's operation.
11. Partial Owner Occupancy: The Owner reserves the right to place and install equipment as necessary in areas of the building in which all remediation procedures have been completed. Such placement of equipment and partial occupancy shall not constitute acceptance of the work, or any part of the work.

H. Contaminated Materials:

1. The following contaminated materials are known to be present at the work site. If any other contaminated materials are found other than those indicated in the Scope of Work, the Contractor shall immediately notify the Project Consultant.
 - a. Drywall
 - b. Ceiling Tile
 - c. Fiberglass Insulation (pipe, batt, etc.)
 - d. Wood Components (doors, trim, molding, etc.)

3.3 INTERPRETATION

- A. If questions arise, the Contracting Authority's Project Consultant shall decide as to the meaning and applicability of any part of the General Conditions, Supplementary Conditions, Special Conditions, or Technical Specifications, and the decision shall be binding and final.
- B. Any work performed after the discovery of a change in conditions, without acceptance by the Contracting Authority's Project Consultant, shall be at the risk and expense of the Contractor with no liability or cost to the or the Contracting Authority's Project Consultant.
- C. All work and materials specified and necessary to make the work complete in all its parts, whether or not they are specifically mentioned in the Specifications, shall be furnished and executed the same as if they were called for by the Specifications without extra

compensation.

3.4 COOPERATION

- A. The Contractor shall fully cooperate with the Owner, Contracting Authority, facility personnel and the Project Consultant in fulfilling and completing the requirements of this Specification and Contract.
- B. This Contract will be proceeding concurrently with others on the site specified. The Contractor shall secure and make safe his work and avoid damage to the work of any other Contractor. The Contractor shall cooperate with the other Contractors in expediting the work of all.
- C. If the Contracting Authority, the Project Consultant or lawful official presents a written Stop Work Order, immediately and automatically stop all work. Do not recommence work until authorized in writing by the Project Consultant.
- D. Careful coordination throughout the project is absolutely essential. Coordination for job meetings, scheduling, phasing, payment request reviews, required inspections and disposal are key to the Contractor's successful completion of work.

3.5 MECHANICAL PRINTING ERRORS

- A. The Contractor shall check the Specifications for missing pages or pages partially blank due to mechanical printing errors. Any such omissions will be replaced upon presentation to the Project Consultant. In no case will allowances in Contract prices be made for such omissions.

3.6 PROCEDURES/PRACTICES AND INSPECTIONS

- A. All Contractor procedures and practices shall be in accordance with these Contract Documents and with all applicable Federal, State, or Local regulations pertaining to this work. Work area inspections shall be conducted by the Project Consultant prior to and throughout the duration of the project. The Contractor shall establish written and/or telephonic communications with the Project Consultant to coordinate proper inspections and area air monitoring as required by this Specification. In no case will extra allowances be made for failure to give proper and timely notification for required inspections.

3.7 BIOLOGICAL DECONTAMINATION PROCEDURES

- A. Reagents:
 - 1. Disinfectant: Fosters First Defense 40-80, Fiberlock Shockwave or approved equivalent.
 - 2. Anti-Microbial Coating: Fosters 40-20, Fiberlock IAQ 6000/6100 or approved equivalent.

NOTE: Prior to starting procedure, ensure work area inspection and approval have been

performed by the Project Consultant, and that the engineering controls as specified are installed and operational to Specification requirements. Provide proper Personal Protective Equipment and respiratory protection to all workers in work area.

- B. Project Consultant shall conduct an inspection, and then approve the work area for application of an anti-microbial surface coating.
- C. The Contractor shall apply an anti-microbial coating / encapsulant to all remediated exposed wall and ceiling cavities at such a level that it can be discerned easily by visual inspection. Do not encapsulate exposed finished surfaces.
- D. Take down enclosures and remove engineering controls specified.
- E. Waste container disposal of all construction waste and contaminated bagged debris.
- F. Final visual inspection, punch list and approval of work by the Project Consultant.
- G. There shall be no surfaces which show visible dust or growth of microorganisms.
- H. Removal of all Contractor equipment off site.
- I. The Contractor shall inform Contracting Authority and the Project Consultant of sources of moisture incursion found during the course of construction such as, but not limited to, stagnant water in septic systems, wall leaks, pipe leaks, etc.
- J. The Consultant shall ensure that the work progresses in accordance with this Contract and these Specifications. The Project Consultant shall make periodic inspections to observe the progress of work.
- K. The Contractor shall follow an agreed upon waste removal route established with the Project Consultant. Measures for the disposal of waste shall be in place at the beginning of each work shift.
- L. The Contractor shall perform and record in the Contractor's daily log the smoke testing of all work area isolation and critical barriers at the beginning of each shift to ensure negative air pressure within each work area. All penetrations observed shall be sealed immediately.
- M. The Contractor shall be responsible for coordinating their work schedule as appropriate with the Contracting Authority and the Project Consultant.
- N. The Contractor shall, at all times, maintain adequate staffing levels to complete the project in the time frame specified in the Contract Documents. The Contractor shall be responsible for all expenses incurred by the Project Consultant due to work performed outside of the calendar day allotment.
- O. The Contractor shall be responsible for any and all costs associated with additional Project Consultant time for inspections beyond the allotted schedule. The Contractor shall be responsible for all costs associated with additional re-cleaning and testing as may be

ordered, which do not meet Specification requirements or testing criteria.

- P. The Contractor shall fully comply with directives provided by the Project Consultant. Under no condition shall the Contractor proceed to another work area or proceed to the next phase of work without written authorization of the Project Consultant.
- Q. The Contractor shall cooperate fully in the event that work area entry is required by any authorized personnel. The Contractor shall have an adequate supply of protective clothing on hand at all times. Respiratory protection shall be the responsibility of any inspection agency.
- R. All accesses leading directly into the work area (e.g., the decontamination unit, waste exit port, and other such direct access doors) shall be properly posted, warning unprotected personnel not to enter. These signs shall be placed at eye level where practical. Notices at all other doors leading to the work area (stairwells, elevator, etc.) shall read to the effect not to enter areas where warning signs are posted.
- S. The Contractor shall exercise extreme care when working around all fixed instrumentation. At the completion of the work and after removal of the polyethylene barriers, all non-moveable items, fixtures and surfaces shall again be decontaminated by means of HEPA vacuuming and surface wet cleaning with biocides as specified.
- T. All building control systems, such as: fire protection and security alarm system(s) shall remain functional, and if required shall be protected so as not to obstruct operation. Where present, smoke detector units within the work areas shall remain operational. Sensor surfaces shall be covered with a filter pad to permit the unit to function while preventing gross surface contamination. Where present, the Contractor shall ensure that the integrity of the systems are not jeopardized or damaged as a result of any activities performed by the Contractor. Should any units be damaged during the project as a result of mishandling by workers or as a result of contact damage, the Contractor shall pay for all repairs and/or replacements of all damaged equipment at no cost to the Owner or the Project Consultant.

NOTE: Where present, the Owner will be responsible for demonstrating to the Contractor any special requirements for protection of security devices which may need special attention. Repairs to security protection devices, if required, shall be made only by an Owner authorized firm. Under no condition will the Contractor attempt to make any repairs.

- U. The Contractor shall perform final surface cleaning and sanitizing activities as per Specifications.
- V. The Contractor shall consider all materials removed from the work area in the execution of this Contract as contaminated (if not cleaned as specified). Contaminated materials shall be disposed of in accordance with the appropriate waste flow plan at an approved facility.
- W. The Contractor shall submit in writing to the Project Consultant a request for a Final Inspection of the work area.
 - 1. All contaminated materials shall be removed from the facility within 48 hours of

the Contractor's submission of a written request for a Final Inspection.

- X. If at any time the above conditions have not been met or any other unacceptable conditions have been identified by the Project Consultant, the Contractor shall immediately perform corrective actions as directed.
- Y. Commencement and Progress Inspections
 - 1. Written notification to the Project Consultant shall be made by the Contractor to request a pre-commencement inspection at a minimum of 48 hours in advance of the desired date of inspection.
 - 2. The Project Consultant shall ensure the following:
 - a. The job site is properly prepared and that all containment measures are in place pursuant to these Specifications.
 - b. The Contractor has provided a list of emergency telephone numbers at the job site which shall include those of the Project Consultant, fire department, police, emergency squad, local hospital and Health Officer.
 - c. If all is in order, the Project Consultant shall issue a written notice to proceed with work.
 - d. If the work area is not in order, the Contractor shall perform any needed additional or corrective action as directed before any work is to commence.
 - e. The Project Consultant shall inspect the work area to ensure that the work site has been properly cleaned and is free of visible dust and debris as specified.
 - f. If additional work is necessary, the Contractor shall perform the work as directed by the Project Consultant prior to proceeding further.

3.8 USE OF SITE/UTILITY REQUIREMENTS

- A. The Contractor shall ensure that emergency escape routes are established in case of fire, or other emergencies. The Contractor shall install appropriate safety barriers and notices at the perimeter of work and maintain the same during the course of work to prevent site access from unauthorized personnel.
- B. Use of temporary electrical power is available at the site; extension to the point of source is the responsibility of the Contractor.
 - 1. The Contractor shall provide receptacle outlets equipped with Ground Fault Circuit Interrupters, reset button and pilot light, for plug-in connection of power tools and equipment.
 - 2. The Contractor shall use only grounded extension cords and shall use hard service cords where exposed to abrasion and traffic. Contractor shall use lengths, or use waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas of work.

- C. As required, the Contractor shall install temporary lighting. Provide one (1) 200 watt incandescent lamp per 1,000 square feet of floor area, uniformly distributed, for general construction lighting, or equivalent illumination of a similar nature. In corridors and similar traffic areas provide one (1) 100 watt incandescent lamp every 50 feet. In stairways and at ladder runs, provide lamp illumination for each landing and flight. Provide sufficient temporary lighting to ensure proper workmanship throughout the project by combined use of daylight, general lighting and portable plug-in task lighting.
- D. Provide lighting in the decontamination units as required to supply a 50 foot candle minimum light level.
- E. Use of water is available at the site; extension to the point of source is the responsibility of the Contractor. The Contractor shall provide a temporary hot water heater for decontamination usage. Provide hot and cold water as required to the decontamination units.
 - 1. The Contractor shall maintain all temporary water connections, hoses and outlet valves in a leak proof condition throughout the project. Replace any leaking hoses and connections immediately upon discovery.
 - 2. Where hot water is required, the Contractor shall provide a supply with a minimum temperature of 100 degrees Fahrenheit.

3.9 PERSONNEL PROTECTIVE CLOTHING AND EQUIPMENT

- A. The Contractor shall provide approved protective clothing and respiratory protection to all Contractor workers and shall provide protective clothing to all official representatives of the Contracting Authority who may inspect the job site.
- B. Respiratory protection for authorized inspecting officials shall be the responsibility of the inspecting officials.
- C. Protective clothing shall consist of full body coveralls, disposable head covers, rubber boots, rubber gloves, eye protection and, where required, hard hats and safety shoes conforming to OSHA regulations.
- D. The Contractor shall require that each person entering the defined work zone wear an approved Organic Vapors/HEPA Filter Cartridge respirator and protective clothing. There shall be no exceptions to this rule.
- E. Respiratory protection shall be in accordance with OSHA Regulation 1910.134 and ANSI Z88.2-1980.
- F. In no instance shall a dust mask be utilized regardless of the certification or approval number.

3.10 WORK AREA PROTECTION

- B. The Contractor shall provide and post all work area entry points with hazard warning signs

indicating that biological decontamination is being conducted and that unprotected personnel should not enter into the designated work area.

- C. Where applicable, all air handling and electric systems shall be shut down. All filters from any air handling device within the work area shall be removed and disposed of as contaminated waste. Air supply and return systems shall be sealed and shall remain shut down until after the prescribed clearance criteria for both visual inspection and air testing results is achieved.
- D. Air filtration devices (AFD's) and/or HEPA vacuums shall be installed in the work area as specified and shall remain on during all phases of biological clean-up.
- E. The Contractor shall isolate the work areas specified
- F. The Contractor shall clean and remove all removable items and/or equipment from the work area. The Contractor shall clean and cover all non-removable items and equipment in the work area.
- G. Containment barriers of six (6) mil polyethylene sheeting shall be constructed as per Specifications.
- H. Removal, decontamination and cleaning work may only proceed after installation of all specified engineering controls, safety devices and equipment and only after the Contractor obtains written approval from the Project Consultant.

3.11 FINAL CLEAN-UP PROCEDURES

- A. At the conclusion of biological decontamination work after visual inspection and approvals as specified, clean all ladders, scaffolds, and other equipment used during work.
- B. The protective plastic enclosures shall also be cleaned as per Specifications. This plastic, along with all wipe cloths, shall be disposed of as contaminated waste and placed into six (6) mil plastic waste bags for disposal.
- C. Similarly, all plastic used to seal doors, windows, vents, or non-removable items shall be cleaned as per Specifications, removed and placed into six (6) mil plastic waste bags for disposal.

3.12 CLEARANCE

- A. Clearance Criteria:
 - 1. Clearance will be based on visual assessment (all visible mold removed, all visible dust removed, based on a "white glove" test) by Project Consultant. "White glove" test shall consist of wiping the surface with a clean cloth of color suitable to reveal expected type of dust. For most surfaces, a white cloth is suitable.
 - 2. Failed remediation areas will be recleaned and the AFDs kept in operation another 12 hours, followed by another visual assessment. Subsequent failures will follow the same routine until a pass condition is secured.

3.13 CLEAN-UP AND DISPOSAL

A. Disposal of Material

1. Dispose of contaminated bagged waste materials removed during this remediation as general construction debris. Follow all applicable local, State, and Federal requirements for the disposal of this material.

B. Material Packaging

1. Place waste, as waste is removed, into a disposal container promptly. Disposal containers shall consist of at a minimum, two layers of clear 6 mil polyethylene bags. Tape bags in a gooseneck fashion to form an airtight seal and label appropriately. Bag waste from vacuums equipped with HEPA filters in 6 mil polyethylene bags.

C. Building Exit (Waste Disposal)

1. HEPA vacuum and damp wipe bags of contaminated waste material prior to removal from the building.

D. Hazardous Material

1. Should the Contractor encounter any hazardous materials, notify the Project Consultant immediately for direction.

END OF SECTION 02 85 01

SECTION 031000 - CONCRETE FORMWORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Provide design, supply, installation and removal of forms wherever necessary to confine concrete and shape it to required dimensions. Provide special formwork or form liners for concrete with smooth or special finishes. Provide all required bracing, shoring and reshoring.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Miscellaneous metal fabrications
(concrete inserts).....Section 055000
- B. Mechanical and Electrical items.....Division 15 & 16

1.03 RELATED SECTIONS

- A. Concrete Reinforcement.....Section 032000
- B. Cast-in-Place Concrete.....Section 033000

1.04 REFERENCES

References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

- A. American Concrete Institute (ACI) standards, latest editions.
 - 1. ACI 301 Specifications for Structural Concrete for Buildings.
 - 2. ACI 347 Guide to Formwork for Concrete.

1.05 DESIGN REQUIREMENTS

- A. The design and engineering of the formwork, as well as its construction, is the responsibility of the Contractor.
- B. Design formwork in accordance with ACI 347 and Section BC 1906 of the 2009 New Jersey Edition of the International Building Code (NJ-IBC).

1.06 SUBMITTALS

A. Product Data

Submit manufacturers' information for the following:

1. Overlaid plyform formwork or form liners
2. Ties, each type and where to be used
3. Form-release agent. Form-release agent to be submitted for review only.

B. Samples

Submit 12" x 12" samples of the following items:

1. Overlaid plyform formwork or form liners

C. Shop Drawings

1. Prepare and submit formwork shop drawings and calculations prepared and sealed by a Professional Engineer licensed in the State of New Jersey for review when required by Section BC 1906.3 of the 2009 NJ-IBC.

D. Quality Control Submittals

1. Contractor Qualifications

Provide proof of Formwork Installer qualifications specified under "Quality Assurance".

1.07 QUALITY ASSURANCE

A. Qualifications

1. Company specializing in performing the Work of this Section shall have three years minimum experience.
2. Person responsible for inspection of formwork shall be a qualified person as defined in Section BC 3302.1 of the 2009 NJ-IBC.

B. Regulatory Requirements

1. Building Code

Work of this Section shall conform to all requirements of the NJ-IBC. Where more severe requirements than those contained in the Building Code are given in this Section and ACI 347, the requirements of this Section and ACI 347 shall govern.

2. ACI 347.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protection

1. Protect formwork materials before, during and after installation.
2. Protect installed work and materials of other trades.

B. Replacement

1. Repair or replace damaged formwork as approved by the the State.
2. Repair overlaid plyform formwork as per manufacturer's instructions. Replace pieces when number of manufacturer recommended reuses is up or when finish deteriorates.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Overlaid Plyform Formwork

1. Simpson Timber Company, Shelton Washington 98584.
2. Dayton Richmond Concrete Accessories, Folcroft PA
3. (Approved Equal).

B. Form Liners

1. Greenstreak, St. Louis Missouri 63177.
2. Architectural Polymers, New Ringgold PA 17960
3. (Approved Equal).

2.02 MATERIALS

A. Rough Formwork

Shall be Commercial Douglas Fir, DFPA: 5/8" thick minimum or modular metal units.

B. Overlaid Plyform Formwork

Plywood with thermosetting phenolic resin or urethane coating bonded to it to provide a flat matte finish. Shall be B-Matte Formguard by Simpson Timber Company, or approved equal.

- C. Smooth Form Finish Form liner
 - 1. Shall be #340 Smooth Face by Greenstreak, or approved equal.
 - 2. Nails and staples used to attach form liner to formwork are to be Type 304 stainless steel.
- D. Left-in-Place Forms: Galvanized per ASTM A653, coating designation G90, and not less than 20 gage.
- E. Release Agent

VOC compliant material such as those of the Cresset Chemical Company for coating forms. Shall be compatible with material or finish to be subsequently applied and free of deleterious effects on final surfaces. Form oils shall not contain castor oil. Release agents shall not discolor concrete where concrete is to be exposed to view.
- F. Form Sealers: Shall be guaranteed by manufacturer to be non-staining and to not impair the bond of paint, waterproofing or other required surface coatings.
 - 1. Sealer for lumber surfaces and plywood edges shall be clear polyurethane.
 - 2. Sealer for board forms shall be penetrating, non-staining and not leave a surface coating.
- G. Form Ties
 - 1. Form ties for exposed concrete shall be adjustable.
 - 2. Form ties for exposed concrete and concrete to receive membranes shall be a break-off type and leave no metal closer than 1¹/₂" to the surface.
 - 3. Form ties for concrete stated in 2 above shall be free of devices which leave holes or depressions larger than 7/8" back of exposed surface.
 - 4. Wire ties not permitted.
 - 5. Ties shall have a minimum capacity of 3000 pounds.

PART 3 - EXECUTION

3.01 PREPARATION OF FORMWORK SURFACES

- A. Clean all surfaces of forms and embedded items of any accumulated mortar or grout from previous concreting and other foreign material before concrete is placed in them. Clean, repair and patch reused forms as required to return them to acceptable condition. Repair or replace any formwork as required.

- B. Before placing either reinforcing steel or concrete, cover the surfaces of the rough or overlaid plyform formwork (when used) with an approved form release agent that will effectively prevent absorption of moisture, prevent bond with the concrete, and which will not stain the concrete surfaces. Coat steel forms with a non-staining, rust-preventative releasing agent. Material shall be carefully applied at the amount recommended by the release agent manufacturer to obtain the desired finish. Do not apply oil or release agents on formwork for concrete to receive coatings such as membrane waterproofing, plaster, or additional concrete (such as at construction joints). Follow manufacturer's recommendations for alternatives. For the overlaid plyform formwork, release agent should be a chemically reactive agent compatible with the factory treatment. Do not allow excess form coating material to stand in puddles in the forms nor allow coating to come in contact with hardened concrete against which fresh concrete is to be placed.

3.02 CONSTRUCTION AND DETAILS

- A. Contractor shall be solely responsible for the design, construction, erection, removal, safety and adequacy of all concrete formwork, falsework, shoring, reshoring and the like. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied, until such loads can be supported by the concrete structure. Design formwork to be readily removable without impact, shock, or damage to cast in place concrete surfaces and adjacent materials.
- B. Adequately support and substantially brace formwork to hold lines, shape, alignment, plumbness and position.
- C. Formwork shall be tight jointed to prevent leakage of mortar from the concrete.
- D. Place chamfer strips in the corners of forms to produce beveled edges (chamfers) on permanently exposed surfaces (such as exposed columns). Do not provide beveled edge for interior corners of such surfaces and where members are flush with partitions or walls, unless required by Drawings or specified elsewhere.
- E. Set slab-forms with camber of 1/4" per 10 feet of span to maintain tolerances. For two way slabs the lesser span dimension shall govern.
- F. Provide positive means of adjustment (wedges or jacks) for shores and struts to take up all settlement during concrete placing operations. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check. Securely brace forms against lateral deflection.
- G. Provide mud sills where shores rest on compressible materials.
- H. Provide temporary openings to permit cleaning and inspection. Provide ample time for proper inspection before placement of concrete.
- I. Provide "Rough Form Finish" for surfaces not exposed to view. Use plywood or metal forms coated with a release agent.

- J. Provide "Smooth Form Finish" for surfaces exposed to view. Use dress, square-edged lumber with form liner or overlaid plyform forms with applicable release agent. Do not exceed manufacturer's recommendations for number of re-uses for the form liner or overlaid plyform. Arrange the forms or form liner in an orderly and symmetrical fashion, keeping the number of seams to a practical minimum. Items indicated as "Architectural Concrete" or Architectural Finish" shall use specially designed formwork to attain the desired finish and shall have a CS 1 surface finish as developed by the Cresset Chemical Company, or other special finish specified. Other exposed concrete shall have CS3 or better surface finish.
- K. Provide openings in formwork to accommodate work of other trades. Form holes for pipes, pipe sleeves, electric outlets, electric conduits, etc. as required. Construct wood forms for wall forms to facilitate loosening, if necessary, to counteract swelling of forms.
- L. Provide runways for moving equipment with struts or legs, which shall be supported directly on the formwork or structural member without resting on the reinforcing steel.
- M. Provide for rebates, offsets, sinkages, keyways, moldings, blocking, bulkheads, anchorages, embeds, reglets, grooves keys, pockets, ground nailers, projections and other built-in work prior to placement of concrete. Install reglets as per manufacturer's instructions.
- N. Install dovetail slots, concrete inserts, and other metal fabrications. Secure to inside forms and space as specified in Section 05500 or as shown on Drawings.
- O. At construction joints, contact surface of the form sheathing for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by not more than 1". The forms shall be held against the hardened concrete to prevent offsets or loss of mortar at the construction joint and to maintain a true surface.
- P. Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be of a commercially manufactured type. Use of non-fabricated wire is not permitted. Construct form ties so that the ends or end fasteners can be removed without causing appreciable spalling at the faces of the concrete. After the ends or end fasteners of the form ties have been removed, terminate the embedded portion of the ties not less than 2 diameters or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view, except that in no case shall this distance be less than 3/4".
When the formed face of the concrete is not to be permanently exposed to view, form ties may be cut off flush with the formed surfaces.
- Q. Carefully check all forms before placement of concrete. Give special care to suspended first floor slabs resting on compressible material to prevent settlement.
- R. Notify the Engineer of Record if openings are required but not shown on the Drawings, who will issue instructions accordingly.
- S. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.

- T. Provide form ties at spacing as required to hold formwork readily and eliminate visible deflection and building of formwork surfaces as well as safely resist all applied loads. Ties shall be coated with an approved bond breaker.
- U. Camber forms as indicated on Drawings and elsewhere as required to achieve level finish surfaces. Camber top surfaces of such locations by setting screeds to follow camber of formwork and maintain uniform thickness. Shape of cambered form surfaces shall be gently curved.
- V. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
- W. For concrete exposed to view locate ties in level and plumb lines in an arrangement acceptable to the architect.
- X. Provide square exposed corners and edges as indicated on architectural drawings, using wood, metal, or PVC strips fabricated to produce uniform smooth lines and tight edge joints.

3.03 REMOVAL OF FORMS AND SHORING

- A. Remove forms in such a manner as to assure the complete safety of the structure as required by Section BC 1906.5 of the 2009 NJ-IBC. In no case remove forms or shoring supporting the weight of concrete in beams, slabs or structural members until the members have reached the minimum compressive strength specified on the Drawings or as permitted by the Engineer of Record.
- B. Contractor shall be solely responsible for proper and safe removal of forms, shoring, and removal of reshoring. Contractor shall do cost of tests and/or calculations needed to determine such techniques, timing and sequences without expense to The State, Architect or Engineer.
- C. Formwork for columns, walls, sides of beams, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations and as required by D below. For temperatures not less than 50 deg F this shall be a minimum of 36 hours after placement. Provide effective curing and protection.
- D. Unless reshoring is used, formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than the time period specified in ACI 347, paragraph 3.7.2.3 unless concrete has attained 75 percent of specified compressive strength at an earlier time. Determine compressive strength of in place concrete by testing field cured cylinders representative of concrete location or members. The Contractor shall pay the cost of such testing.
- E. When repair of surface defects or finishing is required at an early age, remove forms as soon as the concrete has hardened sufficiently to resist damage from removal operations.

- F. Remove top forms on sloping surfaces of concrete as soon as the concrete has attained sufficient stiffness to prevent sagging. Perform any needed repairs or treatment required on such sloping surfaces at once and follow it with the specified curing.
- G. Loosen wood forms for wall openings as soon as this can be accomplished without damage to the concrete.
- H. Reshoring is subject to the approval of the Special Inspector. While reshoring is underway, do not permit live load on new construction. Members shall never be left unsupported until concrete has attained required strength to be left unsupported as verified by the Special Inspector and if approved by the Engineer of Record.
- I. Floors supporting shores under wet concrete shall be reshored or shall have their original shore left in place. Reshores shall be placed in a planned sequence. The reshores shall have at least one-half the load capacity of the shores above and shall be distributed in the same pattern as above. Reshores shall extend at least 3 floors below the level being placed. Tighten reshores to carry the required loads without overstressing the construction. Leave reshores in place until the freshly placed concrete has reached 75% of its 28-day strength, unless otherwise specified.
- J. When reshoring of beam and girder construction is required, do not remove forms from more than one girder at a time and reshore the girder before any other supports are removed. After the supporting girders are reshored, remove the forms from one beam with its adjacent slab (half slab on each side) and reshore the beam and slab before any other supports are removed.
- K. When reshoring of flat slab construction is required, leave the shores for the area within the intersection of the middle strip of each panel in place at all times until the concrete has attained sufficient strength to support the loading to which it will be subjected. After the other shores in each panel have been removed (within the bay), place reshores on the column lines at the midpoints between columns, before the next panel is stripped.
- L. Stripping and reshoring shall conform to the requirements of Section BC 1906.6 of the 2009 NJ-IBC. Perform control tests as per Section BC 1906.5.6 for the removal of forms and shoring without simultaneous reshoring. Proper number, adequacy, size, and location of reshores shall be in accordance with acceptable good construction practice and it is the sole responsibility of the Contractor to provide safe conditions at all times during stripping and reshoring operations.
- M. Contractor shall replace or repair, at Engineer's direction, any and all work damaged by improper removal or reshoring operations.
- N. Prior to removing reshores, the underside of the slab shall be surveyed to determine the relative elevation of the slab. At a minimum, survey points are to be located next to columns and at center of column strips and middle strips. Slab edges and cantilevers are to be surveyed at points of theoretical maximum and minimum deflections within each span. Surveyor is to submit a general layout of points to engineer for approval prior to surveying the slabs. Additional points may be required at the engineer's discretion. The Contractor is

to contract out the surveying service to a surveyor independent of the concrete contractor. The cost of this survey is to be included in the lump sum bid.

3.04 TOLERANCES

- A. Construct formwork so that concrete surfaces will conform to the tolerance limits listed in ACI 117.
- B. Establish and maintain in an undisturbed condition and until final completion and acceptance of the project sufficient control points and bench marks to be used for reference purposes to check tolerances.
- C. Regardless of the tolerances listed, do not extend any portion of the concrete work beyond the lot or street line.

3.05 INSPECTION

- A. Under the requirements of Section BC 1906.2 of the 2009 NJ-IBC, formwork, including shores, reshores, braces, and other supports shall be inspected by a qualified person engaged by the Contractor. The qualified person shall make inspections prior to placement of steel to verify correct sizes of members formed and subsequently periodically after placement and during placement of concrete to detect incipient problems. Maintain a record of all inspections.
- B. Under the requirements of Section 1704.4 of the Building Code, the Contractor will engage a Special Inspector to inspect formwork for size of members and to verify in-situ concrete strengths prior to removal of formwork and shores from beams and slabs.
- C. During and after concrete placement, check elevations, camber, and vertical alignment of formwork systems using tell-tale devices.
- D. Keep a record of all inspections, the name of the persons making them, and the name of the foreman in charge of formwork at the site. Submit to the State's representative on the site a copy of the inspection records prior to each concrete placement.

NEXT PAGE

LIST OF SUBMITTALS

SUBMITTAL	DATE SUBMITTED	DATE APPROVED
Product Data:		_____
1. Overlaid plyform formwork		
2. Form liners		
3. Ties		
4. Form release agent (for review only)		
Samples:		_____
1. Overlaid plyform formwork		
2. Form liners		
Shop Drawings:		_____
1. Formwork (when required by code)		
Qualifications		_____
1. Formwork Installer		

END OF SECTION

SECTION 032000 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Provide and install all reinforcement, stud rails, reinforcing supports and associated items required for cast-in-place.

1.02 RELATED SECTIONS

- A. Concrete Formwork.....Section 031000
- B. Cast-in-Place Concrete.....Section 033000

1.03 REFERENCES

References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

- A. American Society of Testing and Materials (ASTM) standards, latest editions.
 - A82 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - A185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement.
 - A496 Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 - A615 Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - A706 Standard Specifications for Low-Alloy Steel Deformed and Plain Bars for Concrete reinforcement
- B. American Concrete Institute (ACI) standards, latest editions.
 - ACI 301 "Specification for Structural Concrete for Buildings."
 - ACI Detailing Manual SP66 (Includes ACI 315 & 315R)
 - ACI 318-02 "Building Code Requirements for Reinforced Concrete (With modifications per Section BC 1908 of the 2009 New Jersey Edition of the International Building Code (NJ-IBC))."
- C. "Placing Reinforcing Bars - CRSI-WCRSI Recommended Practices", latest edition. Concrete Reinforcing Steel Institute.

- D. "Structural Welding Code - Reinforcing Steel" D1.4 - American Welding Society (AWS).

1.04 DESIGN REQUIREMENTS

- A. Detailing requirements for reinforced concrete structures shall meet the structural integrity requirements as set in Section BC 1917 of the 2009 New Jersey Edition of the International Building Code (NJ-IBC).

1.05 SUBMITTALS

- A. Product Data

Submit manufacturers' information for the following:

1. Steel welded wire fabric
2. Steel welded wire reinforcement.
3. Supports
4. Mechanical connectors
5. Synthetic fiber reinforcement

- B. Shop Drawings

1. Submit shop drawings to the Engineer for acceptance in accordance with the requirements of the Contract Documents. Engineer shall have two weeks to review submittal packages from day after submittal arrives in Engineer's office until day that submittal is sent returned by Engineer. Submit drawings gradually and not all at the same time so that sufficient time is allowed for checking and approval.
2. At least two weeks of the notice to proceed, Contractor shall provide Engineer with a comprehensive list of all shop drawing submittals, and a schedule indicating when all submittals are to be sent to Engineer. If Contractor deviates from this schedule, Engineer shall be allowed additional time to review shop drawings.
3. Shop drawings shall conform to the highest standards of the construction industry. Include enough plans, elevations, sections and details at adequate scale to completely describe all work to be provided. All detailing work shall be in accordance with ACI 315 and shall be not less complete than examples given in ACI SP 04. Improperly prepared and incomplete shop drawings will be disapproved without review.
4. Submit shop drawings to Engineer in coordinated packages so that all required information is in hand at time of review. Prior to resubmission of shop drawings, all changes from prior issue shall be clearly circled and identified. Do not fabricate before shop drawings have been reviewed and returned to Contractor marked "No Exceptions Taken" or "Make Corrections Noted" only.

5. Contractor shall coordinate and cross check for accuracy, completeness and correct relationship to the work of other sections, each shop drawing prepared for the work of this Section, including each shop drawing prepared by accepted subcontractors. Show and dimension holes required for passage of work of other sections through cast in place concrete. Engineer's review of shop drawings does not relieve Contractor from these responsibilities.
6. Prior to sending submittals to Engineer, Contractor and Construction Manager (if applicable) shall coordinate and cross-check for accuracy and completeness each shop drawing prepared for work of this Section with the approved Construction Documents and Specifications. Shop drawings shall bear the stamp of Contractor and Construction Manager indicating that this review has been performed. Engineer will not review submittals for which Contractor and Construction Manager have not performed this review.
7. Reinforcing detail drawings shall include, but not be limited to the following:
 - a. Setting plans, wall elevations, detailed bending diagrams, cutting lists and other information so as to completely demonstrate the location, spacing, size, length, bending, shape of all reinforcing steel, and position and length of all splices.
 - b. The yield strength and ASTM designation of all reinforcing.
 - c. All control, expansion and construction joints including keys and waterstops.
 - d. Cover for reinforcing, indicated and shown on every shop drawing.
 - e. Wall reinforcing detailed on wall elevations, not on plans.
 - f. Separate top and bottom bar plans for slabs, with schedules attached. Loose 8.5 x 11 schedules are not allowed.
 - g. All openings, depressions, trenches, sleeves, embedded inserts and any other project requirements affecting reinforcing details and placing.
 - h. Type, size and location of all metal and plastic accessories required for the proper assembling, placing and support of the reinforcement.
8. Reinforcing steel shop drawings must provide all information, sections, details and marks so that reinforcing steel can be easily placed without the use of any other drawings or information. Reproduction of Structural Drawings, in entirety or part, for use as shop drawing is not permitted.
9. Detail reinforcing steel for curbs, pads, trenches, openings and the like from information given in Architectural, HVAC, Plumbing, Electrical and other Contract Documents.

10. Provide all reinforcement shown or scheduled in the Drawings, including that required by typical details and general notes, but not less than required by ACI Code minimums.
11. Detailing of reinforcement shall consider the arrangement, shape and size of individual bars, including hooks and lap splices, so as to preclude interference between bars, and embedded items and to provide clear spacing and concrete cover as required by ACI 318. Provide placing sequence information when required to properly install reinforcement in the field. Provide enough sections and enlarged details, whether they are given on Structural Drawings or not, to fully illustrate placement locations.
12. Fieldwork drawings shall be submitted for review of and acceptance for all work required to accommodate field conditions.
13. Shop drawings will be checked for size of material and spacing by the Engineer of Record, which shall not render the Engineer responsible for any errors in construction dimensions, quantities, bends, etc. that have been made in preparation of the shop drawings. The Contractor shall assume full responsibility for the correctness of quantities, dimensions and fit.

C. Quality Control Submittals

1. Certificates

- a. Submit to Testing Agency and Engineer certified copies of mill test reports for all steel reinforcement, including bars, welded wire fabric, stud rails, prestressing bars and strands.

2. Contractor Qualifications

Provide proof of Installer and Detailer qualifications specified under "Quality Assurance".

1.06 QUALITY ASSURANCE

A. Qualifications

1. Rebar Installer: Company specializing in performing the Work of this Section shall have three years minimum experience on successful projects of similar size.
2. Rebar Detailer: Company shall be specialized in the detailing of reinforcing bar shop drawings with a minimum of three years experience.

B. Regulatory Requirements

1. Building Code

Work of this section shall conform to all requirements of the NJ-IBC. Deliveries will be rejected unless:

- a. All reinforcing bars are identifiable as to point of origin, grade of steel, and size.
- b. All bundles or rolls of cold drawn steel wire reinforcement are securely tagged to identify the manufacturer, the grade of steel, and the size.

Where more severe requirements than those contained in the Building Code are given in this Section and ACI 318, the requirements of this Section and ACI 318 shall govern.

2. Industry Standards

Details of Concrete reinforcement not covered herein shall be in accordance with "Building Code Requirements for Reinforced Concrete" (ACI 318) and "Details and Detailing of Concrete Reinforcement" (ACI 315), latest editions and the Concrete Reinforcing Steel Institute Manual on "Placing Reinforcing Bars" (CRSI).

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in location to prevent rusting, etc.
- B. Protect reinforcement before, during, and after installation.
- C. Insure proper identification after bundles are broken.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars

1. All reinforcing bars, except those to be welded, shall be of deformed type of new billet steel conforming to current requirements of ASTM A615, and where not noted shall be Grade 60. No rail or re-rolled steel will be permitted. Reinforcement to be welded shall conform to the requirements of ASTM A706.
2. Grade or yield strength of reinforcing bars is indicated on Drawings.

B. Welded Steel Wire Fabric

1. Wire Fabric shall conform to the requirements of ASTM A185.
2. Required net area, placement details, and other requirements are indicated on Drawings.

C. Supports for Reinforcement

1. Supports for reinforcement supported by formwork or deck shall consist of metal bolsters and chairs of adequate strength, size, and number. Provide CRSI Class C

supports (plastic tipped) for formed concrete surfaces and Class A (bright basic) for metal deck.

2. Supports for reinforcement of slabs supported by ground shall consist of above supports with sand plates or horizontal runners. Support for reinforcement of footings/pile-caps shall consist of the above supports or precast concrete block, 4" square, having a compressive strength equal to that of the concrete being placed.
- D. Mechanical Tension Splices for Reinforcing Bars: Cadweld Rebar Splices or Lenton Couplers by Erico Products, Inc., BarGrip by BarSplice Products Inc., or equivalent accepted by Engineer.
- E. Mechanical Compression Splices for Reinforcing Bars: Speed-Sleeve Splices by Erico Products, Inc. or equivalent accepted by Engineer.

2.02 FABRICATION

- A. Fabricate reinforcing bars in accordance with fabricating allowances given in ACI 315 and accepted shop drawings.
1. Partially embedded reinforcement shall not be bent or re-bent without the express written acceptance of the engineer. Offset bars shall be bent before placing.

PART 3 - EXECUTION

3.01 PLACEMENT

- A. General
1. Place reinforcement in accordance with CRSI "Placing Reinforcement Bars" and Section BC 1907.5 of the 2009 NJ-IBC.
 2. Unless otherwise permitted, welding of crossing bars (tack welding) for assembly of reinforcement is prohibited.
 3. Avoid cutting or puncturing vapor barrier during placement.
 4. Clean reinforcement of loose rust and mill scale, earth, ice and other bond inhibiting materials.
 5. Accurately position as shown on accepted shop drawings. Support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
- B. Supports

1. Support and fasten together all reinforcement to prevent displacement by construction loads or placing of concrete. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces. Tie wire ends shall not fall within required clear concrete cover.
 2. Provide supports specified in Article 2.01.
 3. Provide Continuous High Chair Upper (CHCU) or Continuous Support (CS) for welded wire fabric in the metal deck and place every four feet (4') parallel to the supporting beams.
 4. Lifting of bars and welded wire fabric into position during placement of concrete is not permitted.
 5. Where the concrete surface will be exposed to the weather in the finished structure, the portions of all accessories within 1/2" of the concrete surface shall be non-corrosive or protected against corrosion.
 6. Neither top nor bottom bars shall be allowed to sag below tolerances specified herein.
 7. For #8 bars and smaller, separate adjacent layers of parallel bars with short length of #8 bars, securely tied to the layers. For #9 bars and larger, separator bar shall be of the largest bar size separated.
- C. Cover
1. Provide minimum protective cover given in Section 1907.7 of the 2009 NJ-IBC.
 2. Place reinforcement to obtain at least minimum coverages for concrete protection as required.
- D. Splices
1. All splices not shown on the Project Drawings shall be shown on the shop drawings and approved by the Engineer of Record.
 2. Provide welded splices where indicated on Drawings. All welding shall conform to AWS D1.4. At these locations, only reinforcement conforming to ASTM A706 shall be used.
 3. Provide mechanical connectors where indicated on Drawings. Install in accordance with splice device manufacturer's recommendations.
 4. For wwf in slabs on ground lap adjoining pieces at least one full mesh plus two inches and lace splices with wire.
- E. Embedment Lengths
- All embedment lengths not shown on the Project Drawings shall be shown on the shop drawings and approved by the Engineer of Record.

3.02 TOLERANCES

- A. Fabricate bars in accordance with the fabricating tolerances given in ACI 315. Place reinforcing bars in accordance with the tolerances given in Section 1907.5.2 of the 2009 NJ-IBC, ACI 318 Chapter 7, or provided herein, whichever is more stringent.
1. Bars shall be placed to the following tolerances:
 - a. Clear distance to formed surfaces + 1/4"
 - b. Minimum spacing between bars + 1/4"
 - c. Top bars in slabs and beams:
 - 1) Members < 8" deep + 1/4"
 - 2) 8" < Members < 24" deep + 1/2"
 - d. Crosswise of members: spaced evenly within 2"
 - e. Lengthwise of members: + 2"
- B. Move bars as necessary to avoid interference with other reinforcement, conduits, or imbedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangements are subject to approval by the Engineer of Record.

3.03 FIELD QUALITY CONTROL

- A. Under the requirements of Section BC 1704.4 of the 2009 NJ-IBC, the Contractor will engage a Special Inspector to inspect the size and placement of reinforcement. A record will be made of all inspection of reinforcement at the bending bench and in place. The Contractor shall conduct all required Special Inspections by independent testing agencies listed, approved and classified by the State.
- B. Do not proceed with the completion of wall forms until all reinforcement has been approved and recorded by the Special Inspector.
- C. Do not proceed with concreting until all reinforcing in place has been approved and recorded.
- D. Promptly correct all reinforcement displaced during pouring of concrete.
- E. Protect reinforcing steel and mesh from scaling, oil, grease and distortion. Reinforcing steel and mesh that has rusted to the extent of scaling will be rejected and may be placed in the work only after proper cleaning and approval by the Testing Agency. Damaged reinforcement shall not be used.

3.04 CLEANING

- A. Steel reinforcement shall be free of all rust, scale, oil, paint, grease, loose mill scale, and all other foreign matter that will prevent bonding of concrete and steel just prior to pouring of concrete.

NEXT PAGE

LIST OF SUBMITTALS

SUBMITTAL	DATE SUBMITTED	DATE APPROVED
Product Data:		_____
1. Welded wire fabric		
2. Welded wire reinforcement		
3. Supports		
4. Mechanical connectors		
Shop Drawings:		_____
1. Reinforcement layout		
Certificates:		_____
1. Reinforcing bars		
2. Welded wire fabric		
3. Welded wire reinforcement		
Qualifications:		_____
1. Rebar Installer		
2. Rebar Detailer		

END OF SECTION

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Drawings, conditions of the Contract (including General, Supplementary and Special Conditions), Division 1 Specification Sections and all other Contract Documents apply to work of this section.
- B. Extent of cast-in-place concrete is indicated on the Drawings, including layout and sizes of members, type and strength of concrete, reinforcing and accessories.
- C. Furnish material, equipment, labor, and services required to provide for cast-in-place concrete.
- D. Structural work includes but is not limited to piers, pile caps, slabs on ground including vapor barriers and porous fill, pits, steel encasement, walls, formed slabs, beam and column pockets, sleeves and openings, depressions and drops.
- E. Additional work includes but is not limited to fill and topping slabs, expansion, contraction and control joints, keys, sitework, concrete fire protection, equipment pads, and installation of miscellaneous inserts, waterstops, vapor barriers, and other items listed herein. Also included is finishing and treatment of exposed concrete floors and stairs, finishing of concrete exposed to view, designing and testing of concrete mixes, and submittals as listed in 1.08.
- F. All materials, equipment, labor and services required to complete the work. Allow ample time and facility for the Work of other Divisions to be installed.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

Products to be installed include, but are not limited to, the following:

- A. Anchor bolts and other anchors
cast into concrete.....Section 051200
- B. Wedge inserts and other miscellaneous
items cast into concrete.....Section 055000
- C. Joint fillers.....Section 079200
- D. Sleeve for pipe and conduit, other items
Cast into concrete.....Divisions 15 & 16

1.03 RELATED SECTIONS

- A. Concrete Formwork.....Section 031000
- B. Concrete Reinforcement.....Section 032000

1.04 REFERENCES

References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

- A. Conform to the requirements of the New Jersey version of the International Building Code.
- B. American Society of Testing and Materials (ASTM) standards, latest editions.
 - C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - C33 Standard Specifications for Concrete Aggregates.
 - C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - C78 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Three-point Loading)
 - C94 Standard Specification for Ready-Mixed Concrete.
 - C127 Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Course Aggregate.
 - C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - C138 Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
 - C143 Standard Test Method for Slump of Hydraulic Cement Concrete.
 - C150 Standard Specification for Portland Cement.
 - C172 Standard Method of Sampling Freshly Mixed Concrete.
 - C173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - C192 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
 - C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - C260 Standard Specifications for Air-Entraining Admixtures for Concrete.

- C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - C330 Standard Specification for Lightweight Aggregates for Structural Concrete.
 - C387 Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
 - C494 Standard Specification for Chemical Admixture for Concrete.
 - C496 Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
 - C567 Standard Test Method for Density of Structural Lightweight Concrete.
 - C685 Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
 - C882 Standard Test Method for Bond Strength of Epoxy-Resin Systems used with Concrete by Slant Shear
 - C1315 Standard Specification for Liquid-Forming Compounds Having Special properties for Curing and Sealing Concrete
 - E96 Standard Test Methods for Water Vapor Transmission of Materials
 - E154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
 - E329 Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction
 - E1643 Standard Practicew for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
 - E1745 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
- C. American Concrete Institute (ACI) standards, latest editions.
- ACI 117 Standard Tolerances for Concrete Construction and Materials.
 - ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - ACI 211.2 Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
 - ACI 212.3R Chemical Admixtures for Concrete.

ACI 214R	Evaluation of Results of Tests Used to Determine the Strength of Concrete.
ACI 301	Specifications for Structural Concrete for Buildings.
ACI 302.1R	Guide for Concrete Floor and Slab Construction.
ACI 304R	Guide for Measuring, Mixing, Transporting and Placing Concrete.
ACI 304.2R	Placing Concrete by Pumping Methods
ACI 304.5R	Batching, Mixing and Job Control of Lightweight Concrete
ACI 305R	Hot Weather Concreting.
ACI 306R	Cold Weather Concreting.
ACI 308	Standard Practice for Curing Concrete.
ACI 309R	Guide for Consolidation of Concrete.
ACI 311.4R	Guide for Concrete Inspection.
ACI 318-02	Building Code Requirements for Reinforced Concrete (With modifications per Section BC 1908 of the 2009 NJ-IBC).
SP-66(04)	ACI Detailing Manual

D. American Association of State Highway and Transportation Officials

T318	Water Content of Freshly Mixed Concrete Using Microwave Oven Testing
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1.05 DEFINITIONS

A. Exposed to view

Situated so that it can be seen from eye level from a public location. A public location is that which is accessible to persons not responsible for operation or maintenance of the building.

B. Lightweight concrete

Concrete intentionally made to have low density by use of lightweight aggregate conforming to ASTM C330 and required to have an air-dry unit weight less than 115 lb/ft³.

C. Normal weight concrete

Concrete for which density is not a controlling attribute, made with aggregates of the types covered by ASTM C33 and usually having unit weights in the range of 135 to 160 lb/ft³.

1.06 DESIGN REQUIREMENTS

A. Performance Characteristics:

1. All concrete shall adhere to the durability and minimum strength requirements set forth in Section BC 1904 of the Building Code.
2. Concrete strengths shall be as shown on the drawings and drawing notes.

1.07 SUBMITTALS

A. Product Data

Submit manufacturers' information for the following:

1. Admixtures
2. Curing compounds
3. Hardener
4. Bonding & Repair Agents
5. Beam clips
6. Vapor barrier
7. Vapor retarder
8. Waterstop
9. Joint Fillers

B. Samples

Submit samples of the following items

1. Vapor Barrier
2. Vapor Retarder
3. Beam clips
4. Waterstop

C. Concrete Mix Design

Submit proposed concrete mix designs for each type of concrete as required in Part 2.03 of this Section for acceptance by the Engineer at least three weeks prior to the start of any concrete work. Reports shall be signed and sealed by a Professional Engineer licensed in the state of NJ and experienced in the design and testing of concrete mixes.

The reports shall be made on the mix design submittal form included at the end of this specification, or with a similar format.

1. Reports for each mix shall include:
 - a. Source and type of each cement, including results of chemical and physical tests, if requested by Engineer.
 - b. Complete identification of source of supply for each type of aggregate.
 - c. Results of tests of aggregates for compliance with specified requirements, if requested by Engineer.
 - d. Scale weight of each aggregate.
 - e. Absorbed water in each aggregate.
 - f. Brand, type and amount per cubic yard of each admixture used (including synthetic fiber reinforcement).
 - g. Amount of free water used per cubic yard.
 - h. Proportions of each material per cubic yard.
 - i. Gross weight per cubic foot.
 - j. Measured slump.
 - k. Water/cementitious materials ratio, by weight. Submit strength vs. water/cementitious materials ratio curve based upon compressive tests, and indicating water/cementitious materials ratio to be used.
 - l. Total air content, by percent.
 - m. Water soluble ion chloride content, percent by weight of cement, if maximum is specified in this Section.
 - n. Compressive strength at seven and 28 days, from not less than two cylinders at seven days and not less than four at 28 days, for at least four different water/cement ratios.
 - o. Complete standard deviation analysis or trial mix test data.
 - p. For mixes with a design strength of more than 4 ksi, results of at least 4 cement cube strength tests.
2. If requested by Engineer, submit manufacturer or supplier's certificates of conformance to applicable standards for each ingredient.

D. Deviations

Requests for deviations from the Drawings or Specifications shall be submitted on Contractor's letterhead. Acceptance of shop drawings including deviations not detected during shop drawing review will not relieve Contractor from responsibility to conform strictly to the Contract Documents. Deviations will be allowed only where permitted by Engineer in writing. Proposed deviations must be accompanied by documented and physical evidence, which will establish that its quality equals or exceeds the quality specified.

E. Protective Measures

Submit hot and cold weather concreting procedures prior to start of any work. Including cold weather heating systems, enclosures, insulation, curing procedures and the like. Procedures shall be reviewed at a preconstruction conference.

F. Quality Control Submittals

1. Certificates

- a. Admixture manufacturer's certificate stating that the chloride content of the admixture will not exceed 0.05% by weight.
- b. Concrete laboratory license number and certification of meeting ASTM E329 standards.
- c. Concrete producer's Computer Batch Ticket in accordance with Section BC 1905.8.2 of the 2009 NJ-IBC must be presented at site before concrete is placed for every load of concrete delivered.

2. Manufactures' Instructions

Waterstop manufacturer's instructions for proper installation of waterstop, including manner in which splices are to be made.

3. Contractor Qualifications

Provide proof of Installer and Producer qualifications specified under "Quality Assurance".

H. Survey

Submit signed and sealed copies of surveys conducted by a Licensed Land Surveyor showing elevations of all finished slab surfaces.

I. Mock-up

Provide mock-up as indicated under Quality Assurance.

1.08 QUALITY ASSURANCE

A. General

Contractor shall examine all Contract Documents and note any discrepancies or items requiring close coordination or time schedules; assume responsibility of same and administer action such that the proper solution will result.

1. Contractor's material control procedures shall be effective and shall assure that all work fulfills the requirements of applicable provisions of the Contract Documents.
2. Contractor shall maintain sufficient staff to assure that all data and drawings for work of other sections is transmitted to detailers to allow proper detailing of holes, penetrations and the like and to assure proper execution of the work in the field.
3. Perform quality control functions required to achieve and to document that work conforms to the Contract Documents. Provide a reasonable number of copies of quality control reports and make all documents available up on request to the Architect, The State and Engineer.
4. Contractor and Construction Manager shall coordinate and schedule the work of this section with the work of other sections of this specification in order to optimize quality and to avoid delay in job progress.
5. Prior to starting work the contractor shall cooperate and coordinate with each trade affected by the work of this section. Contractor shall report unsatisfactory or nonconforming conditions to the Engineer in writing prior to the start of work.
6. Construction loads shall not exceed the superimposed load which the member, with necessary supplemental support, is capable of carrying safely and without damage. The amount, method of distribution, and proposed supplemental support is the sole responsibility of the contractor.

B. Qualifications

1. General: Provide at least one person who shall be thoroughly familiar with the Construction Documents and other applicable requirements, trained and experienced in the necessary skills, and who shall be present at the site and direct all work performed under this section. Use an adequate number of skilled workmen to ensure installation in strict accordance with the approved design.
2. Concrete Installer: Company specializing in performing the Work of this Section shall have three years minimum experience on successful projects of similar size.

C. Regulatory Requirements

1. Building Code: Work of this Section shall conform to all requirements of the New Jersey Edition of the International Building Code (NJ-IBC) and all applicable regulations of governmental authorities having jurisdiction including safety, health, noise, and anti-pollution regulations. Where more severe requirements than those

contained in the Building Code are given in this Section, the requirements of this Section shall govern.

2. Industry Standards: The ACI Standards listed under references apply to Work of this Section. Where more severe requirements than those contained in the Standards are given in this Section or the Building Code, requirements of this Section or the Building Code shall govern. The Contractor shall keep a copy of ACI SP-15 - "Field Reference Manual" at the site.
3. Recommendations or suggestions in the codes and references listed in this Article and under "References" shall be deemed to be mandatory unless they are in violation of the Building Code.

D. Certifications

1. Cast-in-Place Concrete shall conform to the material acceptance, certification, and inspection requirements of Sections BC 1701 and BC 1905 of the 2009 NJ-IBC.
2. Cement and aggregate shall be acquired from the same source for all work. If a change in suppliers is required, a new mix submittal must be produced with the new material and submitted for approval.

E. Cold Weather

When casting concrete in cold weather, plans to protect the concrete shall be made in advance and in accordance with ACI306.1 and all necessary material and equipment shall be on site well in advance of concrete placement. The contractor is responsible for ensuring the proper planning for cold weather concreting.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Materials and products shall be delivered to the site in the manufacturer's original and unopened containers and packaging bearing labels as to type of material, brand name and manufacturer's name. Delivered materials shall be identical to accepted samples.
- B. Materials and products shall be handled in a workmanship like manner per manufacturer's specifications. Storage shall be under cover in dry, weathertight, ventilated and clean locations off the ground.
- C. Storage of ingredients for concrete:
 1. Cement shall be stored in weathertight containers.
 2. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates. To ensure that this condition is met, any test for determining conformance to requirements for cleanliness and grading shall be performed on samples secured from the aggregates at the point of batching. Frozen or partially frozen aggregates shall not be used.

3. Stockpiles of natural or manufactured sand shall be allowed to drain to ensure a relatively uniform moisture content throughout the stockpile.
 4. Unless predampening is not considered desirable by the manufacturer or is considered impractical by the Engineer, dry lightweight aggregates shall be predampened as necessary. To prevent excessive variations in moisture content, predampened aggregates shall be allowed to remain in the stockpiles for a minimum of 12 hours before use.
 5. Admixtures shall be stored in a manner that will avoid contamination, evaporation, or damage. For admixtures used in the form of suspensions or nonstable solutions, agitating equipment shall be provided to ensure thorough distribution of the ingredients. Liquid admixtures shall be protected from freezing and from temperature changes which would adversely affect their characteristics.
- D. Delivered materials which are damaged or otherwise not suitable for installation, shall be removed from the jobsite and replaced with acceptable materials.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Adequately protect concrete placed during rain, sleet, or snow, or when the mean daily temperature falls below 40°F or rises above 90°F as provided in Article 3.05.

1.11 PROJECT SITE CONDITIONS

- A. The Contractor shall report in writing to the Engineer any discrepancies between the design drawings and the existing site conditions.
- B. The Contractor shall field verify all information related to existing conditions such as: Surrounding structures, underground utilities and any other conditions that may exist.
- C. The Contractor shall survey surrounding structures to obtain information such as: Elevation of existing footings, bearing walls, water supply, sewage, utility piping and other utilities installations which may interfere with the construction.
- D. The Contractor shall obtain the pertaining information described above before starting a particular phase of work.
- E. Examine the substrata and the conditions under which the concrete is to be installed, and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the work until the unsatisfactory conditions have been corrected.
- F. All concrete work shall be properly protected during casting against freezing, excessive heat, acid rain or any other environmental destructive agent. Completed work shall be covered temporarily, permanently or as required. Protect adjacent finish materials against spatter during concrete placing.
- G. The Contractor shall comply with any and all federal, state and local environmental code requirements.
- H. Descriptions of, or limitations on, sequences of construction given in the Contract Documents are intended to assist the Contractor. Descriptions or limitations given are not by any means intended to fully describe construction limitations, sequence or techniques, nor preclude use of other methods if accepted by Engineer in writing. Whether or not Contractor follows the limitations and descriptions given herein, Contractor remains fully responsible for both the stability and the safety of the work; adherence to the limitations described herein does not relieve the Contractor from that responsibility.

1.12 DEFICIENT WORK

- A. Deficient work or any work failing to strictly conform to the Contract Documents shall be removed and replaced, or repaired if accepted by Engineer, at no cost to the State, Architect or Engineer.
 - 1. Contractor shall prepare appropriate details and procedures to bring such work into conformance with the Contract Documents and submit to Engineer for review and acceptance. Contractor shall, through the State, reimburse the Engineer for time and expense incurred reviewing proposal procedures and details in accordance with the Engineer's current fee schedule.
 - 2. Nonconforming work may be rejected by The State, Architect or Engineer at any time, regardless of prior acceptance in shop drawings, prior inspection, inclusion in inspection or test reports, or inclusions in certificates of payments.

- B. Deficient work shall include, but not be limited to:
1. Low cylinder strength, as defined by this Specification.
 2. Excessive or deficient air content.
 3. Slump not in accordance with this Specification.
 4. Spalling, honeycombing, surface defects, cracking, improper consolidation or the like.
 5. Unauthorized cutting, construction joints, cold joints and so forth.
 6. Workmanship not in accordance with the Drawings, with this Specification, with accepted samples, or with referenced codes or standards.
 7. Incorrect forming, finishing or treating of concrete surfaces.
 8. Exceedance of tolerances.
 9. Evidence of improper curing and the like.
 10. Higher than specified water content and/or w/cm ratio as determined by Microwave testing.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Lightweight Aggregate
1. Northeast Solite Corporation,
 2. Norlite Corporation,
 3. (Approved equal)
- B. Admixtures
1. Euclid Chemical Company, Cleveland, OH 44110
 2. Master Builders,
 3. Sika Chemical Corporation,
 4. Anti Hydro Company,
 5. Chem Masters,
 6. W.R. Grace & Co.,

7. St. Lawrence Cement Company,
7. BASF
8. (Approved equal)

C. Curing Compounds

1. Euclid Chemical Company, Cleveland, OH 44110
2. Master Builders,
3. (Approved equal)

D. Waterstops

1. BBZ USA-Greenstreak, St. Louis, MO 63122
2. Sika Corp, Lyndhurst NJ 07071
3. DeNeef Construction Chemicals, Waller, TX 77484
4. (Approved Equal)

E. Bonding Agent

1. Sto Concrete Restoration Division, Atlanta GA
2. Sika Corp, Lyndhurst NJ
3. Euclid Chemical Company, Cleveland, OH 44110
4. (Approved Equal)

F. Densifier/Sealer

1. Euclid Chemical Company, Cleveland, OH 44110
2. Curecrete Chemical Company, Inc., Springville, UT 84663
3. (Approved Equal)

2.02 MATERIALS

A. Cement

Shall conform to ASTM C150 and shall be of the non air-entrained types, from a single supplier:

1. Unless otherwise specified or approved by the Engineer of Record, cement shall be Type I or II.
2. Type II shall be used for exterior pavements.
3. Cement shall not contain ingredients that would result in more than two percent air being entrained in the concrete.
4. For concrete mixes with a design strength of more than 4ksi, cement shall have a minimum 28 day cube strength of 4000 psi when tested in accordance with ASTM C109.

B. Admixtures

1. General
 - a. The use of admixtures shall comply with the requirements of Section BC 1903.6 of the 2009 NJ-IBC.
 - b. The final soluble chloride content in concrete, percent by weight of cement, due to the addition of admixtures and other ingredients shall not exceed 0.05 at 28 days. All admixtures shall be non-corrosive.
 - c. The amount of cement required by the Building Code may be reduced by 40% as per the code with the use of slag cement that has been reviewed and approved by the State.
 - d. All admixtures shall be added at separate intervals of the mix cycle.
2. Air-entraining admixture: Shall conform to ASTM C260.
3. Water-reducing admixture: Shall conform to ASTM C494, Type A or D, and contain no more chloride ions than found in drinking water.
4. High range, water-reducing admixture (super- plasticizer): Shall conform to ASTM C494, Type F or G, and contain no more chloride ions than found in drinking water.
5. Water reducing, accelerating admixture: Shall conform to ASTM 494, Type C or E, and contain no more chloride ions than found in drinking water.
6. Water reducing, retarding admixture: Shall conform to ASTM C494, Type D, and contain no more chloride ions than found in drinking water.
7. Slag cement: ASTM C989, Grade 100 or 120. Shall be GranCem slag cement as manufactured by the St. Lawrence Cement Company.
8. Fly Ash: ASTM C618, Class F except that maximum carbon content shall not exceed three percent and maximum percentage retained on the #325 screen shall not exceed 25 percent. Fly ash shall be from a single, domestic source.

9. Corrosion inhibiting, calcium nitrite based compound; "Eucon CIA" by the Euclid Chemical Company, "DCI Corrosion Inhibitor" by W.R. Grace & Co., "Rheocrete CNI" by BASF Admixture Systems.
10. Microsilica; "MSA" by the Euclid Chemical Company, "Force 10,000" by W.R. Grace & Co., or "Rheomac SF" by BASF Admixture Systems.

C. Water

Shall be clean potable water free of injurious foreign matter conforming to the requirements of Section BC 1903.4 of the Building Code.

D. Aggregates

Fine and coarse aggregates shall be regarded as separate ingredients. Each size of coarse aggregate, as well as the combination of sizes when two or more are used, shall conform to the appropriate grading requirements of the applicable ASTM specifications. Maximum size of coarse aggregate shall conform to paragraph 3.3.2 of ACI 318.

1. Aggregates for normal weight concrete shall conform to ASTM C33 and be of Size No.67 and/or No.8.
2. Aggregates for lightweight concrete shall conform to ASTM C330 and be of sizes 3/4" to No.4, 1/2" to No.4, and/or 3/8" to No.8. Lightweight coarse aggregate shall be rotary kiln product of expanded shale or slate and conforming to the requirements for normal weight coarse aggregates.
3. Fine aggregate shall be clean, hard, light colored sand.
4. Pea gravel aggregate shall be as given above except coarse aggregate shall be ASTM C33 size #8.
5. Aggregates for slab on ground shall conform to the recommendations of ACI 302.1R Chapter 4.

E. Curing Compounds

1. Non-strippable
 - a. Clear Curing and Sealing Compound (A.I.M. Regulations - VOC Compliant, 350 g/l): Liquid type membrane-forming curing compound, clear styrene acrylate type, complying with ASTM C1315, Type I, Class A, 25% solids content minimum. Moisture loss shall be not more than 0.40 Kg/m² when applied at 300 sq. ft./gal. Manufacturer's certification is required.
 - b. Curing Compounds shall be "Super Diamond Clear VOX" by The Euclid Chemical Company or "Masterkure 100W" by Master Builders, or approved equal.

2. Strippable

- a. Clear Curing Compound: Liquid type membrane-forming curing compound, complying with ASTM C309.
- b. Curing Compounds shall be "Kurez DR Vox, Kurez W Vox by The Euclid Chemical Company or "Masterkure N-Seal VOC" by Master Builders, or approved equal.

F. Curing Materials

Sheet materials shall conform to ASTM C171 and be non-bleeding and non-staining. Burlap cloth shall be made from jute or kraft and conform to AASHTO M182, using at least 2 layers.

G. Bonding Agent

1. Epoxy/acrylic resin that will not form a vapor barrier with the concrete with the following properties:
 - a. Bond strength of 1800 psi in 2 hours when tested in accordance with ASTM C882.
 - b. Flexural strength of 2000 psi in 28 days when tested in accordance with ASTM C78.
 - c. Tensile strength of 600 psi in 28 days when tested in accordance with ASTM C496.
2. Bonding agent shall be "CR246 Sto Bonding and Anti-corrosion Agent" by Sto Concrete Restoration Division, Armatec 110 by Sika Corp, Corr-bond by Euclid Chemical Company, SBR Latex by Euclid Chemical Company, Daraweld-C by W.R. Grace & Co. or equivalent accepted by Engineer.

H. Densifier/Sealer

1. The densifier/sealer compound shall be a VOC compliant, non-yellowing, silicate-based sealer that penetrates concrete surfaces and increases abrasion resistance and provides a "low-sheen" surface that is easy to clean. The compound shall contain a minimum solids content of 20%, of which 50% is silicate.
2. Densifier/Sealer shall be "Euco Diamond Hard" by The Euclid Chemical Co. or "Ashford Formula" by Curecrete Chemical Co., or approved equal.

I. Waterstops

1. Concrete Joints

- a. Water-swelling acrylate ester resin, hydrophilic rubber, or polyurethane type capable of expanding and contracting over multiple number of wet-dry cycles without reduction in its expansion ratio. If concrete surface is very uneven, provide paste type indicated in 2 below.
 - b. Shall be Duroseal Gasket Waterstop by BBZ USA-Greenstreak, Swellseal 8 by DeNeef, SikaSwell Profile by Sika Corp., or Waterstop-RX by Volclay Provide approximately 1" x 3/4" chemical resistant type. Attach to concrete and membranes with manufacturer's recommended adhesive or paste type waterproofing.
 - c. PVC type shall be 6" wide dumbbell or serrated type made from virgin PVC; Style 748 or 679 by Greenstreak, Type R6-316 by Vinylex, or equivalent accepted by Engineer.
2. Steel, pipe and metal penetrations
- a. Water-swelling acrylate ester or polyurethane paste type capable of expanding and contracting over multiple number of wet-dry cycles without reduction in it expansion ratio. Paste is a thixotropic grade material capable of being placed on uneven surfaces.
 - b. Shall be Duroseal Paste by BBZ USA, Swellseal Mastic by DeNeef, or SikaSwell S by Sika Corp. Provide chemical resistant type. Provide a minimum of 3/8" by 1/2" bead of material.
- J. Granular Fill
- Under slabs on ground shall be well a graded run of bank sand and gravel with maximum size of 1-1/2", between 30% and 50% passing a #4 sieve, between 10% and 25% passing a #50 sieve and not more than 5% of particles by weight passing a #200 sieve. Imported material, if required, shall consist of a well graded mixture of sand and durable, hard limestone. The Contractor shall provide laboratory gradation tests (i.e., before and after laboratory compaction tests) and compaction tests (ASTM D 1557) prior to delivery for evaluation and approval by the geotechnical engineer.
- M. Gravel or Crushed Stone
- Under slabs on ground shall be hard, clean, natural rock, free of dust or other contaminants, and graded to requirements of ASTM C33, size #67.
- N. Bond Breaker
- Under fill and topping slabs shall be 4 mil thick polyethylene sheet.
- P. Expansion Dowels
- ASTM A36 bars, hot-dipped galvanized and provided with a suitable expansion shield securely positioned and end filled with a readily compressible material assuring adequate expansion space beyond.

Q. Neoprene Pads

Shall conform to AASHTO Standard Specification, Division II, Chapter 18 ASTM D2240, grade 50 Durometer hardness.

R. Premolded Joint Filler

Non-extruding bituminous-type preformed expansion joint filler conforming to ASTM D1751.

S. Expansion Joint Filler

Sponge neoprene, closed cell, ASTM C1056, Grade SCO-11, high performance.

T. Semi Rigid Joint Filler

For contraction and construction joints in slabs on grade a two (2) component 100% solids compound, with a minimum shore A hardness of 80. Provide "Euco 700" or "QWIKjoint 200" by The Euclid Chemical Company or Masterfill CJ by BASF Admixture Systems.

U. High Strength Repair Mortar

A flowable high strength, microsilica modified repair mortar for large horizontal placements or form and pour applications; Eucocrete by Euclid Chemical.

V. Underlayment Compound

Free flowing, self-leveling, pumpable cementitious base compound, Flo-Top or Super Flo-Top by The Euclid Chemical Company, Ardex by Ardex Company, or Underlayment 110, by BASF Admixture Systems.

2.03 MIXES

A. General

1. Contractor shall employ a consultant, acceptable to the Engineer, hereinafter called the "Concrete Consultant", to prepare concrete mix designs from representative samples of the materials to be used to produce the concrete for each "type" of concrete required. A new "type" of concrete exists whenever there are changes to source or type of ingredient, source or type of cement, design strength, proportioning, or placing methods.
2. The Concrete Consultant shall design or verify mixes for each "type" of concrete in accordance with the trial mixture method or field experience method of ACI 318 Article 5.3. Test results of trial mixes shall be submitted to Engineer for acceptance prior to concreting. Each mix shall clearly state the location where mix is to be used.

3. The proportion of ingredients shall be selected by the Concrete Consultant to produce proper placeability, durability, strength, and to produce a mixture which will work readily into the corners and angles of forms and around reinforcement by methods of placement and consolidation employed on the work, but without permitting materials to segregate or permitting excessive free water to collect on surface. Comply with recommendations of ACI 211.1, 211.2 and 302.1R.
4. When a source, type, kind or brand of each constituent has been established and approved for the project mixes, it shall not be changed throughout the duration of the concreting. Batch all constituents including admixtures at the central batch plant.

B. Method of Proportioning

1. Proportion, batch, and mix concrete in accordance with Section BC 1905. The licensed concrete laboratory is responsible running the mix. Proportion concrete mix in accordance with Section BC 1905.3.
2. Mix designs are specific to material used, concrete producer, and method of placement. Each mix design must be reviewed by the Engineer of Record and accepted prior to placement
3. The recycled content in the concrete mix shall be 40% of the cementitious content or a minimum of 6% of the dry weight.

C. General Mix Requirements

1. Concrete mixes shall be designed to provide for all of the requirements given in this Specification and on the Drawings even if strength or any other criteria must be exceeded to meet another criteria.
2. Strength requirements given on the Drawings shall be based on 28-day compressive strength (56 days for concrete containing 40% alternate cementitious material - slag) for Type I and II cement and 7-day for Type III, unless a different test age is specified.
3. Concrete to be exposed to deicing salts, to brackish water, or to salt laden air in service shall have a maximum water-to-cement ratio, by weight, of 0.40, a minimum strength of 5000 psi, a minimum cement content of 650 pounds per cubic yard, air entrainment, Type II cement, and a maximum water soluble chloride ion content of 0.15 percent by weight of cement.
4. All concrete required to be watertight shall have a maximum water-to-cement ratio, by weight, of 0.45 and a minimum strength of 4500 psi.
5. All trowel finished interior slabs subjected to vehicular traffic, shall have a maximum water-to-cement ratio, by weight, of 0.53 and a maximum air content of

3% (no air entraining admixture used).

6. Provide pea gravel aggregate concrete for all sections thinner than 6 inches, and where required due to congestion of reinforcing steel.
7. Concrete mixes to be exposed to earth or weather shall have a maximum water soluble chloride ion content of 0.30 percent by weight of cement.
10. All normal weight concrete subject to freezing and thawing shall contain 4½% minimum to 7% maximum total air content. All light weight concrete shall contain 5% total air content. The allowable tolerance shall be plus or minus 1 ½% of the air content indicated in the mix design.

D. Normal Weight Concrete

1. Unless otherwise specified, proportion and produce normal weight concrete to have a maximum slump of 4" or less. A tolerance of up to 1" above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. The slump shall be determined by ASTM C143. Concrete containing High Range Water Reducer shall have a slump not exceeding 9", unless otherwise approved by the Engineer of Record. The concrete shall arrive at the job site at a slump of 2" to 3", be verified, and the HRWR admixture added to increase the slump to the approved level.
2. All normal weight concrete subject to freezing and thawing shall be air-entrained, provide the following air content for the grading size of coarse aggregate as follows:
 - a. No.8.....7½%
 - b. No.67.....6%Tolerance on air content as delivered shall be +1.5%.
3. Normal weight concrete shall have a maximum water-to-cement ratio, by weight, of 0.50 and a minimum strength of 4,000 psi unless otherwise noted.

E. Admixtures

1. Concrete mixes with admixture dosages exceeding 64 ounces per cubic yard of concrete shall have free water content of concrete mix reduced by aqueous portion of admixtures in order to adhere to water to cementitious ratio requirements.
2. A water reducing admixture or high-range water reducing admixture shall be used in all mix designs.
3. A high range, water reducing admixture shall be used when any of the conditions below apply. Self-Consolidating concrete shall have a slump/flow of 20" to 30".

- a. Water to cementitious ratio is 0.45 or less, architectural concrete, self-consolidating concrete, and synthetic fiber concrete.
 - b. Concrete is to be pumped.
 - c. When requested by the Contractor and accepted by the Engineer in concrete mix design.
4. An air-entraining admixture shall be used in all mix designs for concrete subject to freezing and thawing.
 5. A water reducing, retarding admixture shall be used when concrete is to be placed during hot weather as defined by ACI 305R.
 6. Fly ash shall be used as an admixture for all lightweight concrete to be pumped.
 7. A non-corrosive accelerator shall be used when concrete is to be placed during cold weather as defined by ACI 306.1.
 8. Synthetic macro fiber reinforcement shall be used where called for on the Drawings and when requested by Contractor and accepted by the Engineer. Unless noted otherwise on the Drawings, or otherwise recommended by the manufacturer, dosage rate shall be 1-1/4 pounds per cubic yard.

2.04 SOURCE QUALITY CONTROL

A. Testing and Inspection

1. The Contractor shall conduct all required tests and special inspections by independent testing laboratories and agencies listed, approved and classified by the State.
2. The Testing Laboratory will perform field tests as work progresses as listed in "Field Quality Control".

B. Inspection

1. Testing Laboratory
 - a. The Laboratory will perform the following services:
 - 1) Review and/or check-test the Contractor's proposed materials for compliance with the Specifications.
 - 2) Review and/or check-test the Contractor's proposed mix design.
 - 3) Secure production samples of materials at plants or stock-piles during the course of the Work and test for compliance with the Specifications.

- 4) Perform tests during construction as required by Section BC 1905.6.2 of the 2009 NJ-IBC. The Laboratory will obtain samples at the mixer and when directed by the Engineer at the point of placement by the following methods:
 - a) Secure composite samples in accordance with ASTM C172. Each sample shall be obtained from a different batch of concrete on a random basis, avoiding any selection of the test batch other than by a number selected at random before commencement of concrete placement.
 - b) Mold and cure specimens from each sample in accordance with ASTM C31 and perform strength tests.
- b. The State may assign a qualified concrete technician to be stationed at the batch plant depending on the size of the project or evidence of poor concrete breaks. At least one qualified concrete technician will be stationed at the site to obtain the test specimens.
- c. The Laboratory will be responsible to and under the supervision of the Contractor.

2. Special Inspector

- a. The Contractor will engage, under the requirements of Section BC 1704 a Special Inspector who will supervise the testing of the materials and the inspection of concrete construction. The Special Inspector is responsible for any required filing with the Building Department, as well as maintaining a log book of the concrete work.
- b. The Special Inspector will check that all required tests are made and the results submitted and shall have the right to order the Contractor to make such changes of the mix of concrete as required to produce concrete of the necessary strength provided that it satisfies the drawings, specifications and building code. Any changes to the mix shall be submitted to the engineer for approval.

3. Notifications

- a. Notify the State in writing at least seventy-two hours in advance of each concrete placement. The State will notify the State Inspector immediately to order out the necessary concrete technicians to cover the work.
- b. During the placement of the concrete, notify the State immediately of any delay at the concrete plant or at the job site. Where the State decides to provide a technician at the plant, do not mix concrete or add admixtures unless the Technician is present. Do not add admixtures to be added at the site unless the Technician is present.

- c. The Testing Agency shall report through the Contractor to the State and Engineer the results of all testing and inspection by means of daily written reports. When any test or inspection reveals deficient or nonconforming work the Testing Agency shall notify the State and Engineer immediately by means of a written report specially and clearly marked and identified to show deficient areas of work.

4. Contractors Responsibility for Quality Control

- a. The Contractor will receive a copy of all reports prepared by the Laboratory and/or Special Inspector. Copies of the daily concrete reports prepared by the Special Inspector will be available for reference.
- b. The Contractor will therefore be afforded an opportunity to review all reports and mix data and submit to the Special Inspector and Engineer any recommendations in changing the mixes provided they conform to the Code and Specifications. Any testing required because of changes in materials or proportions of the mix requested by the Contractor, as well as any extra testing of concrete or materials occasioned by the failure to meet Specification requirements shall be at the Contractor's expense. The Contractor, at any time, can arrange to have independent tests made at own expense by an approved laboratory and submit the reports and recommendations to the Special Inspector and Engineer of Record.
- c. The tests and inspections or waiving of tests and inspections by testing agency, as provided in the Code, do not in any way relieve the Contractor of responsibility to construct the Work in accordance with the Drawings and Specifications and to use safe, standard methods of construction at all times, safeguarding the public, workmen, and structure. The Contractor shall be solely responsible for the physical control of the materials and concrete mixes, and shall see that such mix designs, tests, and controls are in accordance with the Code and Specifications.
- d. It shall be the Contractor's complete responsibility to adjust, alter, and/or correct any controls necessary in materials and/or concrete operation based upon tests and inspections made by the State or the Contractor's independent tests. If, during the course of the concrete operations, a lower water content or more cement is needed per cubic yard above that used in the approved design mix, provide same at no additional cost to the State.
- e. If the Contractor requests any deviation from the Specifications and Drawings, or makes or causes to be made any change of construction from Drawings and Specifications, and such request requires the time and investigation of the Engineer of Record, pay all costs incurred by the State relating to such time and investigation.
- f. Where additional tests are deemed necessary by Engineer due to failure to pass tests, the cost of additional testing will be deducted from payments to Contractor.

- g. If, due to errors by the contractor or failure to perform his work in accordance with the Contract Documents, the Engineer must perform additional design or drafting work or review proposed solutions, the Contractor shall, through the State, reimburse the Engineer in accordance with the Engineer's current fee schedule, plus out of pocket expenses incurred.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to placement of concrete, verify that the concrete cover over the reinforcement is that specified on Drawings.
- B. Verify that anchor bolts, reinforcement, and all other embedded items are provided and held securely, positioned accurately, and will not be a detriment to concrete placement.
- C. Examine all adjoining work on which this Work is in anyway dependent for proper installation and workmanship. Report to the Engineer and The State any condition that prevents the performance of this Work.

3.02 PROTECTION

- A. Protect concrete members on grade and the subgrade from freezing before and after installation. Provide blankets and other items necessary.
- B. Protect adjacent finish materials and previously poured concrete against spatter during concrete placement.
- C. Provide and maintain barricades and safeguards around openings, etc. to protect workmen from injury and to comply with all Building Code, OSHA, and other authorities having jurisdiction regulations.

3.03 PREPARATION

- A. Remove ice, excess water, trash, and rubbish from forms.
- B. Remove hardened concrete from inner surfaces of conveying equipment and all formwork, reinforcement, and dowels.
- C. Prepare previously placed concrete to be in contact with new concrete in the manner described under "Construction Joints".
- D. Prepare existing concrete to be in contact with new concrete by roughening and cleaning the surface and applying a bonding agent. Surface must be free of laitance. Concrete must be placed after agent cures and within 20 hours of applying bonding agent. If time elapses, apply a new application in accordance with the directions of the manufacturer.

- E. In case a conflict arises between concrete as poured and other Work that requires cutting into concrete beams, columns, walls, or slabs, submit requests to the Engineer of Record, who will issue instructions accordingly. Cutting of concrete is otherwise prohibited.
- F. Do not place concrete on frozen ground.
- G. Contractor is solely responsible for the protection, shoring, bracing, stability and underpinning of existing structures either on or adjacent to the site. Details and extent of such work shown on the Drawings are suggestions only; Contractor is to determine requirements and methods. All of the above operations shall be done under the supervision of a qualified Professional Engineer licensed in the state of NJ.
- H. Contractor shall examine all existing surfaces, structures and the like which the work must attach to, clear or abut. Notify Engineer in writing of any conditions, which will delay or be detrimental to work. Start of work shall represent acceptance by Contractor of existing conditions as suitable for completing work as specified.
- I. Contractor shall verify, by measurements at the site, all existing dimensions, which affect the work of this Section. Field dimensions varying from those on the design drawings or accepted shop drawings shall be brought to the Architect's and Engineer's attention in writing.

3.04 JOINTS AND EMBEDDED ITEMS

- A. Construction Joints
 - 1. Shall be made and located only as shown or indicated on the Drawings or accepted shop drawings. Conform to ACI 318, Article 6.4. All construction joints not shown or indicated on the Drawings shall be submitted in writing for acceptance.
 - 2. Place construction joints perpendicular to main reinforcement and continue reinforcement across joints. Provide longitudinal keys at least 1¹/₂" deep in walls, slabs and between walls and footings. Accepted bulkhead designs for this purpose may be used for slabs. Drawings indicate keys or roughened surface at interface of walls and footings.
 - 3. Thoroughly clean concrete surface of oil, grease, and other contaminants and remove all laitance prior to placement of adjoining concrete. Roughen surface of the concrete in an approved manner that will expose the aggregate uniformly to a 1/4" amplitude and will not leave laitance, loosened particles of aggregate, or damaged concrete at the surface. Dampen surface immediately prior to placement.
 - 4. Provide waterstops in construction joints as indicated on drawings and specifications. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during the progress of work. Fabricate field joints in waterstops in accordance with manufacturer's instructions.
 - 5. Do not exceed maximum distance between construction joints noted in the Drawings or this Specification. If no criteria is given, do not space greater than 40

feet for walls, 100 feet in any direction for formed slabs, or 40 feet for slabs on ground.

6. Do not cast columns higher than 1/2 inch or lower than 1 inch below lowest girder, beam or slab supported by the column.
7. Construction joints designated to be specially roughened, or joints of new concrete connecting to existing concrete, shall be bush hammered to 1/4-inch minimum roughness amplitude and thoroughly cleaned. Apply specified bonding agent where noted or specified.
8. Properly install all embedded items where required.
9. Construction joints shall be made in accordance with Section BC 1906.8 of the Building Code.

B. Expansion Joints

1. Do not extend reinforcement or other embedded metal items bonded to concrete continuously through expansion joint and keep joint free of all other materials. Provide smooth dowels greased on one end at the joints with end cap or insert into pvc sleeve of length greater than the dowel length by .75" minimum.
2. Provide joint filler of type specified in Section 07900 at the expansion joint of the sizes indicated on the Drawings or specified herein.

C. Contraction (Control) Joints in Slabs-On-Ground

1. Construct in pattern as shown or noted on Drawings.
2. Inserts shall be laid into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of inserts. After concrete has cured, remove inserts and clean groove of loose debris.
3. Saw cuts shall be made as soon as possible after slab finishing and may be done without dislodging aggregate.
 - a. Maximum joint spacing shall be 36 times the slab thickness unless otherwise noted on the drawings. The Soff-Cut saw shall be used immediately after final finishing and to a depth of 1 1/4". A conventional saw shall be used as soon as possible without dislodging aggregate and to a depth of 1/4 slab thickness.
 - b. Use load plate baskets under saw cuts where designated on the plans for load transfer.
4. Joints, in slabs on grade, subjected to hard wheeled traffic shall be filled with the specified semi-rigid joint filler. The installation shall be made in strict accordance with the instructions from the manufacturer. The surface must be level with the concrete shoulders.

D. Isolation Joints in Slabs On Ground

1. Provide at points of contact between slabs on ground and vertical surfaces where shown or called for on drawings. Provide joint filler and sealant as specified.

C. Waterstops

1. Provide waterstops at all joints and all penetrations of type indicated in Part 2 of this Section. All surfaces onto which material is placed shall be clean and smooth. Do not let materials come in contact with water by covering waterstop, forms, or other means necessary. Provide minimum clearance from edge of concrete as per manufacturer's recommendations, typically 3".
2. Provide maximum practical lengths for each piece so that the number of end joints will be held to a minimum.
3. Make joints in such a manner that they develop effective watertightness fully equal to that of the continuous material. All joints to be lapped as per manufacturer's instructions.
4. Use manufacturer's adhesive or swelling paste type for applying gasket type to previously poured concrete and/or waterproofing membrane. Surface onto which waterstop is placed shall be smooth.
5. Provide swelling paste type at all pipe penetrations, conduits, drains, steel members, and other areas where items penetrate the concrete foundation system and at uneven concrete surfaces.
6. If water penetrates joints in which waterstops are placed at contract locations or at cracks and cold joints, the Contractor shall remediate the crack with injection material recommended by the State and approved by the Engineer that will provide a 5-year labor and material guarantee against water seepage at no cost to the State.

D. Other embedded items

1. Place all fence sleeves and shoes, pipe sleeves, inserts, anchors, anchor bolts, and other embedded items required for the Work of other Divisions or for their support prior to concreting. Install Link-seal Watertight Sleeves by Thunderline Corp. through foundation walls and other locations where watertight construction is required and where indicated on Drawings as per manufacturer's instructions. Coordinate with other trades, all Drawings, and manufacturer for sizes, location, and quantity.
2. Provide ample notice and opportunity for items of other Division to be introduced and/or furnished for installation before concrete is placed. Coordinate the Work of the other Divisions so all items are placed in their proper location.
3. Set metal pipe sleeves, sockets, shoes, etc. into concrete to receive fence posts or any other items, all as indicated on details.

E. Placement of Embedded Items

Position expansion joint material, waterstops, and other embedded items accurately and support against displacement. Fill voids in sleeves, anchor slots, and inserts temporarily with readily removable material to prevent the entry of concrete into the voids.

3.05 MIXING AND PLACING CONCRETE

A. General

1. Notify The State at least 48 hours in advance of each concrete placement. Do not place concrete without approval of the Special Inspector.
2. Do not allow rainwater to increase mixing water nor damage surface finish.
3. When placing concrete in cold weather (air temperature below 40°F), concrete shall contain either an accelerating admixture or use Type III cement.

B. Mixing

1. Batch, mix, and transport ready-mixed concrete in accordance with the appropriate sections of ASTM C94 and Section BC 1905.8.2 of the 2009 NJ-IBC. Truck mixers and agitators shall meet the requirements of the Truck Mixers Manufacturer's Bureau or shall comply with Section 8.1.2 of ASTM C94. All trucks shall have working revolution counters and site gages. Batch all other concretes in accordance with subsection 4.3.1 of ACI 301 only if permitted by the Engineer of Record and Special Inspector.
2. Unless otherwise approved by the Engineer of Record, concrete shall be deposited within 1½ hours or 300 revolutions of the mixing drum, whichever comes first, after introduction of water to the cement or cement to the aggregate. When the ambient temperature rises above 90°F, the time shall be decreased to 1 hour.
3. Tempering and control of mixing water
 - a. Mix concrete only in quantities for immediate use. Concrete that has started to set shall not be retempered, but shall be discarded. After the introduction of initial mixing water for the batch, no additional water shall be added at the site.
 - b. For concrete containing HRWR (Superplasticizer), if loss of slump occurs, HRWR may be redosed at the site as long as a "flash set" has not occurred. Redosage procedures must be discussed and approved by the Engineer and the admixture manufacturer at the Pre-Concrete Conference.

4. Weather Conditions

a. Cold weather (Air Temperatures below 40°F)

- 1) Concrete shall have either an accelerating admixture or use Type III cement. Do not use calcium chloride, salt, materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- 2) The temperature of concrete delivered at the site shall conform to the temperature limitations given in Section 5 of ACI 301.
- 3) If water or aggregate is heated above 100°F, combine the water with the aggregate in the mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 100°F.
- 4) Detailed requirements are given in ACI 306R.

b. Hot Weather (Air Temperatures above 90°F)

- 1) Cool the ingredients before mixing, or substitute flake ice or well-crushed ice of a size that will melt completely during mixing for all or part of the mixing water if, due to high temperature, low slump, flash set, or cold joints are encountered. Water equivalent of ice must be calculated to total amount of mixing water.
- 2) Detailed requirements are given in ACI 305.

5. Admixtures - General

- a. Add all admixtures prior to mixing unless otherwise specified or directed.
- b. Air-entraining admixtures and other chemical admixtures shall be charged into the mixer as solutions and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if so recommended by the manufacturer. The accuracy of measurement of any admixture shall be within +3 percent.
- c. If two or more admixtures are used in the concrete, add them separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete. Do not charge admixtures into the mixer in such a manner that they will come in direct contact with the cement.
- d. Use of accelerating admixtures or Type III cement shall not relax cold weather placement requirements.

- e. Use of retarding admixtures in hot weather must be approved by the Special Inspector. Use of such admixtures will not relax hot weather placement requirements.
 - f. Where using high-range, water-reducing admixture shall be added at the jobsite or at the initial batching, in accordance with the manufacturer's instructions.
 - g. Where synthetic macro fiber reinforcement is used, fibers shall be added when concrete is batched. Follow manufacturer's instructions and standard ASTM C94 practices.
6. Hand-Mixed concrete shall not be used without written acceptance by Engineer. When permitted, such concrete shall be mixed only in watertight containers. Each ingredient shall be measured dry and sand and cement shall be mixed prior to adding coarse aggregate. Water shall be added slowly so as to provide an even mixture

C. Placing

- 1. General: Place concrete in accordance with ACI 304R, ACI309R ACI 318, and Sections BC 1905.9 and BC 1905.10 of the 2009 NJ-IBC.
 - a. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work; cooperate in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
 - b. Forms and other surfaces to receive fresh concrete shall be clean and free of frost, dirt and any other debris immediately prior to and during concrete placing.
 - c. Apply temporary protective covering to lower 2 feet of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.
- 2. Conveying
 - a. Handle concrete from the mixer to place of final deposit as rapidly as practicable by methods that will prevent separation or loss of ingredients and in a manner that will assure that the required quality of concrete is obtained.
 - b. Conveying equipment shall be approved and shall be of a size and design such that detectable setting of concrete shall not occur before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or workday. Conveying equipment and operations shall conform to the following additional requirements:

- 1) Truck mixers, agitators, and non-agitating units and their manner of operation shall conform to the applicable requirements of ASTM C94.
 - 2) Belt conveyors shall be horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Concrete shall be protected against undue drying or rise in temperature. An approved arrangement shall be used at the discharge end to prevent apparent segregation. Mortar shall not be allowed to adhere to the return length of the belt. Long runs shall be discharged into a hopper or through a baffle.
 - 3) Chutes shall be metal or metal-lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20' long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.
 - 4) Pumping or pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete. The loss of slump in pumping or pneumatic conveying equipment shall not exceed 2". Pumping is permitted only if a pump mix is approved. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy.
3. Depositing: Detailed recommendations are given in ACI 304R.
- a. General
 - 1) Deposit concrete continuously, or in layers of such thickness that no concrete will be deposited on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, locate construction joints at points as provided for in the Drawings, shop drawings, or as approved. Should cold joints form, cease operations. Submit detailed drawings showing remedial measures for acceptance. Drilled dowels or anchors or chipped keyways may be required by the Engineer.
 - 2) Carry out placement at such a rate that the concrete that is being integrated with fresh concrete is still plastic. Do not deposit concrete that has partially hardened or has been contaminated by foreign material.
 - 3) Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

- 3) Place concrete on metal deck in a manner that uniformly distributes the material over the metal deck in order to avoid overloading the deck joints.
 - 4) Remove temporary spreaders in forms when the concrete placing has reached an elevation rendering their service unnecessary. They may remain embedded in the concrete only if made of metal or concrete and if prior approval has been obtained.
 - 5) Placing of concrete in supported elements shall not be started until the concrete previously placed in columns and walls is no longer plastic.
 - 6) Deposit concrete as near as practical to its final location. Minimize lateral movement of fresh concrete. Placement procedures shall not allow concrete to drop thru successive reinforcing grids, nor strike cages in columns or layers in walls.
- b. Segregation: Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure that will cause segregation. Free drop of concrete shall not exceed 8 feet for columns or 4 feet for other elements. Self-Consolidating Concrete may be dropped further when approved by the engineer. Canvas or rubber elephant trunks may be used to limit free drop.
- c. Consolidation
- 1) Consolidation of concrete and the use and type of concrete shall be in accordance with ACI 309R.
 - 2) Where a surface mortar is to be the basis of the finish, the coarse aggregate shall be worked back from the forms with a suitable tool so as to bring a full surface of mortar against the form, without the formation of excessive surface voids.
 - 3) Consolidate all concrete by vibration so that the concrete is thoroughly worked around the reinforcement, around embedded items and into corners of forms, eliminating all air or stone pocket or weakness. Internal vibrators shall be the largest size and most powerful that can be used in the Work, as described in Table 5.1.5 of ACI 309R, with a minimum frequency of 7000 revolutions per minute and shall be operated by competent workmen. Overvibrating and use of vibrators to transport concrete within forms is not permitted. Insert and withdraw vibrators at many points, from 18" to 30" apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not sufficient to cause segregation, generally from 5 to 15 sec duration, and shall reach the bottom of the pour. Keep a spare vibrator on the job site during all concrete placing operations.

- 4) Self-Consolidating Concrete may not require vibration if successful placement is demonstrated on site.
4. Cold Weather Concrete Placement and Protection: Detailed requirements are given in ACI 306.

When the mean daily temperature of the atmosphere is less than 40°F during concreting, or within 72 hours there after (or the air temperature is not greater than 50°F for more than one-half of any 24-hr period for a period of 3 consecutive days), follow the procedures outlined in ACI 306R to protect the concrete. Provide a cold weather concreting plan as well as list of equipment and material (e.g. thermometers, blankets) to be used to the Special Inspector. Temperature of the plastic concrete shall be no lower than 55°F and not more than 80 °F at point of placement. Heat all forms, reinforcing steel, subgrades and surfaces to receive concrete above the freezing point and keep them completely free of frost, snow, and ice. Protection shall consist of insulating boards, blankets, or heated enclosures. Underside of slabs shall be heated during placement and protection period. Initial protection period shall be as indicated in tables 5.1 and 5.3 of ACI 306R. Maximum temperature drop of concrete surface after protection is removed shall follow table 5.5 of ACI 306R. Protect concrete work from physical damage or reduced strength, which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.1 and as herein specified.

5. Hot Weather Placement and Protection: When the mean daily temperature of the atmosphere is over 90°F during concreting, follow the procedures outlined in ACI 305R to protect the concrete.
 - a. All concrete, at the time it is actually deposited in the forms, shall have a temperature not lower than 50°F but never above 90°F.
 - b. Reduce concrete mixing time as required and specified herein to avoid quick stiffening of the concrete.
 - c. Cover reinforcement with water-soaked burlap to cool steel so its temperature will not exceed the ambient air temperature immediately before concrete placement.
 - d. Dry surfaces that are to receive concrete should be wet down with fog spray before commencing placement of concrete and the temperature of such surfaces should not exceed the temperature of the concrete being placed.
6. Concrete shall not be placed during rain, sleet or snow, nor shall rain, sleet or snow be permitted to fall upon uncured surfaces.

3.06 FINISHING OF SURFACES AND REPAIR OF SURFACE DEFECTS

A. General

1. Remove forms as soon as practicable. Refer to Section 03100 and Section BC 1906.5 of the 2009 NJ-IBC.
2. Repair surface defects, including tie holes and cracks, immediately after form removal. Patches shall be of quality to match the specified finish.
3. Remove oil, grease, compounds, and other contaminants from surfaces and areas to be repaired, those surfaces in contact with sprayed fireproofing, and those receiving coatings (ie. plaster, waterproofing, paint, and membranes of any kind).
4. Provide finishes specified below immediately after form removal.
5. Provide curing and protection.

B. Repair of Surface Defects

1. Remove all honeycombed and other defective concrete down to sound concrete. If chipping is necessary, the edges shall be perpendicular to the surface or slightly undercut. Undercut all cracks a minimum of 1" x 1". No feathered edges will be permitted. Dampen the area to be patched and an area at least 6" wide surrounding it to prevent absorption of water from the patching mortar. A bonding grout shall be prepared using a mix of approximately 1 part cement to 1 part fine sand passing a No. 30 mesh sieve, mixed to the consistency of thick cream, and then well brushed into the surface.
2. The patching mortar shall be made of the same materials and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2¹/₂ parts sand by damp loose volume. Substitute white Portland cement for a part of the gray portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. If the material color cannot be matched properly, the Contractor shall use a specialty repair mortar of the Engineer of Record's choice at the Engineer's discretion. The quantity of mixing water shall be no more than necessary for handling and placing. Mix the patching mortar in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.
3. After surface water has evaporated from the area to be patched, brush the bond coat well into the surface. When the bond coat begins to lose the water sheen, apply the premixed patching mortar. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave it undisturbed for at least 1 hr before final finishing. Keep the patched area damp for 7 days. Do not use metal tools for finishing a patch in a formed wall that will be exposed.

C. Repair of Tie Holes and Formed Surfaces

1. Remove ties, nails, and other form accessories below the concrete surface when the surface is exposed to view, the elements, or for surfaces to receive waterproofing or dampproofing. For surfaces not exposed to view or the above-mentioned conditions, remove metal to the surface. Refer to Section 03100.
2. Undercut surfaces of holes. After cleaning and thoroughly dampening the holes, fill them solid with the patching mortar. The mortar shall match the color of the existing concrete for concrete exposed to view as specified in paragraph B.2 above.
3. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect or Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discoloration that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
4. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

D. Repair of Unformed Surfaces

1. Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.
2. Repair finished unformed surfaces that contain defects, which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement, spalling, pop outs, honeycomb, rock pockets, and other objectionable conditions.
2. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days, but without exposing the reinforcing.
4. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Use the specified underlayment or repair topping.
5. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

6. Repair isolated random cracks and single holes not over 1" in diameter by dry pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry pack, consisting of one part portland cement to 2 1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

E. Formed Finishes

1. Rough Form Finish

- a. Provide for concrete not exposed to view and not covered with a material applied directly to the concrete, unless otherwise indicated under "Finishing" below.
- b. Formwork material given in Section 03100.
- c. Repair surface as indicated in B. and C. above.
- d. Chip or rub off fins exceeding 1/4" in height.

2. Smooth Form Finish

- a. Provide for concrete exposed to view, concrete receiving sheet membrane waterproofing or other covering material applied directly to the concrete, or as indicated under "Finishing" below. Areas exposed to view shall have a CS 3 or better finish as developed by the Cresset Chemical Company.
- b. Formwork material is given in Section 03100.
- c. Repair surfaces as indicated in B. and C. above.
- d. Chip or rub off fins completely and grind smooth.
- e. Provide smooth rubbed finish unless otherwise indicated below.

F. Unformed Finishes

At top of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

G. Finishing

1. Smooth Rubbed Finish

- a. Provide for smooth form finish except for those items listed in 2 below.
- b. Produce on newly hardened concrete no later than the day following form removal.
- c. Wet the surfaces and rub with a No. 16 carborundum brick or other equal abrasive to obtain a smooth, even surface of uniform appearance without applying any cement or other coating.
- d. Obtain the final finish by thoroughly rubbing with a No. 30 carborundum brick. The surface shall be wet for a period of 3 days. The State shall be the sole judge of whether the finish is proper.

H. Acceptance of Concrete Finish

If the finish produced is not acceptable to the State, the Contractor shall be responsible for all costs incurred to produce an acceptable finish by whatever means determined by the State.

3.07 SLABS

A. Placement

1. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints (if required), until the placing of a panel or section is completed. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners. To obtain good surfaces and avoid cold joints, the size of finishing crews shall be planned with due regard for the effects of concrete temperature and atmospheric conditions on the rate of hardening of the concrete.
2. Mixing and placing shall be carefully coordinated with finishing. Do not place concrete on the subgrade or forms more rapidly than it can be spread, straightedged, and darbied or bull floated. Provide leveling, floating, troweling, etc. at the correct time interval after poring to prevent dusting and a non-durable surface as specified in ACI 302.1R. These operations must be performed before bleeding water has an opportunity to collect on the surface.

B. Leveling and Finishing

1. General

- a. Carefully provide slab depressions as required for the finishes indicated on the Drawings.

- b. Where floor drains or floor slopes are indicated, slope slabs uniformly to provide even fall for drainage.
- c. Follow detailed recommendations for finishing given in ACI 301, Section 5, and ACI 302.1R.
- d. Protect finishes from contamination from time of placing until time of acceptance, placement of topping, etc.
- e. Remove defects of sufficient magnitude to show through floor coverings or that do not meet tolerances by grinding.

2. Finishes

- a. Surfaces that are to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, and as otherwise indicated: After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power driven floats, or both. Consolidate surface with power driven floats, or by hand floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of FF 18 FL 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- b. Surfaces with no finishes: Areaways, pipe and duct, and crawl spaces; Level and wood float surface level or toward drains if required.

3.08 MISCELLANEOUS CONCRETE WORK

- A. Provide pits, curbs, walls, and other miscellaneous concrete items.
- B. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel troweling surfaces to a hard, dense finish with corners, intersection, and terminations slightly rounded. If the curb is part of a beam, the form shall be removed as specified in the section for beams.
- C. Provide concrete topping as shown on drawings. Clean surface of underlying slab of all oil, dirt, laitance and any other material, which could impair bond. Moisten existing concrete thoroughly prior to placing topping. Use structural macro fibers at 4 lbs. per cubic yard in 4000 psi topping, with a maximum w/cm of 0.50, unless otherwise indicated on the plans. Approved curing procedure must begin immediately after final finishing. The joint pattern must be approved by the engineer.

3.09 PATCHING AND BONDING TO EXISTING CONCRETE

- A. Provide bonding agent whenever new concrete is to be poured against existing concrete, whenever the time between concrete pours is longer than that allowed for proper bond, and wherever bonding agent is indicated on the Drawings to be applied.
- B. Remove loose concrete from surface to be bonded with new concrete and clean. Remove rust from reinforcement and structural steel by power chipping and power driven brushes.
- C. Apply bonding agent in accordance with manufacturer's specifications. Pour concrete as soon as bonding agent has cured and within 20 hours after application. If the 20-hour period has elapsed, then the bonding agent must be reapplied.

3.10 CURING AND PROTECTION

A. General

- 1. Begin curing concrete as soon as free water has disappeared from concrete surface after placement and finishing. Protect all freshly deposited concrete from rain, premature drying and excessively hot or cold temperatures and maintain it with minimal moisture loss at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete. Detailed procedures are given in ACI 308 and Section BC 1905.11 of the 2009 NJ-IBC.
- 2. Cure floor surfaces in accordance with ACI 308.
- 3. Do not apply curing compounds to surfaces receiving waterproofing, adhesives, membranes or additional concrete unless approved by adhesive or material manufacturer or compound is removed in an approved manner. As an alternate, provide wet curing.
- 4. All exposed interior slabs, not receiving a liquid densifier, and troweled slabs receiving mastic applied adhesives or "shake-on" hardeners shall be cured with the specified curing and sealing compound. Exterior slabs, sidewalks, curbs, and architectural concrete, not receiving a penetrating sealer, shall be cured with the specified curing and sealing compound. Maximum coverage shall be 400 ft²/gallon on steel troweled surfaces and 300 ft²/gallon on floated or broomed surfaces for curing/sealing compound.

B. Procedure

- 1. Concrete surfaces not in contact with forms:
 - a. Ponding or continuous non-manual sprinkling.
 - b. Absorptive mat or fabric, sand, or other covering kept continuously wet. Place to provide coverage of concrete surfaces and edges, with 4" lap over adjacent covers.
 - c. Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3"

and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

- d. Curing compounds conforming to ASTM C1315 or where bond and adhesion of mortar, adhesive or other finish material will be adversely affected use strippable curing compound conforming to ASTM C309.
 - e. Treat slabs, ramps, curbs and columns and walls two feet up from top of slabs with penetrating sealer in areas that will be exposed to deicing salts in service. Follow manufacturer's instructions for dosage and procedures.
2. Concrete surfaces in contact with forms:
 - a. Minimize moisture loss from forms exposed to heating by the sun by keeping forms wet until they are removed.
 - b. After form removal, cure with one of the methods listed in 1 above.
 3. Begin final curing immediately following initial curing and continue curing until a total of 7 days has elapsed during which the temperature of the air in contact with concrete has remained above 50°F, in accordance with ACI 301 procedures. Prevent rapid drying during and at the end of the curing period.
 4. Remove all curing compounds with cleaners recommended by curing compound manufacturer.

C. Cold Weather Curing

1. Concrete must be protected from water loss. This shall be accomplished by the application as soon as possible without harm to the concrete surfaces of either (a) exhaust steam, or vapor-resistant paper or polyethylene film, or (b) curing compounds. In all other respects, curing shall conform to applicable provisions of this Section. Concrete temperature shall be maintained between 50°F and 70°F. Comply with ACI 306.1
2. Protection of concrete in cold weather shall continue long enough to ensure the strength required, but not less than 72 hours. The temperatures shall be kept sufficiently above freezing. Protection from freezing for the first 24 hours does not ensure the strength required.
3. The surface temperature of the concrete shall be monitored especially at corners and edges of concrete. Use thermometers or any other equipment approved for this type of work. The Contractor shall provide all the equipment necessary to protect and monitor the curing of concrete. After the concrete has cured and the above requirements are no longer necessary, the temperature shall be decreased slowly and gradually as required by ACI 306.1. Under no circumstances are sudden changes of temperature in the concrete allowed. Heating units shall be vented. The concrete shall be protected from drying when heated locally by the heating locally by the heating equipment.
4. The heating enclosures, if used, must be strong, windproof and weatherproof.

5. Concrete shall not be exposed to carbon dioxide (CO₂) gas or any other pollution resulting from the use of heating equipment. The temperature shall not exceed those shown in ACI 306.1.
 6. The use of urethane foams as insulation shall be avoided if possible or done with caution, as it generates highly noxious fumes when subject to fire.
- D. Hot Weather Curing
1. During the period June 1 to October 1 or when hot weather conditions require it, maintain continuous water curing for a minimum period of twenty-four hours. Provide for windbreaks, shading, and other necessary provisions.
 2. After 24 hours, curing shall be by one of the methods specified under B above. In all other respects, curing shall conform to applicable provisions of this Specification. Upon termination of the specified moist curing, every effort should be made to reduce the rate of drying by avoiding air circulation.
 3. Comply with ACI 305R.
- E. Protection from mechanical injury: Protect concrete from mechanical disturbances during curing period as described under "Protection and Cleaning".

3.11 FIELD QUALITY CONTROL

A. Tests

Method of tests shall in all cases comply in detail with the latest applicable ACI and ASTM requirements as well as the NJ-IBC and be performed by an ACI Concrete Field Testing Technician Grade 1 or equivalent. Tests to be performed by the Contractor's Independent Testing Laboratory during construction are as follows:

1. Compliance of materials to Specifications tested from production samples.
2. Testing Agency may inspect and test materials and work at the source before shipment as well as at the site before, during or at any time after installation. Deficient or incomplete work or materials shall be corrected or replaced, as directed by the Engineer, without additional costs or delays to the State.
3. Determination of the slump of the concrete for each sample taken and whenever consistency of the concrete appears to vary using ASTM C143. When a high-range, water reducing admixture is being used, slump tests shall be made before and after the admixture is added. The Special Inspector will reject any concrete that does not meet the slump requirements.
4. Determination of water content of freshly mixed normal weight concrete utilizing the procedure of AASHTO T318. Concrete that does not meet the maximum water

to cement ratio or the proportions given in the approved design mix will be immediately rejected regardless of slump.

5. Strength tests on the specimens in accordance with ASTM C39:
 - a. The frequency of conducting strength tests of concrete shall be in accordance with Section BC 1905.6.2 of the 2009 NJ-IBC, with additional cylinders taken for an additional strength test and one cylinder for a 7-day break. Strength tests shall be performed for each 50 cubic yards, or portions thereof, of concrete placed in any one day's concreting. Specimens will be stored at the site in the insulated curing box provided by the Contractor. Each group of specimens is considered one strength test. One cylinder will be broken at 7 days for information.
 - 1) Portland cement concrete: A strength test shall be performed at 28 days for acceptance. The remaining cylinders for the additional strength test will be tested only if the 28-day breaks are low or durability of the concrete is in question.
 - 2) Portland cement concrete with 40% alternate cementitious material: A strength test will be performed at 28 days to determine if the strength has been made and/or if the strengths are sufficient to continue work, even if not at the required design compressive strength. Depending on temperature, concrete strength can be attained at 28 days even though the strength is considered a 56-day strength. If the first cylinder tested indicates the strength has not been met, the remaining cylinders of the test will be broken at a later date. One set of strength test will be done at 56 days.
 - b. If one specimen in a test manifests evidence of improper sampling, molding, or testing, it shall be discarded and the average strength of the remaining cylinders shall be considered the test result. Should all specimens in a test show any of the above defects, the entire test shall be discarded.
 - c. When intermediate conveyance is used to place the concrete, one additional set of cylinders shall be taken for each 150 cubic yards or fraction thereof for each type of concrete placed in any one day's concreting. These test cylinders shall be separate and distinct from those made in the mixer and shall be made in the same batch and cured and tested in the same manner as samples taken from the mixer.
 - d. Test reports shall include name of Testing Agency and project, date of concrete placement, type of concrete, exact location of concrete batch in structure and results of 7 and 28 day tests and shall be specially marked to clearly identify any and all results falling below specified strength.
6. Determination of air content and unit weight of normal weight concrete sample for each strength test in accordance with ASTM C173 or C231 and ASTM C138. Test

every time compressive strength cylinders are taken. The results of such tests shall be included in the Testing Agency's written reports.

7. Determination of air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 or C231 and ASTM C567. Test every time compressive strength cylinders are taken. The results of such tests shall be included in the Testing Agency's written reports.
8. Determination of temperature of concrete sample for each strength test. When the air temperature is below 40 degrees F or above 80 degrees F, test at discharge from every truck. The results of such tests shall be included in the written reports.
9. Tests for water soluble ion chloride content shall be made in accordance with ASTM C114 for concrete that has a maximum chloride ion content specified in this Specification. Test every time compressive strength cylinders are taken. The results of such tests shall be included in the Testing Agency's written reports.
10. For concrete with a design strength of more than 4 ksi, cement samples shall be taken directly from the hopper at the batching plant and tested in accordance with ASTM C109. Samples shall be taken randomly, in quantities directed by the Engineer, throughout the project at each shipments of bulk cement and at additional times as directed by the Engineer.

B. Inspections

1. Refer to "Source Quality Control" for responsibility and procedure.
2. The Contractor shall cooperate in the making of all tests by the Laboratory Technician by:
 - a. Providing a well-constructed shanty, to be approved by the State, located adjoining the State's inspector's office. This shanty shall have an area of not less than 50 sq ft, be well lighted, and provided with a table for mixing concrete, shelves for storage of the Laboratory's equipment, molds, etc., one chair, hinged door with suitable lock and complying with all requirements of ACI and ASTM.
 - b. Providing an insulated curing box of sufficient size and strength to contain all specimens made in any four consecutive working days. The Contractor shall furnish an outlet to provide the necessary temperature in the storage box, pending delivery to the Laboratory of the test cylinders.
 - c. Providing a buggy for transporting the concrete taken from the mixer (and/or point of placement) to the shanty for testing and the preparation of specimens.
 - d. Protecting the property of the Laboratory to be stored in the shanty and keeping test specimens free from vibration and other disturbances.
 - e. Providing a microwave of the size specified in AASHTO T318 and a portable generator.

- f. Provide a complete set of all current Construction Documents (including a current sketch log) and Specifications.
 - g. Provide a current set of approved Shop Drawings.
 - d. Provide concrete placement schedules.
3. Inspections shall include but not be limited to:
- a. Control of concrete at the batching plant, including tests of materials for moisture, gradation and cleanliness; and determination and recording of all mixture quantities and water/cement ratios. Verify that quantities and materials conform to the accepted trial mixes, adjusted for moisture content of aggregates.
 - b. Verification of sizes and thickness of structural members, such as slab and wall thickness, beam and column dimensions, etc. Layout, alignment, plumbness, etc. are the sole responsibility of the Contractor.
 - c. Inspection of all concrete placing, finishing, and curing operations. Verify that all concrete forms and reinforcing are clean and free of dirt and debris at time of pour and that concrete is properly deposited, consolidated, finished and cured.
 - d. Inspection of all reinforcing; verifying size, number, spacing, location, splices, support, wiring, etc. of all reinforcing bars, mesh, and stud rails. The location and installation details of reinforcing and prestressing steel shall be inspected for compliance with the approved Construction Documents and ACI 318. Inspections shall be made only with shop drawings bearing the Engineer's stamp and marked "No Exception Taken" or "Make Corrections Noted" only. Refer to Reinforcing Specification.
 - e. Placement and location of embedded items such as sleeves, inserts, railings, etc. is the responsibility of the Contractor and Construction Manager.
- C. Evaluation and Acceptance of Concrete
- 1. Strength tests on structural concrete will be evaluated according to Section BC 1905.6.3.3 of the 2009 NJ-IBC.
 - 2. When the average strength of the test cylinders, as defined in Section BC 1905.6.3.3 falls consistently below the specified strength (f_c), the Engineer shall have the right to order the Contractor to change the proportions or the water content of the concrete to secure the required strength for the remaining portion of the structure, all at the Contractor's expense. It is the Contractor's complete responsibility to modify the concrete mix design, material controls, and/or concrete operations where necessary to obtain the compressive strength required by the design and Specification.

3. When the average strength of test cylinders for any portion of the structure is less than that required by the design or Specification, or where there is other evidence that the quality of the concrete is below Specification requirements, the adequacy of the concrete will be checked according to the requirements of Section BC 1905.6 either by structural analysis or by core or load tests or by any combination of these procedures. The Engineer of Record will determine which procedures to use:
 - a. Structural Analysis Computations (Section BC 1905.6.5.5), which will be performed by the Engineer of Record.
 - b. Core Tests (Section BC 1905.6.5.2) - Performed in accordance with ASTM C42.
 - c. Load Tests (AC1318 Paragraph 20.3 or Section BC 1713 of the Building Code).
4. Exterior concrete exposed to the elements with low strength test results or other evidence of poor durability will be rejected.
5. Low Strength Tests of Concrete or evidence of poor durability - Results
 - a. Pay for additional costs of labor and materials required at the job for all damages resulting from load tests and the taking of cores. Remove and replace concrete work that is not of adequate strength or durability and cannot be made to work by remedial methods acceptable to the State at own cost. The Contractor shall be held responsible for all delays and damages to the work of other Divisions that occur as a result of non-conformance.
 - b. Pay for all expenses borne by the State resulting from low strength test procedures or evidence of poor durability (such as high slump) specified above.

3.12 PROTECTION AND CLEANING

A. General

During the curing period, and thereafter as conditions may require, protect the concrete from damaging mechanical disturbances, particularly excessive load stresses, heavy shock, and excess vibration. Protect all finished concrete surfaces from damage caused by construction equipment, materials or methods, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

3.13 ACCEPTANCE OF CONCRETE WORK

A. General

1. Completed concrete work that meets all applicable requirements will be accepted without qualification.
2. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.
3. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Specifications or in the Contract Documents. In this event, modifications may be required to assure that remaining work complies with the requirements.
4. Concrete work judged inadequate by structural analysis, core test, results of load test or deemed unacceptable due to appearance or durability concerns shall be repaired, reinforced with additional construction if so directed by the Engineer of Record, or be replaced if so directed by the Engineer at the Contractor's expense.
5. Pay all costs incurred by the State in providing additional testing and/or analysis required by this Section.
6. The State will pay all costs of additional testing and analysis made at its own request that is not required by this Section or that shows concrete is in compliance with the Contract Documents.

B. Dimensional Tolerances and Measurements

1. Lay out each part of the work in strict accordance with the Contract Documents. Precise measurements and layout are the sole responsibility of the Contractor.
2. Obtain all field measurements required for proper detailing, fabrication and installation of the work. Field verify all dimensions and locations of existing conditions shown on the Contract Documents. Where discrepancies exist, notify Engineer in writing, and by sketch when applicable, of discrepancies and proposed solutions to correct discrepancies.
3. For Formed Surfaces unless otherwise specified or noted on the Drawings, conform to the requirements given below or as given in ACI 117, whichever is more stringent. All tolerances shall apply to the full height of the building. Variations from grade shall be measured prior to removal of formwork.

a. Variation from plumb:

- i. In the lines and surfaces of columns, piers, walls, corners and the like:
 - a. In any 10 ft. of length 1/4 in.
 - b. Maximum for the entire height 1 in.

- ii. For exposed corner columns, control joint grooves, and other conspicuous lines:
 - a. In any 20 ft. of length 1/4 in.
 - b. Maximum for the entire height 1/2 in.
- b. Alignment:
 - i. At slab and/or beam, alignment of columns or walls above and below:
 - a. Maximum offset 1/4 in.
- c. Variation from level or specified grades and elevations:
 - i. In slab, beam and girder soffits and the like:
 - a. In any 10 ft. length 1/4 in.
 - b. In any bay or in any 20 ft. length 3/8 in.
 - c. Maximum for the entire length 3/4 in.
 - ii. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
 - a. In any bay or in 20 ft. length 1/4 in.
 - b. Maximum for the entire length 1/2 in.
- d. Variation of building lines from theoretical positions in plan and related positions of columns, walls, piers and the like:
 - i) In any bay 1/4 in.
 - ii) In any 20 ft. length 1/4 in.
 - iii) Maximum for the entire length 1/2 in.
- e. Sleeves, wall openings and floor openings:
 - i) Variation in size 1/4 in.
 - ii) Variation in location 1/2 in.
- f. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls:
 - i) Minus 1/4 in.
 - ii) Plus 1/2 in.
- g. Variation in the location of anchors and inserts shown in accepted shop drawings, unless more stringent tolerances are required for work of other Sections:
 - i) Vertically 3/8 in.
 - ii) Horizontally 1/4 in.

- h. Faces of formed slab edges, turned down spandrels, and parapets shall not deviate from theoretical position or alignment by more than the distance in consideration divided by 500 or by 1/2 inch, whichever is less.
- i. Pile Caps & Footings:
 - i) Variations in dimensions in plan:
 - a. Minus 1/2 in.
 - b. Plus 2 in.
 - ii) Misplacement or eccentricity:
 - a. 2 percent of the pile cap width in direction of misplacement but not more than 2 in.
 - iii) Thickness:
 - a. Decrease in specified thickness 5 percent
 - b. Increase in specified thickness No limit
 - iv) Elevation at steel bearing plates:
 - a. Plus 1/4 in.
 - b. Minus 1/4 in.
- j. Variation in stair dimensions:
 - a. In a flight of stairs:
 - a. Rise 1/8 in.
 - b. Run 1/4 in.
 - b. In consecutive steps:
 - a. Riser 1/16 in.
 - b. Tread 1/8 in.
- 4. Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances of this Section or Section 03100 shall be considered potentially deficient in strength and subject to the provisions of paragraph D below.
- 5. Formed surfaces resulting in concrete outlines larger than permitted by the tolerances of this Section or Section 03100 may be rejected and the excess material subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance.
- 6. Concrete members cast in the wrong location may be rejected if the strength, appearance, or function of the structure is adversely affected or if misplaced items interfere with other construction.
- 7. Inaccurately formed concrete surfaces exceeding the tolerances of this Section or Section 03100 and which are exposed to view may be rejected and shall be repaired or removed and replaced if required.

8. Slab tolerance from theoretical elevation is 1/2" plus or minus in accordance with ACI 117. Finished slabs exceeding the tolerances, including specified levelness tolerances, may be repaired provided that the strength or appearance is not adversely affected. High spots may be removed with a terrazzo grinder, low spots filled with a structural repair mortars, or other remedial measures performed as permitted. Provide self-leveling cement based materials for large expanses of deficient areas. All materials shall be approved by the Engineer of record and installed by the Contractor at its cost.
9. For tolerances not specifically indicated in the Contract Document, follow requirements of ACI 117.

C. Appearance

1. Concrete exposed to view with defects that adversely affect the appearance of the specified finish may be repaired only by approved methods.
2. Concrete not exposed to view is not subject to rejection for defective appearance.

D. Strength of Structure

1. The strength of the structure in place will be considered potentially deficient if it fails to comply with any requirements that control the strength of the structure, including but not necessarily limited to the following conditions:
 - a. Low concrete strength as described under "Field Quality Control".
 - b. Reinforcing steel size, quantity, strength, position, or arrangement at variance with the requirements of Section 03200 or the Contract Documents.
 - c. Concrete that differs from the required dimensions or location in such a manner as to reduce the strength.
 - d. Curing less than that specified.
 - e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
 - f. Mechanical injury as defined under "Protection and Cleaning", construction fires, accidents, or premature removal of formwork likely to result in deficient strength.
2. Structural analysis and/or additional testing may be required when the strength of the structure is considered potentially deficient.
3. Core tests may be required when the strength of the concrete in place is considered potentially deficient.

2. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be required and their results evaluated in accordance with Chapter 20 of ACI 318.

3.15 CONCRETE STRUCTURAL REPAIRS

- A. Perform structural repairs only where accepted, by Architect, State and Engineer, in detailed procedure submitted by Contractor in writing. All other defective areas shall be removed and replaced.
 1. Conform to Article 1.7 of ACI 301, "Specification for Structural Concrete for Buildings" and to instructions of Engineer.

END OF SECTION

SECTION 040130 INTERIOR MASONRY RESTORATION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. The Contractor shall furnish all labor, materials and equipment and perform all operations necessary for the restoration of the limestone, bluestone, granite, and sandstone in the interior spaces of the CRRNJ Terminal as indicated in the Contract Drawings or specified herein as directed by the Architect.
- B. The work of this Section consists of but is not limited to:
 - 1. Removal of any efflorescence that remains or has reappeared on the surface of the stone after initial cleaning.
 - 2. Removal of deteriorated limestone and bluestone and replacement with Dutchmen units. Larger Dutchman will require fabrication and pinning of units. New masonry is to match historic material in color, texture, finish and profile.
 - 3. Patching of cracks in limestone and bluestone.
 - 4. Remove damaged limestone patches and replace with new patches that match the surrounding masonry in color, texture, and finish.
 - 5. Repoint open joints in limestone and bluestone with mortar that matches existing in color, texture and profile.
 - 6. Re-polish granite to uniform appearance.

1.2 REFERENCED SECTIONS:

- A. Section 040140 Interior Masonry Cleaning
- B. Section 042116 Interior Brick and Tile Restoration
- C. Section 057000 Ornamental Metal Restoration
- D. Section 060140 Architectural Woodwork Restoration

1.3 REFERENCES:

- A. Materials and methods shall conform to the "Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings," 1995.

- B. ASTM - American Society of Testing and Materials
- C. ILIA – Indiana Limestone Institute of America
- D. Portland Cement Association
- E. ANSI A41.1 Building Code Requirements for Masonry (ANSI)
- F. Manufacturer’s printed recommendations

1.4 JOB CONDITIONS:

- A. Protect masonry materials during storage and construction from wetting by rain, snow, seepage or ground water and from soilage or interior-mixture with earth or other materials.
- B. Protect all adjacent areas from damage during the work of this Section using approved means of physical protection.

1.5 QUALITY CONTROL:

- A. All masonry restoration shall be done by a qualified Restoration Contractor classified by DPMC.
- B. Contractor shall maintain a steady work crew consisting of skilled mechanics who are experienced with the materials and methods specified, and are familiar with the design requirements. Contractor shall maintain a full-time Forman who fluently speaks, reads and writes English. Contractor shall confirm that all workers understand the job’s requirements. Mechanics shall be fully supervised to ensure that the work is accomplished to meet or exceed the highest standards of the trade.
- C. Architect shall be given regular access to the Contractor’s scaffolding or work site so that he/she may inspect work being performed.
- D. Contractor shall replace at no additional expense to the State all broken, lost or damaged materials during the masonry restoration.
- E. Work is to be performed on a daily basis without interruption unless directed otherwise by the Architect.
- F. Obtain materials for masonry restoration from a single source for each type of material required to ensure match in quality, color, texture and pattern.
- G. In acceptance or rejection of the work of this Section, no allowances shall be made for lack of skill on the part of the mechanics.
- H. All procedures shall be done in accordance with done in accordance with regulations, safety standards and requirements of all federal, state and local authorities having jurisdiction over the work including, but not limited to, the applicable stands for protecting

the public and control of pollutants and debris, and O.S.H.A. regulations for the protection of all workers and the public.

- I. Materials shall be used only at the manufacturer's recommended temperature tolerances.

1.6 SUBMITTALS:

- A. Submit qualification data and references for firms and persons specified in Section 1.5 "Quality Assurance" to demonstrate their capabilities and experience.
- B. Contractor shall submit a work plan including detailed description of how the work of this Section will be accomplished. This should include products to be used, methods and equipment for masonry restoration, etc. In addition, a quality control program shall be submitted which will include provisions for supervising performance when cutting horizontal joints with a mechanical grinder and preventing damage due to worker fatigue.
- C. Provide written descriptions, drawings and diagrams outlining proposed methods and procedures for protection of personnel, the public and the existing construction during the work of this Section.
- D. Contractor shall submit copies of the manufacturer's technical data for each product indicated or proposed for use, including recommendations for their application and use. Include test reports and certificates that verify the product's compliance with the specification's requirements. One complete set of product literature and MSDS shall be placed in a 3-ring, loose-leaf binder and shall be present on the job site at all times for the reference of the Architect.
- E. Shop Drawing:
 1. Submit complete shop drawings of all cut stone work, including those for the large limestone Dutchman. These drawings when viewed together shall show all details of bedding, bonding, jointing, anchoring and other essential aspects of the work. In addition the finish, dimensions and setting number of each piece of stone shall be shown.
 2. The Contractor shall be responsible for all field measurements in the preparation of setting drawings fully defining the conditions for the installation of all stone masonry and Dutchmen repairs.
 3. The cut stone fabricator shall prepare all shop drawings, fully defining the conditions for fabrication, finishing and fastening all cut stone and Dutchmen.
 4. Show intended application method and configuration of limestone and marble patching, including dimensions, profiles and tooling.
- F. Samples:
 1. Submit three (3) samples of Indiana Limestone to be used for Dutchmen. New material must match existing in color, texture, finish and profile.

2. Submit three (3) samples of bluestone to be used for replacement. New bluestone must match existing in color, texture, finish and profile.
 3. Submit three (3) composite patching samples matching the existing limestone and bluestone. Sample size shall be a minimum of 2" X 2". Such sample must be approved by the Architect after proper curing and finishing prior to the start of composite patch repairs. All work shall conform to the approved samples
 4. All masonry pins and anchoring devices.
 5. Repointing mortar for limestone
 - a. Provide cured samples of mortar in the form of 6 inch long by 1/2 inch long wide sample strips of mortar set in aluminum or plastic channels.
 6. Repointing mortar for bluestone
 - a. Provide cured samples of mortar in the form of 6 inch long by 1/2 inch long wide sample strips of mortar set in aluminum or plastic channels.
 7. Provide a sample (Minimum 50 grams) of each aggregate to be used in each mortar.
- G. If alternate methods and materials to those specified are proposed for any phase of the work, provide written description. Provide evidence of successful use on comparable projects and demonstrate its effectiveness for use on this project.
- H. Mock-ups:
1. Prior to executing work, provide in-place mock-ups for the Architect's approval. Resubmit panels until the Architect is fully satisfied. Mock-ups shall be prepared by the Contractor using the same workmen, methods and materials that will be employed for the remainder of the work. Upon approval, the mock-ups will remain the standards of work throughout the job. The approved mock-ups shall be retained, undisturbed and suitably marked, throughout construction. Mock-ups may be incorporated into the finished work, when so approved by the Architect.
 2. No mock-ups shall be made until the methods and locations are approved by the Architect.
 3. Architect will be present during the creation of all mock-ups. Do not proceed with the work unless the Architect is present. Notify the Architect not less than forty-eight (48) hours in advance of masonry restoration mock-ups.
 4. Provide protection for adjacent surfaces during the mock-up phase.
 5. Mock-ups of repair work shall match the original in all respects, including color, texture, finish, dimensions, coursing, bond type, etc.
 6. The mock-ups are as follows:
 - a. Removal of deteriorated limestone to sound stone.

- b. Installation of limestone Dutchman requiring pins
- c. Removal of damaged limestone patch
- d. Installation of new limestone patch
- e. Removal of damaged bluestone unit at base
- f. Installation of new bluestone unit at base
- g. Pointing sample, including raking and re-pointing six (6) linear feet.
- h. Polishing of granite two (2) square feet.
- i. Efflorescence removal four (4) square feet.

1.7 COORDINATION:

- A. At least three weeks prior to commencing the work of this Section, a meeting must be scheduled at the jobsite to discuss conformance with the requirements of specifications and job site conditions. Representatives of the Contractor, Architect and other parties involved in the scope of this work shall attend the meeting.
- B. The Contractor shall coordinate his or her work with that of all other trades related to the successful completion of the work of this section.
- C. The work of this Section is not to commence until the cleaning of the waiting room has been completed.

1.8 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered to the job site in factory-sealed containers clearly labeled as to product, manufacturer, color, and other pertinent characteristics.
- B. All materials for use in the work of this Section shall be stored under environmental conditions recommended by the manufacturer. Materials should be kept dry (includes protection from liquid moisture and water vapor), well-ventilated and free of foreign matter.
- C. Arrangement shall be made with the Architect to store equipment and materials in designated areas. The Architect shall not be responsible for damaged or stolen materials or equipment left on the premises by the Contractor.

PART 2 - PRODUCTS

2.1 TOOLS:

- A. Contractor shall furnish all materials and equipment necessary to accomplish all aspects of the work in this Section.
- B. Hand tools shall be used for removal of deteriorated stone and squaring off of openings for Dutchmen and patches.
- C. Scaling back of limestone may be accomplished using an electric hand sander with diamond abrasive sanding pads.

- D. use of other rotary grinders, power saws, power chisels, or any other power tools will not be permitted without prior written approval of tool types and locations by the Architect.

2.2 MATERIALS:

A. New Limestone:

1. New limestone is to match historic materials in color, texture, finish and profile.

B. New Bluestone:

1. New bluestone is to match existing in color, veining pattern, finish and profile.

C. Dutchmen

1. Dutchmen shall be made from replacement stone approved by the Architect. The stone shall match the existing material to be repaired.
2. All new stone shall be of standard grade, free of cracks, seams, or starts which may impair its structural integrity or function. Inherent color variations characteristic of the quarry from which it is obtained may be acceptable if consistent with the existing stone which is being matched. The Architect shall determine the acceptability of this variation. Texture and finish shall be approved by the Architect as shown on the samples against the stone to be matched.
3. Stone replication elements shall be fabricated to match existing stone in appearance including color, texture, profile and surface finish.
4. Dutchmen shall be appropriately sized to fit the openings they will fill. Joints should measure no more than 3/8".
5. Prior to the installation of any Dutchmen, the Architect will review them for soundness and sizing.
6. Holes for anchors shall be diamond cored.

D. Dutchmen Anchors and Accessories

1. Provide anchors of type and size required to support Dutchmen. Anchors shall be stainless steel, AISI Type 302 or 304.
2. Provide hardwood or plastic shims, non-staining to stone, sized to suit joint thickness and bed depths of Dutchmen.
3. Rods/Pins: Stainless steel threaded rods sized for each type of repair for Dutchmen and reattachment of pieces where necessary. Anchors and pins shall be AISI type 302 or 304 stainless steel. Pins shall meet ASTM A167, a minimum of 1/4 inch in diameter and in lengths as required.

E. Adhesives

1. Akepox 5000, epoxy based stone adhesive, UV stable, knife grade by Akemi.

2. Sikadur 31, Hi-Mod Gel and manufactured by Sika.
 3. Flexi-weld 520T Epoxy Adhesive” as manufactured by Edison Coatings, Inc. Plainville, CT.
 4. Or approved equal.
- F. Limestone Patching Mix and Components
1. Use custom patching mix that is tinted to match the existing limestone.
 2. Jahn M70 Limestone/Sandstone/Brownstone Repair Mortar as manufactured by Cathedral Stone.
 - a. Only installers with certification from Cathedral Stone can purchase or install Jahn Repair Mortars.
 3. Or Approved Equal.
- G. Bluestone Patching Mix and Components
1. Use custom patching mix that is tinted to match the existing bluestone.
 2. Jahn M160 Granite and Bluestone Repair Mortar as manufactured by Cathedral Stone.
 - a. Only installers with certification from Cathedral Stone can purchase or install Jahn Repair Mortars.
 3. Or Approved Equal.
- H. Masonry Crack Repairs
1. For hairline cracks up to 1/8 inch in width, acceptable products include:
 - a. PumpX53iL Pumpable injection grout manufactured by Edison Coatings, Inc., Plainville, CT.
 - b. Injection Grout 101G as manufactured by U.S. Heritage Group, Chicago, IL.
 - c. Jahn M30 #32 Micro Injection Grout as manufactured by Cathedral Stone.
 - d. Or approved equal when approved in advance by the Architect.
 2. For cracks greater than or equal to 1/8 inch in width, acceptable products include:
 - a. Jahn M40 Crack and Void Injection Grout as manufactured by Cathedral Stone.
 - b. Injection Grout 101G as manufactured by U.S. Heritage Group, Chicago, IL.
 - c. PumpX53iL Pumpable injection grout manufactured by Edison Coatings, Inc., Plainville, CT.
 - d. Or approved equal when approved in advance by the Architect.
 3. **If Jahn patching material is used, all installers must be certified Jahn installers.**
 4. Injection shall be by disposable syringe, acceptable products include:

- a. Monoject Non-Sterile Disposable Syringe without needle #79-4215 Supplied by PGC Scientifics (www.pgesci.com)
 - b. Air-Tite Brand 30cc Luer Lock Syringe #3 supplied by Air-Tite Products Co., Inc. (www.air-tite.com).
 - c. Or approved equal.
5. Syringe needles shall be used as necessary for injecting grout into cracks. Needles shall be lengths as required and shall be supplied by a veterinary supply company such as:
 - a. Air-Tite Products Co., Inc. (www.air-tite.com)
 - b. Or approved equal.
6. Ports and cracks shall be sealed during injection grouting using a non-staining, water based clay.
7. Capping Mortars shall be custom colored to match the limestone or limestone. Approved products include:
 - a. Jahn M125 Thin Set Mortar as manufactured by Jahn International and supplied by Cathedral Stone.
 - b. Or approved equal when approved in advance by the Architect.
- I. Pointing and Bedding Mortars
 1. Mortar for pointing stone units shall be custom colored, lime based mortar. Acceptable pointing mortars include:
 - a. Jahn M110 Historic Pointing Mortar as manufactured by Jahn International and supplied by Cathedral Stone products.
 - b. High Lime Hydrate Mortar – Restoration Mortar as manufactured by U.S. Heritage Group.
 - c. Or approved equal.
- J. Grout
 1. Provide a cement acrylic grout with color added to match the color of the original marble grout.
- K. Polishing Materials
 1. Grinding stones: Fine grit emery stones manufactured specifically for restorative type grinding and surfacing of granite surfaces (#40 and #80 grit stones).
 2. Hand tools
 - a. Trowel
 - b. Chisel
 - c. Hand grinder
 4. Resurfacing Screens: a fine grit screen manufactured specifically for restorative type grinding and resurfacing granite surfaces.
- L. Efflorescence Removal
 1. Poultice of acid-free paper and Water

PART 3 - EXECUTION

3.1 INSPECTION:

- A. The Contractor shall examine substrates and conditions under which this work is to be performed and notify the Architect in writing of conditions detrimental to the proper completion of the work. Do not proceed until unsatisfactory conditions are corrected. Commencement of work indicates that Contractor accepts substrate and conditions.
- B. Review the amount and extent of work to be accomplished and review areas with the Architect prior to the execution of Work.
- C. Correct any conditions that are detrimental to the successful completion of the work. Sequencing of work should be scheduled to ensure that completed work will match existing.
- D. All efflorescent salts must be removed from the masonry prior to any repair work.

3.2 EFFLORESCENCE REMOVAL

- A. For light areas of efflorescent salts that re-appear after cleaning, remove with a dry brush or vacuum. Repeat as necessary until salts no longer appear on stone surface.
- B. For heavier areas of efflorescence, reapply poultice in accordance with Section 040140 Interior Masonry Cleaning. Reapply as necessary until salts no longer appear on stone surface.

3.3 DUTCHMEN REPAIRS:

- A. The Dutchman repairs can vary in overall size, but shall not under any circumstance be less than two (2) inches thick. Replacement stone shall be carefully cut and selected to be sound and in good condition, free of defects, cracks, breaks, or other observable defects. The surface of the replacement stone shall be dressed to resemble the appearance, tooling and texture of the adjoining stone by an approved method. All surface dressing of Dutchman repair shall be done before the Dutchman is set.
- B. Dutchmen shall be fastened with stainless, pins and anchors as necessary, designed to facilitate mechanical locking and to prevent possible slippage of the stone. The fasteners shall be positioned without weakening the stone in any way.
- C. Preparation:
 - 1. Ensure that all salts have been removed from stone prior to repairs.
 - 2. Using hand held tools or if approved, power tools, remove unsound or damaged stone taking great care not to abrade or mar adjacent masonry surfaces or edges
 - 3. Square-up voids, leaving a sound and level bed on which to place Dutchman.

4. Remaining masonry surface shall be cleaned and all loose material shall be rinsed with water to remove all dust and debris.
- D. Pinning Dutchmen: Large Dutchman units should be repaired and reattached using stainless steel pins and epoxy adhesive. Where possible, blind pinning should be employed.
1. Pre-drill pin holes into the Dutchmen units to be re-set and into the limestone substrate. The pin holes shall be no greater than 1/8 inch larger than the diameter of the pins. Recess the pins a minimum of $\frac{3}{4}$ inch beneath the surface of the stone.
 2. Coat the inside of each hole and the surface of each pin with the specified epoxy.
 3. Insert epoxy-coated pin into hole and counter sink pin a minimum of 1/2 inch beneath the surface of the stone.
 4. After the pin has been set and the epoxy has cured, fill the pin holes with the specified composite patching mortar. The patch area shall exactly replicate the color, texture, reflectance and original profile of the stone.
- E. Setting Dutchman:
1. Rinse Dutchman before setting, do not install dirty or dusty stone and dampen joint and surrounding stone surfaces prior to placing mortar.
 2. Use water soaked hardwood or plastic shims to stabilize stone Dutchmen in proper alignment while mortar is setting. Make sure that sufficient shim material is placed to avoid point loading the stone as this may squeeze freshly applied mortar out of joints.
 3. Set stone Dutchman to existing masonry with approved epoxy accurately and in accordance with the approved setting drawings. A thin layer of epoxy shall be applied to stone to within 1/4 inch of its edges. Do not allow epoxy to spread out over exposed edges.
 4. The thickness of joints in all masonry will be uniform and shall match those in the adjacent work in which the unit replacement or Dutchman is being installed. In no case shall the joint exceed $\frac{1}{4}$ inch.
 5. Patching of defects in the Dutchman shall not be permitted. Chips and stains on surfaces shall be redressed, cleaned or replaced with new stone. No acid leaching agent shall be permitted.
 6. Fill joints between units, packing mortar tightly. Verify proper horizontal and vertical alignment before bedding mortar sets.
 7. Remove shims only after mortar has set. Do not disrupt bond.
 8. Tool final layer of mortar to match pre-approved joint profile.
- F. Protect all adjacent materials during Dutchman repairs. Once epoxy materials have set remove any epoxy, grout or patching material accidentally splashed onto adjacent surfaces. Remove set epoxy adhesive with acetone. Any damage to stone or materials to

remain resulting from Dutchman repairs shall be restored to the full satisfaction of the Architect at no additional cost.

- G. The face of all Dutchman repairs shall be cleaned following the completion of all setting work. Clean patch material splashes, smears, etc. by vigorously brushing with stiff natural-bristle brushes and potable water. If necessary, clean white sand may be added to the water.
- H. Any work judged to be defective by the Architect shall be removed and reset at no cost.

3.4 MASONRY COMPOSITE PATCHING MATERIAL

- A. Preparing void: Where required remove existing composite patch and all unsound stone. Existing patches shall be removed using hand tools and chisels or other approved method that will not damage, abrade or break the stone, its edges or surrounding elements.
- B. Using a toothed chisel, even up the sides and back of the void, creating a minimum depth of ¼ inch below the surface where possible. Dovetail walls of void to form key for patching. Do not install patch repairs that have a feathered edge. Incorrect installation will cause repairs to fail prematurely.
- C. Surfaces to receive patching material must be sound and free of all dust, dirt, grease, laitance and/or any other coating or foreign substance which may prevent property adhesion. Remove all loose particles with water and brush from void. If necessary, use a vacuum cleaner to produce a dust-free surface.
- D. If using Jahn patching materials, follow the manufacturer's instructions for application, tooling, moistening and curing. If Jahn patching material is used, all installers must be certified Jahn installers.
- E. Moisten the substrate using clean water; do not allow water to pool in voids. Jahn Mortar or approved equal should be applied to a glistening wet surface on vertical applications and a well dampened surface, with no pooling water on horizontal applications. If the surface is allowed to dry out before applying the product, this step must be repeated.
- F. Jahn mortar should be mixed with water to the consistency of wet putty. Apply the Jahn mortar to the glistening web substrate approximately 1/8 inch thick.
- G. Patching materials are to be applied as per manufacturer's instructions. Deeper voids are to be filled in lifts. Follow manufacturer's instructions for curing, moistening and tooling.
- H. The restored areas shall match the original contours and detail of the limestone units.
- I. Unacceptable patches will be removed and replaced as directed by the Architect. Unacceptable conditions include, but are not limited to:
 - 1. Separation of the patch from the sound stone at the edges of the patch.
 - 2. Hairline cracking of the patch.

3. Feathered patches.
 4. White hazing or other discoloration of the patch.
- J. Additional Mechanical Bond for Patches at Arises:
1. If the composite patch is located at an arris of the masonry unit, drill pin holes into the masonry unit to be patched. The pin holes shall be no greater than 1/16 inch larger than the diameter of the pin. Recess the pins a minimum of 3/4 inch beneath the surface of the stone.
 2. Coat the inside of each hold and the surface of each pin with the specified epoxy.
 3. Insert epoxy-coated pin into hole and insert pin a minimum of 1/2 inch beneath the surface of the stone.
 4. After the pin has been set and the epoxy has cured apply patching mortar. Anchor must be covered with a minimum of 3/4 inch of patching material.

3.6 MASONRY CRACK REPAIR

- A. Cracks narrower than 1/8 inch shall be filled with injectable grout.
1. Preparation:
 - a. Lateral cracks shall have a series of injection ports, which shall measure 1/4 inch in diameter and shall be spaced as required. Injection pots shall be drilled in a downward direction along the length of the crack.
 - b. Moisten the interior of the crack immediately prior to injection by flushing with water. Repeat this step if the surface becomes dry before grout is injected.
 2. Mixing:
 - a. Precautions should be taken while mixing grouting materials. Safety goggles, dust mask and gloves should be worn.
 - b. No more material than can be used in 30 minutes shall be mixed at any one time. Material that has exceeded its pot life shall be discarded.
 - c. Follow manufacturer's product literature for proportions of injection grout and water. Mix for a minimum of three (3) minutes.
 3. Injection Procedure:
 - a. Seal ports and lower portions of crack using non-staining, water-based clay. Add new clay prior to grout being injected into higher injection ports.
 - b. Lateral cracks shall be filled from the lowest injection port continuing until it flows freely from this port. Where necessary, insert stainless steel rods after some grout has been injected. Tap to remove voids or air pockets. Inject grout into the next highest port and proceed in the same fashion. Clean up overflow immediately.
 - c. When the grout has set and is thoroughly dried, the entry ports and crack surfaces shall be patched with composite patch material matching the

color, texture and reflectance of the surrounding sandstone. The patching material shall be level with the adjacent masonry.

- B. Cracks equal to or wider than 1/8 inch shall be routed and filled with grout and subsequently patched with approved composite patching material to match the color, texture and level of the surrounding clean masonry.
 - 1. Routing and Filling of Cracks:
 - a. Cracks and fractures of masonry surfaces shall be filled with grout mortar. The crack shall be cut to a depth of 3/4 inch and a width of 1/8 inch. The crack shall be thoroughly cleaned, brushed with mortar slurry coat and filled with a grout mortar. The surface shall be finished with the approved composite patching material matching the profile, color and texture of the adjacent cleaned masonry
- C. All repaired cracks shall be flush with the face of the masonry. All entry ports and crack surfaces shall be subsequently patched with approved composite patching mortar to match the color, texture and level of surrounding clean masonry
- D. **If using Jahn grouting materials, follow the manufacturer's instructions for application, tooling, moistening, and curing. If Jahn patching material is used, all installers must be certified Jahn installers.**

3.7 JOINT RAKING AND PREPRATION

- A. Carefully document original joint profiles and widths prior to all raking activities.
- B. Rake out mortar and grout from joints to depths equal to 2 ½ times their widths, but not less than ½ inch to expose sound, un-deteriorated mortar or grout. Remove mortar or grout to provide reveals with square backs and to expose masonry for contact with pointing materials Brush, vacuum or flush joints to remove all dirt and loose debris.
- C. Cut out old mortar or grout by hand with chisel and mallet. Power operated, rotary hand-held saws and grinders will be permitted with the approval of the Architect, for use on the horizontal joints if the Contractor can demonstrate the ability of the operators to use tools without damaging the masonry. If masonry damage is caused by power tools, only chisels and mallets will be permitted for the remainder of the project.
- D. Do not break or mar edges of masonry units or widen joints. Replace in kind all masonry units which become damaged.

3.8 POLISHING GRANITE

- A. Sand surface with a hand sander or small grinding tool, using fine stones to achieve desired finish.
 - 1. Use a #40 or finer grit stone for the initial grinding. Follow with a fine #80 grit stone.
- B. Thoroughly rinse surface with clean, clear water.

- C. Final polish with a #80 or finer grit stone.

3.9 POINTING MASONRY

- A. Rinse joint surfaces with fresh water to remove all dust and loose mortar particles. Time application of rinsing so that at time of pointing excess water has evaporated or run off, and joint surfaces are damp, but free of standing water.
- B. Apply first layer of pointing mortar to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch. Compact each layer thoroughly and allow to become thumbprint-hard before applying next layer.
- C. After joints have been filled to a uniform depth, place pointing material in three steps. Each of the first and second steps should fill approximately 2/5 of joint depth and the third step the remaining 1/5th. Fully compact mortar at each step and allow to become thumbprint-hard before applying next step. Take care not to spread mortar over edges onto exposed masonry surfaces or to feather edge the mortar.
- D. When mortar is thumbprint-hard, tool joints to match original appearance of joints and approved mock-ups. Remove excess mortar from edges of joints by brushing.
- E. Cure mortar by maintaining a damp condition for not less than 72 hours.
- F. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter using stiff nylon or Tampico bristle brushes and clean water. The use of metal scrapers or brushes will not be permitted.

3.10 CLEAN UP

- A. Remove protective materials from adjacent surfaces.
- B. Upon completion of work, clean all surfaces of any debris, mortar droppings, construction materials, etc.

END OF SECTION

SECTION 040140 - INTERIOR MASONRY CLEANING

PART 1.00 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the Contract Documents.

1.02 WORK INCLUDED

- A. The work of this Section consists of the cleaning of the masonry materials at the interior of the CRRNJ Terminal. Conditions may include, but are not limited to atmospheric soiling, efflorescence, water staining, and adhesive. Cleaning is intended to remove the majority of surface dirt and other deposits from the masonry and return the surface to a more uniform color. Surfaces shall be evenly cleaned with no evidence of streaking, bleaching or unnatural color variations. Masonry pores will be left free of any residual chemical cleaner and be pH neutral. Work shall include:

1. Supervised testing program to determine the most effective products and methods for cleaning each type of material.
2. The removal of atmospheric soiling and water staining from the limestone, bluestone, glazed brick, and red brick walls using chemical cleaners
3. The removal of atmospheric soiling from the tile floor using a chemical cleaner
4. The removal of efflorescence from the brick, glazed brick, limestone and sandstone walls

1.03 RELATED WORK

- A. Section 040130 – Interior Masonry Restoration

1.04 QUALITY ASSURANCE

- A. All masonry restoration shall be done by a qualified Restoration classified by DPMC.
- B. Contractor shall maintain a steady work crew consisting of skilled mechanics who are experienced with the materials and methods specified, and are familiar with the design requirements. Contractor shall maintain a full-time Forman who fluently speaks, reads and writes English. Contractor shall confirm that all workers understand the job's requirements. Mechanics shall be fully supervised to ensure that the work is accomplished to meet or exceed the highest standards of the trade.

- C. Architect shall be given regular access to the Contractor's scaffolding or work site so that he/she may inspect work being performed.
- D. Contractor shall replace at no additional expense to the State all broken, lost or damaged materials during the masonry restoration.
- E. Work is to be performed on a daily basis without interruption unless directed otherwise by the Architect.
- F. Obtain materials for masonry restoration from a single source for each type of material required to ensure match in quality, color, texture and pattern.
- G. In acceptance or rejection of the work of this Section, no allowances shall be made for lack of skill on the part of the mechanics.
- H. Materials shall be used only at the manufacturer's recommended temperature tolerances.
- I. Coordination: Contractor shall coordinate work of all other trades related to the successful completion of this work.
- J. All environmental restrictions (City, State and Federal), health, and safety code requirements regarding items in this Section shall be observed. This includes complying with all environmental regulations (City, State and Federal) regarding VOC and effluent collection and disposal. Do not allow run off from the cleaning process to enter storm and sanitary drains, catch basins and sewer systems, contaminate water supplies, or to enter natural bodies of water. Dispose of effluent in a safe and legal mater.
- K. References
 - 1. American Society for Testing and Materials (ASTM). ASTM 100 Barr Harbor Drive, West Conshohocken, PA 19428. (610) 832-9500.
 - 2. MSDS – Material Safety Data Sheets
 - 3. Comply with the cleaning recommendations of the National Park Service Technical Preservation Services Division as outlined in *Keeping it Clean: Removing Exterior Dirt, Paint, Stains and Graffiti from Historic Masonry Buildings*, Preservation Assistance Division (1988) except as modified by these Specifications.

1.05 SUBMITTALS

- A. Submit qualification data and references for firms and persons specified in Section "Quality Assurance" to demonstrate their capabilities and experience.
- B. Contractor shall submit a work plan including detailed description of how the work of this Section shall be accomplished. This should include products to be used, methods and equipment for restoration, etc.

- C. Provide written descriptions, drawings and diagrams outlining proposed methods and procedures for protection of personnel, the public and the existing construction during the work of this Section.
- D. The Contractor shall submit copies of the manufacturer's technical data for each product including their recommendations for application and use. One complete set of product literature and MSDS shall be placed in a 3-ring loose-leaf binder and shall be present on the job site at all times for the reference of the Architect.
- E. Samples: Submit to the Architect samples of each cleaning agent to be tested in their original unopened containers.

1.06 SAMPLE PANELS

- A. Testing Program: Prior to executing work, provide in-place chemical test panels for the Architect's review and approval.
 - 1. Test panels shall consist of 5-10 products appropriate for removing each type of soiling or staining from each type of masonry. Each product shall be tested on discrete areas approximately one (1) square foot (1' x 1') in size. Each product shall be separated from adjacent chemicals using tape or strippable masking to prevent cross-contamination.
 - 2. Location of test panels shall be determined in consultation with the Architect.
 - 3. Apply products in accordance with manufacturer's recommendations.
 - 4. Any alteration in dilution or dwell time must be noted and approved by Architect.
 - 5. Test panels shall be carefully labeled to indicate which chemicals were applied and how long each product was allowed to dwell.
 - 6. Resubmit panels until the Architect is fully satisfied. Providing additional cleaning means and methods as required.
 - 7. Test panels shall be prepared by the Contractor using the same workmen, methods and materials that will be employed for the remainder of the work.
 - 8. At the discretion of the Architect, samples shall be prepared in the presence of the Architect.
 - 9. Architect shall select most appropriate cleaning product for each material and type of soiling from the range of test products provided.
- B. Following approved testing program, provide larger in-place sample panels for the Architect's approval. Resubmit panels until the Architect is fully satisfied. Sample panels shall be prepared by the Contractor using the same workmen, methods and materials that will be employed for the remainder of the work. At the discretion of the Architect, samples shall be prepared in the presence of the Architect. Samples shall be approved for texture, and profile.
- C. Contractor shall protect approved panels for the duration of the work. Samples may be part of the Work, and may be incorporated into the finished work when so approved by the Architect.
- D. Revise sample panels as necessary to secure this approval.

- E. Sample panels will serve as a standard for the acceptance or rejection for the work of this Section.
- F. Provide sample panels measuring four (4) square feet (2' x 2') that are representative of the effect of cleaning materials and methods on the most heavily soiled areas.
- G. The following test panels and mock-ups shall be performed:
 - 1. General soiling removal from the limestone
 - 2. General soiling removal from the bluestone
 - 3. General soiling removal from the yellow glazed brick
 - 4. General soiling removal from the green glazed brick
 - 5. General soiling removal from the red brick
 - 6. Efflorescence removal from the limestone
 - 7. Efflorescence removal from the bluestone
 - 8. Efflorescence removal from the glazed brick
 - 9. Efflorescence removal from the red brick
 - 10. General soiling removal from the floor tiles

1.07 DELIVERY, STORAGE AND HANDLING

- A. All materials are to be delivered to the job site in original unopened containers bearing manufacturer name and label. Store and handle materials in strict compliance with manufacturer's instructions. Do not store directly on the ground.
- B. Protect materials from tampering, acts of vandalism, possible injury to workers, the general public, intrusion of foreign materials and moisture. All vessels shall have tight fitting covers. At no time shall vessels containing chemicals be carried to working levels when vessels are open.

1.08 JOB CONDITIONS

- A. Prevent cleaning agents from spilling or dripping down surfaces, on to adjacent materials, or on to the ground. Remove any spilled or dripped materials immediately and rinse well.
- B. Provide adequate protection from chemical cleaning agents and rinse water for all glass, metal, plaster, drywall, and wood surfaces around and beneath the surfaces being worked on and any adjacent surfaces not included in this work.
- C. The Contractor shall take all necessary precautions for the protection of property and public safety from cleaning agents, rinse water, and wind-drifting chemical cleaners and water.

- D. The Contractor will use all necessary precautions to protect persons performing the work and others from harmful effects of the cleaning agents and rinse water. Workers shall be required to wear protective clothing, goggles, face shields, gloves, and other clothing or equipment in compliance with MSDS, governing Federal, State, and local safety codes and regulations.
- E. Avoid exposing building's inhabitants to fumes.
- F. The Contractor shall provide, erect, and maintain barricades, danger signals, and warning signs as needed.

1.09 COORDINATION

- A. General cleaning shall be performed prior according to Section 040130 Interior Masonry Restoration.

PART 2.00 - PRODUCTS

2.01 EQUIPMENT

- A. Brushes shall be stiff natural bristle brushes and soft-fibered masonry washing brushes, never metal.
- B. Sponges shall be extra-large grout sponges. No scrubbing or dye-colored sponges are to be allowed.
- C. HEPA Vacuum
- L. Paint roller
- M. Airless sprayer
- N. Clean rags
- O. Latex gloves
- P. Eye and skin protection
- Q. Spray bottles
- R. pH strips ranging from 0-14 available from Talas 330 Morgan Avenue Brooklyn, NY 11211, Tel: 212-219-0770.
- S. Wet/dry shop-vacuums
- T. UV light

2.02 CLEANING AGENTS

A. General Cleaning and Water Stain Removal from wall surfaces

1. Provide range of 5-10 cleaning chemicals from multiple manufacturers suited for removing general soiling from each type of masonry for the purposes of cleaning tests. Cleaning tests will be used to select the most appropriate and effective cleaning chemical for cleaning each space.
2. Provide additional cleaners as required.
3. Examples of products include:
 - a. MasonRE B All Purpose Cleaner, manufactured by Cathedral Stone.
 - b. 942 Limestone and Masonry Cleaner, manufactured by Prosoco.
 - c. Liquid Marble Cleaner, manufactured by Prosoco.
 - d. Safe N' Easy Limestone Cleaner, manufactured by Dumond Chemicals.
 - e. or approved equal.

B. General Cleaning of Floor

1. 1:6 dilution of Vulpex Liquid Soap, available from Talas, 330 Morgan Avenue, Brooklyn, NY 11211, Tel: 212-219-0770.
2. Stand-Off Liquid Marble Cleaner, distributed by ProSoCo, Inc., 3741 Greenway Circle, Lawrence, KS 66046, Tel: 800-255-4255.
3. EnviroKlean 2010 All Surface Cleaner, distributed by ProSoCo, Inc., 3741 Greenway Circle, Lawrence, KS 66046, Tel: 800-255-4255.
4. Simple Green, manufactured by Sunshine Makers, Inc, Tel: 800-228-0709.
5. Or approved equal.

C. Efflorescence Removal

1. Poultice of inert clay materials Fuller's earth, kaolin or Stand Off Poultice Powder as manufactured by ProSoCo) and Water.
2. Safe N' Easy Efflorescence Remover as manufactured by Dumond.
3. Ef-Fortless, as manufactured by Eaco Chem.
4. Or approved equal. Paper and water poultice
 - a. Paper used for the poultice shall be acid-free.

D. Adhesive and Residual Varnish Removal

1. Acetone

PART 3.00 - EXECUTION

3.01 INSPECTION

- A. Before starting any work of this section, the Contractor shall make a complete inspection of all elevations and associated elements to confirm all surfaces to be cleaned and all areas that will require special care in cleaning. Review the Contract Drawings describing existing conditions of concern (e.g. open joints, deteriorated material) and carefully inspect these areas on the elevations. Do not proceed until such discrepancies are resolved.
- B. Prior to cleaning, determine degree of cleaning to be carried out and review areas requiring additional treatment with the Architect. Approved cleaning test panels will serve as the standard for cleaning the materials.

3.02 PREPARATION FOR CLEANING

- A. Dry brush or vacuum with a HEPA vacuum any areas with loose dirt or soil, or extreme dirt build-up, to remove as much material as possible, prior to wet cleaning. This is especially important on areas of overhanging ledges.
- B. Using a HEPA vacuum, vacuum debris from all areas exhibiting efflorescence prior to the application of any water or cleaning products.

3.03 CHEMICAL CLEANING

- A. Preparation
 - 1. Vacuum all supports including moldings, carved stonework and the flat areas of the wall and floor. The areas to be cleaned should be dry and free from dust and loose debris.
 - 2. Mask off painted, glass or metal fittings with a light duty polyethylene. Protect doors windows, and other fragile items with heavy duty grade polyethylene. Carefully tape to seal protection completely and to prevent the ingress of water, cleaning fluids, dust or debris.
 - 3. Tape-off working area using blue painter's tape. Limits of the working area should occur at joint lines in the masonry to prevent the appearance of streaking or lines from uneven cleaning.
- B. Application
 - 1. Apply approved chemical products to designated materials and areas of soiling in accordance with approved means and methods from testing program and mockups.

2. Apply approved dilution of each chemical to prewet surfaces, as required by manufacturer's instructions.
3. Tools should be stainless steel or synthetic materials.
4. Apply cleaner using a brush, roller, or airless sprayer to a dry masonry surface to the desired thickness—approximately 3/16-inch. Thin applications will be very difficult to remove.
5. Ensure that the product forms a continuous film that is properly applied to all details and reaches all crevices. Brush the material over the edges of the protective polyethylene to ensure a completely waterproof seal around the borders of the area to be cleaned.
6. Do not apply on hot surfaces. Temperatures for use should be between 50°F and 85°F.
7. Do not allow products to dry on surface.
8. Thoroughly rinse surface to remove all traces of chemical from masonry. Rinse until the wet masonry surface is of the same pH as the clean rinse water. Surfaces shall be tested with pH strips

3.04 GENERAL FLOOR CLEANING

- A. Thoroughly wet surfaces prior to application of the cleaner. Surfaces shall not be allowed to dry prior to application of the cleaner
- B. Apply the properly diluted cleaning solution to the surface of the floor using a natural or synthetic fiber brush (i.e., soft bristled nylon).
- C. Allow the detergent to remain on the surface for 10 minutes, scrubbing lightly with a brush.
- D. Rinse the floor with clean water. Take great care to ensure that all detergent is rinsed from masonry. Rinse until the wet masonry surface is of the same pH as the rinse water. Surfaces shall be tested with pH strips.
- E. Wet shop-vacs can be used to mitigate the rinse water.
- F. Reapply the cleaner, if necessary, according to steps A through E.

3.05 EFFLORESCENCE REMOVAL

- A. Vacuum loose efflorescence from the surface of the wall.
- B. Paper used for poultice is to be acid-free and soaked in water.

- C. Lift paper out water until it stops dripping.
- D. Apply the poultice to areas of the stone exhibiting heavy efflorescence. Poultice should be approximately ¼" thick and overlap the area of efflorescence by about one inch.
- E. Cover the poultice with plastic and tape the edges to seal and allow to dwell for approximately 24 hours.
- F. Remove the plastic and allow the poultice to dry thoroughly (approximately 24 to 48 hours).
- G. Once the poultice is dry, remove it from the wall. Allow to wall to thoroughly dry.
- H. Repeat process until efflorescence no longer comes to the surface. This may require several applications.

3.06 ADHESIVE AND RESIDUAL VARNISH REMOVAL

- A. Mechanically remove any residual tape from the masonry.
- B. Apply acetone to the affected area using a solvent-resistant brush.
- C. Scrub the area and reapply the acetone until all residues are removed.
- D. Rinse with clean water.

3.07 COMPLETION

- A. Clean and water wash adjacent areas and remove any debris or accumulated matter.
- B. Remove all protective materials, ensuring that no adhesive residue remains.
- C. Properly and legally dispose of all refuse and remove all materials from the work site.

END OF SECTION

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMU's).
2. Cast Stone Sills.
3. Face brick.

B. Related Sections:

1. Section 076200 "Sheet Metal Flashing and Trim" for furnishing manufactured reglets installed in masonry joints.

1.2 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Clay Masonry Unit Test: For each type of unit required, according to ASTM C 67 for compressive strength.
2. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
3. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
4. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
5. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

C. Samples for Verification: For each type and color of exposed masonry unit and colored mortar.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product indicated. For masonry units include material test reports substantiating compliance with requirements.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.5 QUALITY ASSURANCE

- A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- B. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1.6 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 - 2. Density Classification: Lightweight unless otherwise indicated.

2.3 BRICK

- A. General: Provide shapes indicated and as follows:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: ASTM C 216.
 - 1. Brick color, size, and finish to match existing.

2.4 CAST STONE SILLS

- A. Provide cast stone units complying with ASTM C 1364 using either the vibrant dry tamp or wet-cast method.
 - 1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.
 - 2. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 - 3. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 - 4. Provide drips on projecting elements unless otherwise indicated.
- B. Cure units as follows:
 - 1. Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
 - 2. Keep units damp and continue curing to comply with one of the following:
 - a. No fewer than five days at mean daily temperature of 70 deg F or above.
 - b. No fewer than six days at mean daily temperature of 60 deg F or above.
 - c. No fewer than seven days at mean daily temperature of 50 deg F or above.
 - d. No fewer than eight days at mean daily temperature of 45 deg F or above.
- C. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- D. Approved Manufacturers:

1. Continental Cast Stone.
2. Advanced Cast Stone, Inc.
3. Edwards Cast Stone Company.
4. Approved equal.

E. Colors and Textures: To match existing.

2.5 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C 91.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
- G. Aggregate for Mortar: ASTM C 144.
1. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 2. White-Mortar Aggregates: Natural white sand or crushed white stone.
 3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- H. Aggregate for Grout: ASTM C 404.
- I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Euclid Chemical Company (The); Accelguard 80.
 - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
 - c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.
- J. Water: Potable.

2.6 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
 - 1. Interior Walls: Hot-dip galvanized, carbon steel.
 - 2. Exterior Walls: Stainless steel.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.
- D. Masonry Joint Reinforcement for Multiwythe Masonry:
 - 1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches wide, plus 1 side rod at each wythe of masonry 4 inches wide or less.
 - 2. Tab type, either ladder or truss design, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
 - 3. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.
- E. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch- diameter, stainless-steel continuous wire.

2.7 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
 - 1. Wire: Fabricate from 3/16-inch- diameter, hot-dip galvanized steel wire.
- D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch- diameter, hot-dip galvanized steel wire.
- E. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- thick, steel sheet, galvanized after fabrication.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch- diameter, hot-dip galvanized steel wire.
 3. Corrugated Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch- thick, steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 1 inch of masonry face.
- F. Partition Top anchors: 0.105-inch- thick metal plate with 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.
- H. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
 2. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors.
 3. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 213 or D/A 210 with D/A 700-708.
 - 2) Heckmann Building Products Inc.; 315-D with 316.
 - 3) Hohmann & Barnard, Inc.; DW-10, DW-10HS or DW-10-X.
 - 4) Approved equal.
 - b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, having slotted holes for inserting wire tie.

- c. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch-thick, steel sheet, galvanized after fabrication.
 - d. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch- diameter, hot-dip galvanized steel wire.
4. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 213S.
 - 2) Hohmann & Barnard, Inc.; DW-10-X-Seismiclip.
 - 3) Heckmann Building Products Inc.
 - 4) Approved equal.
 - b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, having slotted holes for inserting connector section.
 - c. Connector Section: Rib-stiffened, sheet metal bent plate, sheet metal clip, or wire tie and rigid PVC extrusion designed to engage continuous wire. Size connector to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.
 - d. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch-thick, steel sheet, galvanized after fabrication.
 - e. Fabricate wire connector sections from 0.187-inch- diameter, hot-dip galvanized, carbon-steel wire.
- I. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.8 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
1. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 2. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
 3. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.
- B. Flexible Flashing: Use the following unless otherwise indicated:
1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
 - a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Advanced Building Products, Inc.
- 2) Dayton Superior Corporation, Dur-O-Wal Division
- 3) Hohmann & Barnard, Inc.; Flex-Flash.
- 4) Approved equal.

- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene or PVC.
- B. Preformed Control-Joint Gaskets: Made from PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

- a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Blok-Lok Limited; Cell-Vent.
- 2) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
- 3) Heckmann Building Products Inc.; No. 85 Cell Vent.
- 4) Hohmann & Barnard, Inc.; Quadro-Vent.
- 5) Wire-Bond; Cell Vent.
- 6) Approved equal.

- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Advanced Building Products Inc.; Mortar Break, Mortar Break II.
- b. Archovations, Inc.; CavClear Masonry Mat.
- c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
- d. Mortar Net USA, Ltd.; Mortar Net.
- e. Approved equal.

2. Provide one of the following configurations:

- a. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep.
- b. Strips, not less than 3/4 inch thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
- c. Sheets or strips full depth of cavity and installed to full height of cavity.

2.10 CAVITY-WALL INSULATION

- A. Insulation: As specified in Division 07 Section "Thermal Insulation."
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.11 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.
 - d. Approved equal.

2.12 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 1. For masonry below grade or in contact with earth, use Type M.
 2. For reinforced masonry, use Type S.

3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S.
- D. Pigmented Mortar: Use colored cement product. Do not add pigments to colored cement products.
1. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Face brick.
 - b. Acceptable manufacturers: Glen Gery, Lehigh, Spec-Mix or approved equal.
 - c. Color: To match existing.
- E. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.2 TOLERANCES

- A. Dimensions and Locations of Elements:
 1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.

3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: See Drawings.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- E. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick and CMUs as follows:
 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.

3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Exposed joints: V-joint.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
1. Space reinforcement not more than 16 inches o.c.
 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

3.6 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.7 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 32 inches o.c. horizontally with not less than 1 anchor for each 3.5 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.8 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
 4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
- C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
 1. Use specified weep/vent products to form weep holes.
 2. Space weep holes 24 inches o.c. unless otherwise indicated.
 3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
- D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.9 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 Level 2 special inspections according to the "International Building Code."
 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- H. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.11 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 - 2. Protect surfaces from contact with cleaner.
 - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.12 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving." Masonry waste may be used if it meets the requirements of ASTM D 2940 as referenced.
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off the State's property.

END OF SECTION 042000

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042116 – INTERIOR BRICK AND TILE RESTORATION

I. GENERAL REQUIREMENTS

A. Scope of Work

1. The work of this Section includes the installation of new red brick, new glazed ceramic brick and tile, and repair of existing glazed ceramic brick and floor tile on the interior of the CRRNJ Terminal. The work shall include, but is not limited to the following items:

- a. Installation of new red brick, glazed brick or floor tile.
- b. Repair of deteriorated red brick, glazed brick or tile by patching or resetting.
- c. In-painting areas where glaze has spalled but where patches are not required.
- d. Removal of damaged red brick, glazed brick or tile and replacement with new red brick, glazed brick and tile, including coved and bullnose bricks.
- e. Resetting of displaced tiles.
- f. Repointing open mortar joints.
- g. Grouting open joints.

2. Treatments executed as part of this Contract shall be designed and executed in a manner respectful of the historic nature and character of the brick and other historic materials at the CRRNJ Terminal.

3. New brick shall match the original in every aspect including color, texture, dimensions, etc.

4. The Contractor shall bring to the attention of the Architect any items not indicated on the Drawings that require repair work, such as cracked, loose, bulging, or displaced masonry.

B. Related Work

- 1. Section 040130 Interior Masonry Restoration
- 2. Section 040140 Interior Cleaning of Historic Surfaces

C. Applicable Codes and Standards

- 1. Secretary of the Interior's Standards for Rehabilitation.
- 2. American Society for Testing and Materials (ASTM) C 126 criteria (current year).
 - a. ASTM C144, Aggregate for Masonry Mortar.

- b. ASTM C150, Portland Cement.
- c. ASTM C207, Hydrated Lime for Masonry Purposes.
- d. ASTM C270, Mortar for Unit Masonry.

3. Manufacturer's printed recommendations.

D. Quality Assurance

1. The work shall be performed by a Masonry Restoration Contractor classified by DPMC.
2. Contractor shall maintain a steady work crew consisting of skilled mechanics who are experienced with the materials and methods specified, and are familiar with the design requirements. Contractor shall maintain a full-time Foreperson who fluently speaks, reads and writes English. Contractor shall confirm that all workers understand the job's requirements. Mechanics shall be fully supervised to ensure that the work is accomplished to meet or exceed the highest standards of the trade.
3. TESTING OF WORKERS: All technicians planned for use on the job will be required to successfully complete five linear feet of cutting and raking of mortar joints in the presence of the Engineer or Architectural Conservator prior to working on the job. One quarter inch chip of masonry per linear yard will be the standard of acceptable skill. Unsuccessful performance in this test area will be grounds for rejection of this technician for this job.
4. Designer shall be given regular access to the Contractor's scaffolding/work site so that he/she may inspect work being performed.
5. Contractor shall replace at no additional expense to the State all broken, lost and damaged bricks or other materials resulting from removal, installation, transportation, cleaning or storing.
6. Work is to be performed on a daily basis without interruption unless directed otherwise by the Designer.
7. In acceptance or rejection of the work of this Section, no allowances shall be made for lack of skill on the part of the mechanics.
8. Source of materials: Obtain materials for brick installation from a single source to ensure a match in quality, color and texture.
9. All installation and repair work shall match the original in all respects, including surface alignment, grouting, color, texture, finish, dimensions, etc.
10. Materials shall be used only at the manufacturer's recommended temperature tolerances. Installation and restoration work may only be performed as long as the ambient temperature remains above 40° F and below 80° F. Installation may only be performed when ambient temperatures remain in this range for the next 48 hours.

E. Coordination

1. At least three weeks prior to commencing the work of this Section, a meeting must be scheduled at the jobsite to discuss conformance with the requirements of specifications and job site conditions. Representatives of the Contractor, Designer, and other parties involved in the scope of this work shall attend the meeting.
2. Contractor shall coordinate his or her work with that of other trades related to the successful completion of the work of this Section. Contractor shall not proceed with aspects of this work that require completion of other trades until all such work of other trades is completed.
3. Field Supervised Construction: The Contractor shall notify Designer before beginning brick installation and restoration. Obtain the Designer's approval of each type of brick repair before proceeding with the remainder of the work.

F. Submittal Requirements

1. Contractor shall submit a work plan including detailed description of how the work of this Section will be accomplished. This should include products to be used, methods for installation, methods for patching and in-painting, and methods for cleaning the masonry after installation, etc.
2. Provide written descriptions, drawings and diagrams outlining proposed methods and procedures for protection of personnel, the public, and the existing construction during the work of this Section.
3. The Contractor shall submit copies of the manufacturer's technical data for handling, storage and application of each product used in brick installation and restoration, including the manufacturer's recommendations for application and use. Include test reports and certificates that verify the product's compliance with the specification's requirements.
4. If alternate methods and materials to those specified are proposed at any phase of the restoration work, provide written description. Provide evidence of successful use on comparable projects and demonstrate its effectiveness for use on this project.
5. The Contractor shall bring to the attention of the Designer any items not included in the documents that require repair work, such as cracked, loose, bulging or displaced bricks, or serious deterioration of any structural steel members exposed during installation.
6. Shop Drawings showing the following items for glazed brick repair:
 - a. Locations and amounts of red brick, glazed brick, and tile removal and replacement.
 - b. Locations and amounts of patching and coating repair.
 - c. Contractor-verified dimensions and site conditions.

7. Contractor shall review, approve and countersign the drawings prior to their submission to the Designer.
8. All drawings, when viewed together, shall show all details of bedding, bonding, jointing, fastening, and other essential aspects of the work.
9. Samples to be submitted prior to the start of any glazed brick restoration work:
 - a. Three (3) samples of each glazed brick type and size and color requiring replication, including curved and corner bricks. Color shall match cleaned existing glazed brick, and shall be approved by Designer. Once the Designer has approved the samples, all manufactured bricks shall conform in every respect to the approved samples.
 - b. Three (3) samples of each red brick type and size and color requiring replication. Color shall match cleaned existing red brick, and shall be approved by Designer. Once the Designer has approved the samples, all manufactured bricks shall conform in every respect to the approved samples.
 - c. Grout matching the original, cleaned grout.
 - d. Mortar matching the original, cleaned mortar. Provide cured samples of mortar in the form of 6 inch long by 1/2 inch long wide sample strips of mortar set in aluminum or plastic channels.
 - e. Adhesive products and related materials.
 - f. Composite patching materials.
 - g. Coating for glaze spall repair or infill painting. Colors must be submitted and approved by Designer.
10. The Contractor shall be required to submit additional or modified samples as required by the Designer. The Contractor shall be notified in writing by the Designer of the approved final patching materials, formulations, and color selections.
11. Rejected samples shall be revised and resubmitted until the Fabricator receives the Designer's approval.

G. Mockups

1. Prior to executing work, provide in-place mockup panels for the Designer's approval. Resubmit panel until the Designer is fully satisfied. Mockup panels shall be prepared by the Contractor using the same workmen, methods and materials that will be employed for the remainder of the work. At the discretion of the Designer, the mockups shall be prepared in the presence of the Designer. Mockups shall be approved for color, texture, surface finish, and profile.

2. Provide the following mockup panels:
 - a. Demonstrate techniques for removing original bricks and tiles without damaging adjacent materials.
 - b. Demonstrate techniques for installing new bricks and tiles into adjacent materials.
 - c. Composite patching and in-painting of glazed bricks (approximately three [3] inches square).
 - d. Provide 4' x 4' test panel including at least 8 linear feet of mortar joint for each different kind or type of material to be pointed or of pointing mortar to be used. Allow mortar to dry so that its final color can be determined. Notify Designer when test area is ready for approval.
 - e. Provide 4' x 4' test panel including at least 8 linear feet of grout joint for each different kind or type of material to be grouted or of grout to be used. Allow mortar to dry so that its final color can be determined. Notify Designer when test area is ready for approval.
3. Do not proceed with installation or restoration of the brick until approval of the above mockups is secured from the Designer.
4. Contractor shall protect approved mockup panels for the duration of the work. Approved mockups and methods of application will become the standard of work in this Section and for the approval of subsequent work. Approved mockups may be incorporated into the final work.

H. Protection

1. Protect all adjacent areas from damage during the work of this Section using approved means of physical protection.
2. Protect all adjacent surfaces and projections from all dropping grout, patching and coating materials. Use canvas or polyethylene covers, if necessary, and remove all unwanted material that comes in contact with adjacent surfaces immediately so as not to cause staining.

I. Delivery, Storage, and Handling

1. All materials shall be delivered to the job site in factory-sealed containers clearly labeled as to product, manufacturer, color, and other pertinent characteristics.
2. All materials for use in the work of this Section shall be stored under environmental conditions recommended by the manufacturer. Materials should be kept dry (includes protection from liquid moisture and water vapor), well-ventilated and free of foreign matter.

3. Arrangement shall be made with the Designer to store equipment and materials in designated areas. The Designer shall not be responsible for damaged or stolen materials or equipment left on the premises by the Contractor.
4. All vessels shall have tight fitting covers. At no time shall vessels containing chemicals be carried to working levels when vessels are open.
5. Keep mixing water free of harmful and staining substances and such other contaminants as specified.

II. MATERIALS

A. Red Brick

1. Provide samples of red brick matching existing in terms of size, color, texture and shape.

B. Glazed Brick

1. Provide samples of glazed brick of each type (buff, yellow, green, etc.) of glazed brick.
2. Brick shall match existing in terms of size, color, texture, shape, and sheen.
3. The Contractor shall provide all required trim shapes such as cove, bullnose, angles, strips, etc. The profile of all infill brick must match the existing for all curved units.

C. Floor Tiles

1. Provide samples of square floor tile matching the existing in terms of size, color, texture, shape, and sheen.

D. Water

1. Water shall be potable and free from all substances that would be deleterious to brick or restoration materials.

E. Tools

1. Hand tools shall be used for removal and clean up of grout and mortar adjacent to installation area. No power tools shall be used.
2. Brushes for cleaning areas to be replaced shall be stiff, natural bristle brushes.

F. Grout

1. Grout shall be commercially prepared; color shall be selected by the Architect from the manufacturer's standard range to match the existing, cleaned grout color.

2. Use Laticrete sanded or unsanded grout (as recommended by the manufacturer) gauged with Laticrete 1776 Grout Admixture, unless otherwise indicated.

G. Mortar

1. Portland Cement: ASTM C150, Type I.
2. Hydrated Lime: ASTM C207, Type S.
3. Portland Cement.
 - a. White and Gray, Type 1
 - i. Available from Lehigh Cement (610)926-1024 or substitute equal.
4. Sand: ASTM C144, except grading to comply with BIA Technical Note 8A; and of color required to achieve mortar color selection.

H. Patching Materials

1. Patching material shall be custom-matched composite patching materials specifically prepared by the manufacturer to match the existing brick body in texture and composition. Use Jahn M100 (as supplied by Cathedral Stone Products, Hanover, MD 800-684-0901), Edison Custom Patching Compounds (as supplied by Edison Coatings, Inc., 3 Northwest Drive, Plainville, CT 06062, 800-697-8055), or approved equal. If Jahn patching mortars are used, each worker applying the product must be certified by the manufacturer.
2. All patching material is to be in-painted with approved coatings that match the existing glazes in color and gloss.

I. In-Painting/Glazing Spall Coating

1. Coating must match the existing glazes in color, sheen, and texture, and shall be submitted by Contractor for approval. Use Edison Custom Patching Compounds (as supplied by Edison Coatings, Inc., 3 Northwest Drive, Plainville, CT 06062, 800-697-8055), Benjamin Moore Aura (as supplied by Cathedral Stone Products, Hanover, MD 800-684-0901), or approved equal.
2. Spall coating product must be the product specified by the patching mix manufacturer.
3. Repair coatings shall be supplied in colors to match the glaze colors of the existing original brick. All finish paints or coatings shall be ready-mixed, matching the stable adjacent glaze surfaces. Colors shall be pure, non-fading pigments, mildew-proof, sun-proof, finely ground in approved medium, and shall not be restricted to the manufacturer's standard colors.

J. Adhesives for Attaching Anchors and Pins

1. Provide high modulus, high strength moisture-insensitive epoxy adhesive. Adhesive shall be two-component, 100% solid epoxy resin system with a viscosity similar to

petroleum jelly, such as Sikadur 31 Hi-Mod Gel (as manufactured by Sika Corporation, Lyndhurst, NJ 201-933-8800), or approved equal.

K. Crack Repair

1. Crack Filler: An ultrafine, superplasticized grout that can be injected into cracks, is suitable for application to wet or dry cracks, exhibits low shrinkage, and develops high bond strength to all types of ceramic material.
2. Products such as Jahn Injection Grout M30-#32 (as manufactured by Cathedral Stone Products, Inc., Hanover, MD, 800-684-0901), and Edison Pump-X53-i (as manufactured by Edison Coatings, Inc., Plainville, CT 800-697-8055), or approved equals shall be used.

L. Tools

1. Hand tools only shall be used for removal of grout. Power tools shall not be used to grind out those joints.
2. Chisels shall be narrower than the joints in which they are used.
3. Brushes shall be stiff, natural bristle brushes.
4. Trowels used for pointing shall be long, thin pointing trowels that are narrower than the joints being pointed. It may be necessary to custom fabricate such tools

M. Injection Accessories include:

1. Disposable syringes without needles such as #79-4210 from PGC Scientifics, or approved equals.
2. Bulk load caulking guns and cartridges.

N. Temporary Bracing System

1. Bracing elements should be selected to conform to the requirements of this project. Protection of existing historic wall finishes should be considered in the selection of bracing materials.

III. CONSTRUCTION METHODS

A. Inspection

1. Examine all areas scheduled for work to determine whether existing masonry conditions will adversely affect execution of the work of this section. Report any such conditions to the Designer.
2. Review the amount and extent of brick and tile installation to be accomplished and review area with the Designer on site prior to the execution of the work.

3. Prior to the start of restoration, inspect each section of work to verify the elements scheduled to be repaired and distinguish those elements to be replaced from those which are to be repaired. Immediately report any discrepancies and additions to the Designer. Do not proceed with repair work in such areas until all discrepancies have been resolved.

B. Documentation/Recording

1. Existing brick details will be carefully measured and graphically recorded to ensure accurate restoration.

2. All items to be removed should be labeled and numbered with water-resistant materials in places that will not be visible in the finished work. Indicate each of these numbers on drawings or photographs in a legible manner. No removals are to commence until the Designer has given written approval to the documentation.

C. Power Tool Mortar Removal

1. Contractor shall demonstrate that all workmen repointing using power tools are proficient in the use of power tools for preparing joints for repointing prior to commencing with the work. Failure to demonstrate to the Designer's satisfaction that each worker is proficient and that power tool joint preparation does not result in damage to the masonry to remain shall result in the prohibition of the use of power tools for preparing joints. If proficiency is not demonstrated, or if work in progress results in damage to masonry to remain, all power tool preparation shall cease, and joints shall be prepared using hand tools.

2. Do not use blades thicker than 3/32" for scoring joints.

3. In addition, power tools shall not be used to remove mortar from vertical joints less than 1-1/8 times the diameter of the blade.

4. The power tool cut shall be made in the center of the joint. Only one kerf cut shall be made in each joint. Remove the remaining mortar using hand tools. The contractor shall set the depth of the blade so that the resulting kerf does not exceed the minimum depth.

5. Stop the kerf a minimum 3/4 times the blade diameter from inside corners and projecting elements. Remove the remaining mortar using hand tools.

6. The Contractor may construct jigs to guide the power tools and to prevent damage to adjacent masonry.

D. Unit Removals

1. Selective unit removals must be executed with the utmost skill and care. All efforts shall be made to protect historic materials on existing walls and fixtures.

2. Protect and structurally support existing masonry to remain which surrounds or contacts to removal areas.

3. Cut out full brick units from joint to joint in a manner that will permit replacement with full sized units.
4. If water or water-mist is used to control dust, use only such adequate, accepted procedures and equipment that will not adversely affect station elements, interiors, occupants, and historic materials.
5. Follow all New Jersey State Building Codes for required inspections, and provide Designer with a list of those responsible for the inspections.
6. Contractor shall make probes and explorations, coordinated and approved by the Designer, as required to fully determine existing conditions of substrate, utilities, and services to remain which may be hidden by work which is to be removed. At Designer's discretion, Designer shall be present during approved probes and explorations.

E. Crack Repair

1. Cracks wider than 1/16-inch should be grouted full matching the texture of the clean brick units to be repaired and to the level of the surrounding clean brick.
2. Cracks narrower than 1/16-inch shall be filled with an injectable epoxy introduced through ports which should measure no greater than ¼-inch in diameter. Ports shall be spaced as required.
3. Cracks can be temporarily sealed with non-staining clay, or approved equal.
4. Protect face of brick as required to prevent staining by epoxy and grout.
5. After grout has initially set, clean brick faces with water and stiff, natural bristle or nylon bristle (non-metallic) brush to prevent surface staining.
6. Repaired cracks shall be coated with the selected glaze repair coating.

F. Repair of Glaze Spalling and Glaze Failure

1. Repair of failed glaze or glaze spalling shall be limited to those areas in which the glaze has become detached from the substrate. Light crazing of the glaze is a natural aging feature of glazed ceramic and should not be mistaken for failure.
2. The repairs specified in this Section are appropriate for failures less than 1/8" deep.
3. Based on the inspection of the station by the Contractor, areas of glaze spalling or other minor glaze failures shall be identified and recorded on a set of wall elevation drawings which are to be submitted to the Designer.

4. Failing glaze shall be removed by rinsing with a low pressure water wash (less than 300 psi) and brushing with a stiff, natural or nylon bristle brush. No metal tools or brushes are to be used. Removal of deteriorated glaze shall be done in such a manner as to leave in place the maximum amount of sound glaze material.
5. Matte or glossy glaze finishes shall be replicated. Any system used should match the original (cleaned) glaze color, gloss level, and detail.
6. If glaze repair system requires primer, spalls should be primed and prepared according to manufacturer's instructions.
7. Apply two smooth and even coats of selected coating, allowing at least one (1) hour between coats, and a ¼ inch overlap onto sound adjacent glazed surfaces.
8. Protect adjacent surfaces from splatters and overspray of glaze repair coating. Remove any errant paint quickly, using manufacturer-recommended means.

G. Setting Brick

1. New, previously-removed, and restored brick shall be reset in a solid and evenly filled bed of grout or mortar depending on location, with bed, head, and collar joints filled.
2. Units are to be set true and level, matching exactly the existing bond pattern and coursing throughout by "toothing in". Where joining into existing work that is not true or level, incrementally adjust units to compensate and to provide a smooth visual transition between new and existing work.
3. Brick should be adequately pre-wetted (nearly saturated but surface dried when laid) prior to installation.

H. Repointing

1. Apply pointing mortar tightly in layers of 1/4" to fill joint to match original sound joints with a long thin pointing trowel having a blade that is narrower than the width of the joints. Firmly iron each layer to compact mortar to ensure a full bond between mortar and masonry and to form a firm, solid joint. After one layer of mortar has set, apply another layer as necessary to completely fill the joint. Do not let the previous layer dry out before applying succeeding layer. Construct uniform joints.
2. It may be necessary to custom fabricate pointing trowels that are thinner than the joints.
3. Tool joints after final layer is "leather hard" with a flat rule jointer, or as directed by the Engineer or Architectural Conservator.
4. Keep joints damp for at least 48 hours, or until surface is cured.
5. Maintain temperature as required until joint is cured.

6. When stopping work, at the end of each day or for other reasons, stagger the layers of mortar so that there will be no through joints in the pointing. Stagger the joints in the layers so that they are at least three inches (3") from each other.

7. Where one day's work joins that of the previous day, dampen the previous work so that a good bond will be formed.

I. Joint tooling:

1. All joint widths are to match existing work. Tool the joints to match existing profile selected by the Designer.

2. Joints are to be squeezed tight so that grout adheres well to the masonry on both sides of the joints and forms a dense surface.

J. Curing:

1. Cure joints in repaired areas by keeping moist for 72 hours.

2. Do not turn a direct stream of water on the joints while curing.

3. Should any cracks appear in the surface of the joint, cut out the grout and regrout following the requirements of these specifications.

4. All installation is to be completed before commencing regrouting.

5. Broken, cracked, marred or otherwise defective units shall be replaced before the mortar has set. All necessary corners, covers, angles or other trim shapes shall be furnished and installed by the Contractor.

K. Grouting

1. General: Install grout according to manufacturer's instructions. Remove all dust and debris from the surface of the brick with a wet sponge. Do not leave water standing in the joints.

2. Mix according to manufacturer's instructions.

3. Application

a. Dampen surface with water.

b. Spread grout with a sharp, firm rubber grout float.

c. Work the grout into the joints until completely filled. Use diagonal swipes to pack the joints.

d. Insure that the joint is filled and grout is not just sitting on top (i.e. bridging the joint).

4. Cleaning excess grout

a. Excess grout shall be cleaned from the surface as the work progresses, while grout is fresh and before it hardens.

b. Remove excess grout from the face of the brick with the edge of the grout float.

c. Let grout firm up for approximately 20-30 minutes.

d. Remove remaining grout with a damp (not wet) sponge or towel. Work diagonally along the joints.

e. Allow grout to dry. When the joints are firm, polish the surface with a coarse cloth and minimal water.

L. Cleaning

1. After grout has fully hardened, thoroughly clean exposed brick surfaces of excess grout and foreign matter using stiff nylon or Tampico bristle brush and clean water spray-applied at low pressure (50-500 psi).

2. Grout droppings on wall shall be immediately cleaned.

3. The use of metal scrapers or brushes will not be permitted.

4. Upon completion of work in this Section, clean all surfaces of any debris, grout droppings, construction materials, etc. using a non-acidic cleaner approved by the Designer.

M. CORRECTIVE MEASURES

1. Should any cracks occur in the surface of the joint, cut out the mortar or grout and repoint following the requirements of these specifications to the satisfaction of the Designer.

2. Should the Designer determine that any of the work does not equal or exceed the minimum standard established by the approved test area, the Contractor shall cut out the mortar and repoint following the requirements of these specifications to the satisfaction of the Engineer or Architectural Conservator.

SECTION 051200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Furnish and erect all structural steel as shown on Drawings. Provide shop painting and galvanizing as specified.
- B. Extent of structural steel work is shown on the Drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required. Drawings, conditions of the Contract (including General, Supplementary, and Special Conditions), Division 1 Specification Sections and all other Contract Documents apply to work of this Section.
- C. Provide all labor, materials, equipment, services and perform all operations required for complete furnishing, fabrication, and erection of all structural steel as indicated on the Drawings, specified in this Section, and required by job conditions.
- D. The work shall include but not be limited to:
 - 1. Beams, girders, posts, struts and hangers.
 - 2. Base plates and bearing plates, anchor bolts and plates to be embedded in concrete and templates for items to be embedded in or attached to concrete.
 - 3. Structural steel support angles, channels, etc. for metal deck.
 - 4. Shop painting, lacquering and galvanizing and field touch up.
 - 5. Bracing, guying, surveying and plumbing of erected steel and shoring and temporary bracing.
 - 6. Connections.
 - 7. Concrete reinforcing bar coupling devices which are to be welded to structural steel.
 - 8. Drilled-in anchors into concrete or masonry to fasten structural steel.
 - 9. Deformed anchor bars stud welded to structural steel.
 - 10. Erection drawings, shop drawings and samples.
 - 11. Protection of work of this Section and of other work from activities under this Section.
 - 12. Submittals.
 - 13. Provisions for other work.

- 14. All other work shown in the Drawings, specified in this Section or required to make the structural steel work complete.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Loose Bearing and Base Plates for Structural Steel.....Section 055000

1.03 RELATED SECTIONS

- A. Metal Fabrications.....Section 055000
- C. Painting.....Section 099123

1.04 REFERENCES

Conform to the requirements of the New Jersey Edition of the International Building Code. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work. Where conflict amongst codes, standards, and specifications exist, the one having the most stringent requirements shall govern.

- A. American Society of Testing and Materials (ASTM) standards, latest editions.
 - A6 Standard Specification for General Requirements for Rolled Steel Bars, Plates, Shapes, and Sheet Piling.
 - A36 Standard Specification for Carbon Structural Steel.
 - A108 Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
 - A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both.
 - A307 Standard Specification for Carbon Steel Bolts and Studs, 60000 psi Tensile Strength.
 - A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

- A490 Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
- A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- A501 Standard Specification for Hot-Formed Welded Seamless Carbon Steel Structural Tubing.
- A563 Standard Specification for Carbon and Alloy Steel Nuts.
- A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coating.
- A992 Standard Specification for Steel for Structural Shapes for Use in Building Framing
- F436 Standard Specification for Hardened Steel Washers
- F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- B. "Specification for Structural Steel Buildings" 13th edition, including supplements - American Institute of Steel Constructors (AISC 360-05).
- C. Seismic Provisions for Structural Steel Buildings (AISC 341-05).
- D. "Code of Standard Practice for Steel Buildings and Bridges" (AISC 303).
- E. "Standard Symbols for Welding, Brazing and Nondestructive Examination - A2.4" - American Welding Society (AWS).
- F. "Specification for Mild Steel Covered Arc-Welding Electrodes - A5.1" - AWS.
- G. "Specification for Low-Alloy Steel Covered Arc-Welding Electrodes - A5.5" - AWS.
- H. "Structural Welding Code - D1.1" - AWS.
- I. Structural Welding Code Reinforcing Steel, AWS D1.4 98, by the American Welding Society ("AWS D1.4").
- J. Specification for Structural Joints Using ASTM A325 or A490 Bolts by the Research Council on Structural Connections of the Engineering Foundation ("RCSC Specifications").
- K. SSPC Steel Structures Painting Manual, Volume I, 1982 and Volume II, 1991, by the Steel Structures Painting Council ("SSPC").

1.05 DEFINITIONS

A. Structural Steel

Structural Steel consists of the steel elements of the structural steel frame essential to support the design loads. These elements consist of material as shown on the structural steel plan and listed in Article 2.1 of the AISC "Code of Standard Practice for Steel Buildings and Bridges."

B. Other Steel

Structural steel does not apply to those elements listed in Article 2.2 of the AISC "Code of Standard Practice for Steel Buildings and Bridges."

1.06 SUBMITTALS

A. Product Data

Submit producers' or manufacturers' specifications and installation instructions for the following products to the Engineer for acceptance prior to the start of any work. Include laboratory test reports and other data to show compliance with Specifications, including specified standards. Submit samples where requested by Engineer:

1. Primers, paints, and galvanizing repair paint
2. Stud shear connectors
3. Expansion/adhesive anchors
4. Zinc Metallizing
5. High strength bolts (each size, length and type), nuts, and washers, including manufacturer's certification of conformance for each and every lot. When requested by Engineer, submit samples to Testing Agency for testing prior to start of any work or delivery of materials to job site or stockyards.
6. Reinforcing bar coupling devices which are to be shop welded to structural steel. Submit welded sample for testing when requested.
7. Deformed anchor bars to be stud welded to structural steel. Submit welded sample for testing when requested.

B. Deviations

Requests for deviations from Drawings or Specifications shall be submitted on Contractor's letterhead. Acceptance of shop drawings including deviations not detected during shop drawing review will not relieve Contractor from responsibility to conform strictly to the Contract Documents. Deviations will be allowed only where permitted by Engineer in writing. Proposed deviations must be accompanied by documented and

physical evidence, which will establish that its quality equals or exceeds the quality specified.

C. Shop Drawings

1. At least two weeks prior to the first shop drawing submittal, Contractor shall provide Engineer with a comprehensive list of all shop drawing submittals, and a schedule indicating when all submittals are to be sent to the Engineer. If Contractor deviates from this schedule, Engineer shall be allowed additional time to review shop drawings.
2. Failure to submit legible shop drawings will be cause for return without review. Shop drawings furnished under this section shall be not less complete than indicated by the applicable procedures shown in AISC's "Detailing for Steel Construction".
3. All connections shall be designed by and all drawings shall be prepared under supervision of a Professional Engineer licensed in the State of New Jersey. Do not submit unchecked shop drawings. First submissions of all job standards, shop drawings of connections not shown on, or that are in deviation of, the job standards, and calculations shall have one set sealed and signed by the Engineer. After final approval of all shop drawings, submit a final set sealed and signed by the Professional Engineer.
4. Connections (framed beam, seated beam, single plate, moment, truss etc.) shall be designed by the detailer's licensed engineer and detailed by the structural steel detailer, unless otherwise shown on Drawings. Based on the indicated loads (axial force, moment, etc.), the structural steel detailer's engineer shall design the connections.
5. Prior to sending submittals to Engineer, Contractor and Construction Manager (if applicable) shall coordinate and cross-check for accuracy and completeness each shop drawings prepared for work of this Section with the approved Construction Documents and Specifications. Shop drawings shall bear the stamp of Contractor and Construction Manager indicating that this review has been performed. Engineer will not review submittals for which Contractor and Construction Manager have not performed this review.
6. Prepare erection drawings to show clearly the size and location of each member, and the erection mark assigned to each member. Show each field connection complete with data and details necessary for assembling the structure. Direct attention to the possible need for special guying, bracing or shoring.
7. Immediately after award of Contract and before preparing steel shop drawings, submit for review a set of job standards showing all necessary joint details with full particulars of connection pieces, shop and field welds, and holes for erection bolts and permanent bolts. These shall include any moment and shear connection designed by the Engineer of Record as well as those designed by the detailer. Appropriate marks for designating all types and sizes of joint details shall be

- included. Submit all calculations pertaining to the job standards. After approval of these job standards, the erection plans are to be submitted and shall be marked to indicate unmistakably the type and size of joint to be used for every beam connection. Do not order steel in advance of approval of the job standards and the erection plans with joint marks, except at own risk.
8. Prepare remainder of steel shop drawings after approval of job standards and erection plans. Drawings submitted prior to approval of job standards will be returned without review. Submit drawings gradually and not all at the same time so that sufficient time is allowed for checking and approval. No more than 100 drawings are to be submitted within a 14-day period, measured from the day after arrival in Engineer's office, to allow for checking and approval of package before submittal of next package.
 9. Submit shop drawings to Engineer in coordinated packages so that all required information is in hand at time of review. Prior to resubmission of shop drawings, all changes from prior issue shall be clearly circled and identified. Do not fabricate before shop drawings have been reviewed and returned to Contractor marked either "No Exceptions Taken" or "Make Corrections Noted" only.
 10. Steel shop drawings shall include framing plans, elevations, sections and complete details and be accurately dimensioned. Include bolted and welded work, and details such as camber and other pertinent data not shown on job standards. Indicate size and grade of steel for each piece. Detail openings and reinforcement due to other Work. Coordinate with Drawings of other Work. Provide fieldwork drawings for holes not shown in shop drawings.
 11. Prepare, submit and keep up to date, a complete drawing index, cross referencing assigned piece mark with the drawing number upon which the piece is detailed.
 12. Indicate welds by standard AWS symbols and show size, length, spacing, location, orientation and type of each weld in accordance with AWS A2.4. Complete and partial penetration welds shall be indicated by an AWS prequalified joint designation. In addition, for all penetration welds, the complete joint preparation and configuration shall be shown or indicated, including root opening, groove angle, root face, backing bar, etc. as applicable. Bevels shall be graphically detailed in large scale. Welding processes and electrodes shall be indicated on each shop drawing.
 13. Identify columns using same identification system shown on Drawings.
 14. Provide setting drawings, templates, and directions for installation of anchor bolts, embeds, and other anchorages to be installed under other Sections. Provide to the concrete trade in advance of applicable concrete work.
 15. Submit, for review and acceptance, field work drawings depicting all field work required to accommodate field conditions. Contractor shall make a complete survey of all existing conditions prior to detailing.

16. Shop drawings will be checked for size of material and strength of connection by the Engineer of Record, which shall not render the Engineer of Record responsible for any errors in construction dimensions, etc. that have been made in preparation of shop drawings. The Contractor shall assume full responsibility for the correctness of dimensions and fit.
17. Design of structural steel connections to plates or anchors embedded in concrete shall be based on the most severe combination of structural steel, concrete structure, and embedded item location tolerance.
18. Indicate clearly the grade, size and number of bolts, the type, number, position and orientation of each washer and the size of each hole, whether slotted or round. Proportion connection details to ensure adequate wrench clearance for correct bolt tensioning sequences. Indicate method of tensioning for all high strength bolts.
19. Detail shear studs, deformed bar anchors, concrete reinforcing bar couplers and other items which are to be shop applied.
20. Indicate all structural steel shelves required to support steel deck ends and edges at supporting beams, columns, and other structural steel elements.
21. Provide temporary expansion joints in structural steel work and between the work of this Section and that of other sections providing support or restraint until such time as work is thoroughly stabilized. Close and secure such joints at that time.
22. Detail cleaning and painting requirements including clear identification of "no paint" areas.
23. After shop drawings are 100% complete and approved and all field changes have been made, a CD rom of the as-built drawings are to be submitted to the State in an AutoCad format.

D. Quality Control Submittals

1. Certificates and Affidavits
 - a. Submit certified copies of producer's mill certificates for each piece of steel to be used. Reports shall include chemical and physical properties.
 - b. Furnish bolt manufacturer's test reports, covering physical and chemical tests, for each lot of high strength bolts submitted.
 - c. Furnish steel manufacturer's certificate certifying welders employed on the Work have met AWS qualifications within the previous twelve months and are licensed welders in the state of New Jersey.
 - d. Furnish complete listing of ASTM's of materials listed in Part 2 of this Section and certification that materials supplied meet those listed.

- e. For mechanical and adhesive anchors installed in concrete, submit ICC certification for use in cracked concrete.

E. Surveys

Submit signed and sealed copies of surveys conducted by a Licensed Land Surveyor of items listed in Part 3 of this Section and the Drawings.

F. Work Engineered by Contractor

Submit, for record purposes, drawings and calculations as applicable, signed and sealed by a Professional Engineer registered in the state of NJ, for all work engineered by the Contractor. Such work shall include all crane and crane related engineering, shoring and bracing procedures and sequences, and any other areas noted on the Drawings or required by the NJ-IBC.

G. Test Reports

Submit test reports for zinc metallizing and epoxy coating system as specified herein, paragraph titled "Galvanizing by the Zinc Metallizing Process".

1.07 QUALITY ASSURANCE

A. General

1. Contractor shall examine all Contract Documents and note any discrepancies and special construction problems requiring close coordination and exact time schedules; assume the responsibility of same and administer action such that the proper solution will result.
2. Contractor's quality assurance procedures shall be effective and shall assure that all work fulfills the requirements of applicable provisions of the Contract Documents.
3. Contractor shall maintain, on staff, sufficient office, field engineering, and field supervision staff to assure that all data and layout drawings for work of other Sections is transmitted to detailers to allow proper detailing of holes, penetrations, chases, and the like and to assure proper execution of the work in the field.
4. Perform quality control functions required to achieve and to document that work conforms to the Contract Documents. Provide access to Contractor's quality control documents and reports upon request of The State, Architect, Engineer or Testing Agency. Provide reasonable numbers of photocopies of specific quality control reports on request.
5. Contractor and Construction Manager shall coordinate and schedule the work of this Section with the work of other Sections of this Specification in order to optimize quality and to avoid delay in overall job progress.

6. Prior to starting applicable phases of the work of this Section, Contractor shall cooperate and coordinate with each trade affected by the work of this Section, including areas where work of other Specification Sections joins or relates to work of this Section. Contractor shall report unsatisfactory or nonconforming conditions to Engineer in writing prior to the start of work.

B. Qualifications

1. General: Throughout the progress of the work of this Section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills, and who shall be present at the site and shall direct all work performed under this Section.

C. Regulatory Requirements

1. Building Code: Work of this Section shall conform to all requirements of the 2009 New Jersey Version of the International Building Code (NJ-IBC) and all applicable regulations of governmental authorities having jurisdiction, including safety, health, noise, and anti-pollution regulations. Where more severe requirements than those contained in the Building Code are given in this Section, the requirements of this Section shall govern.
2. Industry Standards: Standards specified herein apply to Work of this Section. Where more severe requirements than those contained in the Standards are given in this Section or the Building Code, requirements of this Section or the Building Code shall govern.
 - b. AISC 360-05 as modified by the 2009 NJ-IBC
 - c. Seismic Provisions for Structural Steel Buildings AISC 341-05.
 - d. "Specifications for Structural Joints using ASTM A325 or A490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation (RCRBSJ) – AISC-2005.
 - e. "Structural Welding Code" - AWS.
3. Recommendations or suggestions in the codes and references listed in this Article and under "References" shall be deemed to be mandatory unless they are in violation of the Building Code.

D. Certifications

1. Structural steel shall conform to the material acceptance, certification, and inspection requirements of Section BC 1701 of the 2009 NJ-IBC.
2. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

- E. Fabrication: The fabricator shall be certified by and use the AISC Quality Certification Program in establishing and administering a quality control program. Such program shall ensure that the work is performed in accordance with the Contract Documents.
- F. Erection: The erector shall maintain a quality control program to the extent necessary to ensure that all of the work is performed in accordance with the Contract Documents. The erector shall provide the equipment, personnel and management for the scope, magnitude and specified quality of the work.
- G. Contractor's Responsibilities: The Contractor shall be solely responsible for the items listed below. While the following list is not intended to be a complete listing of all responsibilities, it is provided to bring these items to the specific attention of the Contractor. Engineer's review of shop drawings or other submittals, or performance or waiving of inspection or testing, does not relieve Contractor from these responsibilities.
 - 1. Safety and stability of the work. Construction sequences, whether stated or implied, are intended only to assist the Contractor in coordinating the work of the project.
 - 2. Fabrication procedures and the means, methods, techniques, sequences and procedures of construction.
 - 3. Correctness of dimensions and quantities, for the fitting to other or existing elements, for conditions to be confirmed and correlated at the site, and for the verification of the physical interrelationships of elements of the work.
 - 4. The amount, method of distributing, and proposed supplemental support of loads during construction. Construction loads shall not exceed the superimposed load which the member, with necessary supplemental support, is capable of carrying safely without damage.
 - 5. Obtain all field measurements required for proper fabrication and installation of work covered by this Section. Precise measurements are the responsibility of Contractor.
 - 6. Report unsatisfactory or non-conforming conditions to the Engineer in writing prior to the start of work.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site at such intervals as to insure uninterrupted progress of Work.
- B. Deliver anchor bolts and other anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time so as not to delay Work.
- C. Store materials to permit easy access for inspection and identification.
 - 1. Shop-primed steel. (Painted or galvanized): Primed steel stored in the field or shop shall be kept off ground (using pallets, platforms, or other supports) and so positioned as to minimize water-holding pockets, dust and other contamination of

the primer, and to protect the paint. Repair damage to primed surfaces due to improper storage in a manner approved by the State. Handling, shipping and erecting of shop painted steel pieces shall not be performed until the paint has dried thoroughly. Contractor shall furnish members in place, fully painted, including all touch up painting required as specified herein, at all locations where painting is required in the drawings by provisions of this Specification, and by the NJ-IBC.

2. Unpainted Steel: Steel stored in field or shop shall be kept off ground (using pallets, platforms or other supports), kept clean and in general protected against damage and corrosion.
- D. Do not store materials on erected structure in a manner that might cause distortion, corrosion or damage to the members or supporting structures. Repair or replace damaged materials or structures as directed by the State.
 - E. Include setting drawings, templates, and directions for installation with all anchor bolts and with all other items or devices furnished and delivered to the project site for installation under other sections of this Specification.
 - F. Materials shall be delivered to the site in the manufacturer's original and unopened containers and packaging, bearing labels as to type of material, brand name, and manufacturer's name. Delivered materials which are damaged or otherwise not suitable for installation, shall be removed from the jobsite and replaced with acceptable materials.

1.10 FIELD MEASUREMENTS

- A. Take field measurements as required for proper detailing, fabrication and installation of the work. Where possible take field measurements of existing conditions prior to fabrication. Lay out the work from at least 2 pre established benchmarks and axis lines, individually correct for length and bearing. Verify that field measurements are the same as those shown on Drawings and shop drawings. Report all deviations to the Engineer in writing accompanied by a sketch. Precise measurements and layout are the sole responsibility of the Contractor.

1.11 DEFICIENT WORK

- A. Deficient work or any work failing to strictly conform to the Contract Documents shall be removed and replaced, or repaired if accepted by Engineer, at no cost to the State, Architect or Engineer.
 1. Contractor shall prepare appropriate details and procedures to bring such work into conformance with the Contract Documents and submit to Engineer for review and acceptance. Contractor shall, through the State, reimburse the Engineer for time and expense incurred reviewing proposal procedures and details in accordance with the Engineer's current fee schedule.
 2. Nonconforming work may be rejected by State, Architect or Engineer at any time, regardless of prior acceptance in shop drawings, prior inspection, inclusion in inspection or test reports, or inclusions in certificates of payments.

- B. Deficient work shall include, but not be limited to:
1. Bent, twisted or warped pieces.
 2. Unauthorized cutting or reaming.
 3. Cracking, interior or surface defects.
 4. Painted or unpainted surfaces not sufficiently clean to receive spray fireproofing or finish coat.
 5. Tops of flanges not sufficiently clean to receive field-applied stud shear connectors or welding.
 6. Workmanship not in accordance with the Drawings, with this Specification, with accepted samples, or with referenced codes or standards.
 7. Exceedance of tolerances.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Stud Shear Connectors
1. KSM Products, Inc.
 2. Nelson Stud Welding Co.
 3. (Approved Equal)
- B. Paint
1. Tnemec Co.
 2. Carboline
 3. Sherwin Williams
 4. ZRC
 5. Dupont
 6. Ameron International
 7. (Approved Equal)

C. Expansion/Screw/Adhesive Anchors, Fasteners

1. Hilti, Inc.
2. ITW Ramset/Redhead, Inc.
3. Simpson Strong-Tie Anchor System
3. Powers Fasteners
4. (Approved Equal)

D. Zinc Metallizing

1. Atlantic Coast Metallizing, Deer Park, NY
2. (Approved Equal)

2.02 MATERIAL

A. Structural Steel Shapes, Plates, and Bars

1. Structural steel furnished for each location shall provide the minimum yield point given in the drawings, shall conform to the applicable ASTM steel specification, shall meet the requirements of the NJ-IBC, shall be suitable for use in welded structures and shall meet the requirements both of the drawings and of this Specification. All materials shall be new and of the best commercial quality. Steel produced to modified ASTM specifications shall not be used without the Engineer's prior written acceptance.

2. Stainless Steel: Stainless steel shall be type 18-8 conforming to AISI Grade 304 or 316.

B. Headed Stud-Type Shear Connectors

Shall be of the type shown on the drawings and shall conform to Articles 4.26 and 4.27 of AWS D1.1.

C. Bolts

1. Anchor Bolts (Anchor Rods): Shall be of the type specified in the drawings. Size and detailing indicated on Drawings.
2. High-Strength Bolts: Shall conform to the requirements of ASTM A325 or A490 except where ASTM A307 are specifically permitted in notes or details on the drawings and clearly designated in accepted shop drawings.

- a. Bolts shall be cold forged with rolled threads.
- b. Type 2 A325, Type 3 A325 or A490 bolts shall not be used.
3. Expansion/Screw/Adhesive Anchors: Provide types as indicated on Drawings. The anchor specified shall be considered the basis of design.
 - a. As a minimum, all anchors exposed to weather or embedded in masonry are to be Type 316 stainless steel or galvanized steel.
 - b. Anchors installed in concrete shall have current ICC-ES listing for performance in cracked concrete.
 - c. Design and installation provisions shall be based on current ICC-ES ESR report and ACI 318 Appendix D.
 - d. Where not indicated on drawings:
 - 1) Adhesive Anchors: HVA Adhesive Anchors by Hilti, HIT HY 200 by Hilti, Epcon by ITW/Ramset, Ultrabond by U.S. Anchor, HIT HY 70 by Hilti for anchors to masonry, or other accepted by Engineer.
 - 2) Expansion Bolts: Kwik-Bolt TZ Anchors by Hilti, HSL Heavy Duty Sleeve Anchors by Hilti, Trubolt Wedge by ITW/Ramset, or other accepted by Engineer.
4. Bolts, nuts and washers for a given grade and diameter of bolt shall come from a single domestic manufacturer. For each diameter, only one grade may be used. Bolting materials shall be shipped to the jobsite in the bolt manufacturer's unopened containers with nuts and washers assembled and lot numbers marked on the container.
5. Direct Tension Indicators: DTI's shall conform to ASTM F959; Coronet Direct Tension Indicators by J & M Turner or DTI's by Applied Bolting Technology.
6. Galvanized Steel Bolting Materials: Bolts shall conform to ASTM Type I, nuts shall be ASTM A563 Grade DH or A194 Grade 2H only. Bolts, nuts and washer shall be galvanized under the supervision of the bolt manufacturer in accordance with either ASTM B695 Class 50 or A153 Class C. Nuts must be tapped after hot dip galvanizing or slightly overtapped before wax or equal. The galvanized bolt, washer, nut assembly shall be tested by the bolt manufacturer in accordance with ASTM A325 section 8.5 and shipped and stored in plastic bags in closed containers. Direct tension indicators for galvanized bolts shall be coated by the DTI manufacturer only, in accordance with ASTM B695 Class 50, and tested by the manufacturer after coating.
7. Stainless Steel Bolting materials: Bolts shall conform to ASTM A193 Grade B8. Nuts shall conform to ASTM A194 Grade 8M.

D. Hardware

1. Nuts for A325 bolts shall conform to ASTM A563 Grade C, D or DH or ASTM A194 Grade 2 or 2H. Nuts for A490 bolts shall conform to ASTM A563 Grade DH or ASTM A194 Grade 2H. Nuts for A307 bolts shall conform to ASTM A563 Grade A.
2. Hardened washers shall conform to ASTM F426 and the requirements of the RCSC Specification.

E. Couplers for Concrete Reinforcing Bars: Concrete reinforcing bar couplers, which are to be welded to structural steel, shall be Lenton Half Couplers as manufactured by Erico Products, Grip Twist Coupler by BarSplice Products, or other accepted by Engineer.

F. Deformed Anchor Bars: Deformed bars to be stud welded to structural steel shall be D2L anchors as manufactured by Nelson Stud Division of TRW or other accepted by Engineer.

G. Filler Metal for Welding

1. Welding electrode shall be of the classification shown on the drawings and shall conform to AWS A5.1, A5.5, A5.17, A5.18, A5.20, A5.23, A5.28 OR A5.29.
 2. Welding electrode shall be compatible with existing steel where connections are made to steel of existing building. Electrode shall be E7018 unless determined otherwise. E7018 are low hydrogen electrodes that must be kept extremely dry.
 3. Welding electrodes for welding of stainless steel to stainless or carbon steel shall be E308L.
 4. Welding electrodes which have been wet or contaminated by grease or other substances deleterious to welding shall not be used.

H. Structural Steel Primer Paint

Provide type of primer indicated on steel under the following application conditions.

1. General application: Modified alkyd rust-inhibitive type containing no lead equal to Tnemec Co. No. 10-99 or Carboline Carbocoat 115-SG. Red oxide paint is not acceptable.
2. Cavity wall (including steel within the exterior block back-up or not separated from the cavity by a full block), exterior application, and as a primer after zinc metallizing: Epoxy paint equal to Tnemec Co. Series FC27 Typoxy or Carboline Carboguard 888.
3. Touch-up primer for cavity wall and exterior application: High adhesion high-solids epoxy coating equal to Tnemec Co. Series 135 Chembuild or Carboline Carboguard.

I. Galvanizing by the Hot-dip Method

1. Galvanize structural shapes in accordance with ASTM 123.
2. Galvanize hardware in accordance with ASTM A153.
5. Galvanizing repair paint for regalvanizing welds and damaged areas shall conform to ASTM A780 and comply with Military Specification MIL-P-21035, such as ZRC Cold Galvanizing Compound.

J. Galvanizing by the Zinc Metallizing Process

1. Zinc metallizing is the process of thermally applying an 85/15 zinc-aluminum wire over the surface of steel. Zinc metallizing and coating system shall have the following performance characteristics and results of tests performed on representative samples:
 - a. Adhesion of metallizing: An average of 1500 psi per ASTM D4541.
 - b. Adhesion of epoxy paint to zinc metallizing coating: A rating of 5A per ASTM D3359, Test Method A, after system has been exposed to 10 freeze thaw cycles (1 cycle equals 4 hrs at 100% humidity, 16 hours below 32°F, 4 hours at 140°F).
 - c. Corrosion resistance of zinc metallizing with epoxy paint: A rating of 10 after 1500 hours salt fog (prohesion method) when tested in accordance with ASTM D1654, Procedure A. Scribe shall be cut through all coatings to bare steel substrate. Expose specimens in accordance with ASTM G85.
2. Galvanizing repair paint for regalvanizing welds and damaged areas shall conform to ASTM A780 and comply with Military Specification MIL-P-21035, such as ZRC Cold Galvanizing Compound.

2.03 SHOP ASSEMBLY - FABRICATION

A. General

1. Do not fabricate until shop drawings have been approved.
2. Fabricate and assemble steel in shop to greatest extent possible. Fabricate items and assemblies in accordance with AISC Specifications and the shop drawings.
3. Properly mark members for field assembly. Fabricate items in order to match delivery sequence that will expedite erection.
4. Mill column ends at base plates, cap plates, and splices to a common plane by means of an approved milling machine.
5. Members shall not be shop (or field) spliced except where specifically accepted

by the Engineer and detailed on the shop drawings.

6. Pipes, tubes and built up box members shall be completely sealed with cap plates unless specifically designated otherwise in the Drawings.
7. Curved members of rolled sections shall be bent to uniform smooth curvature by means acceptable to the Engineer.

B. Shop Connections

1. Weld or high-strength bolt shop connections as indicated on Drawings.
2. High-strength bolt connections are friction (slip-critical) connections. Install high-strength bolts in accordance with "Specification for Structural Joints using ASTM A325 or A490 Bolts" (RCRBSJ).
3. Welding: Comply with "Structural Welding Code" for procedures, appearance, and quality of welds and methods used in correcting welded work.
4. Bolt Holes: Bolt holes shall be normal size unless specifically accepted by the Engineer. Do not make or enlarge holes by burning. Drill material where thickness exceeds the connector diameter and in all material thicker than 7/8 inch. Remove burrs from drilling operations. Elongated punch and die sets shall be used to punch elongated holes.
5. Holes for other Work
 - a. Provide holes and openings required for securing other Work to steel framing and for passage of other Work through framing members. Coordinate with Drawings of other Work.
 - b. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other Work.
 - c. Cut, drill, flame cut, or punch holes perpendicular to metal surfaces. Method of cutting must not produce a roughness of over 1000 microinches. Surfaces exceeding these limits must be repaired by machine grinding.
 - d. Beam openings not shown or scheduled may be provided only where specifically accepted by the Engineer. Reinforce all openings with steel shapes as shown on shop drawings.

C. Shear Stud Connectors (Non-Metal Deck Construction)

1. Weld shear studs to beams with automatically timed stud welding equipment at spacing shown on Drawings. Size, type, and length specified on Drawings.
2. Top flanges of beams must be free of paint, heavy rust, mill scale, dirt, ice and/or water, and any other material that will interfere with the welding operation.

- D. Straightening and Tolerances: Contractor shall straighten, square, flatten and torsionally align plates and shapes as necessary to provide fabricated elements within allowable tolerances as well as to provide correct alignment, good fit and uniform erection clearance, as applicable.
1. Fabrication tolerances shall not exceed those of the AISC Code.
 2. Beams shall be fabricated with natural camber up except where specific camber is designated in the Drawings.
 3. Material straightened prior to fabrication shall be examined carefully for signs of distress and for other defects before being placed in fabrication. Distressed or otherwise defective material shall not be used in the work. Straightening by the use of properly controlled heat will be permissible if done by personnel skilled in heat straightening, using equipment and techniques in accordance with written procedure documents and applicable detail sketches prepared by the fabricator and accepted by the Engineer.
 4. Sharp corners, projections, and similar rough or sharp surfaces or edges shall be eased and smoothed by grinding. Fabricated materials containing sharp kinks or bends shall be rejected.
- E. Cutting: Except where accepted by the Engineer, cutting shall be by machine. Gas cutting shall provide smooth, uniform, workmanlike surfaces and shall conform to the prescribed line. Minimum 1/2 inch radius of cut shall be provided at all reentrant corners. Gas cut surfaces shall be made uniform and notch free by chipping, planing, grinding and welding as required.
- F. Finished Surfaces: Finishing shall be mean milled to ANSI 500 or smoother. Finished surfaces shall be protected by a corrosion inhibiting substance as provided herein. Plane contact surfaces of grillages and base plates. Mill edges of bearing stiffeners.
- G. Built-Up Members: Built up members shall be constructed true to line. Plate edges shall be cut or milled true to line. Plate edges to be welded to other plates shall be straight or curved, as applicable, and normal to the plate surface. Provide uniform cross section, minimum practical twist, and minimum practical deviation from true lines. Provide true and uniform camber, where noted in the Drawings, by cutting of web plates prior to assembly. Where splices of material are specifically accepted by the Engineer in shop drawings, splice each component prior to fitting up of plates. Use welding procedures, patterns, sequences and techniques that will avoid distortion of base metal or member.

2.04 SHOP PAINTING

A. General

1. Apply one shop coat of primer paint on structural steel except as follows:
 - a. Structural steel that is encased in concrete.

- b. Steelwork or portions of such to receive sprayed fireproofing. Steel that is exposed to the cavity and within the block back-up is to be painted, unless indicated to be galvanized.
 - c. Top flanges of structural steel members requiring stud shear connectors or supporting metal deck.
 - d. For alkyd primer, epoxy based paint and polyurethane, surfaces to be subsequently bolted or welded shall be blocked out for a minimum of 2 inches each direction from edge of bolt holes or welds.
 - e. For Zinc rich primer, surfaces to be subsequently welded shall be blocked out. Surfaces to be bolted shall not be blocked if slip-critical Class B zinc-rich primer is utilized (no topcoat).
 - f. Surfaces of structural steel within 2" of field welds.
 - g. Contact milled bearing surfaces.
 - h. Steel members, hardware, and miscellaneous pieces to be galvanized and not specified or indicated to be painted.
2. Sharp edges, such as those created by flame cutting or shearing, shall be broken and rounded prior to surface preparation. Breaking the edge can be accomplished by a single pass of a grinder in order to flatten the edge.

B. Cleaning and Surface Preparation

1. Clean all steel first in accordance with SSPC-SP1.
2. Clean steelwork not to be painted (except steel work to be galvanized) in accordance with SSPC-SP3.
3. Clean steelwork to be painted within the same day as it will be applied and in accordance with the following methods, determined by location and exposure:
 - a. Interior steel not exposed to view: SSPC-SP3.
 - b. Interior steel exposed to view: SSPC-SP6.
 - c. Cavity wall and exterior steel exposed to weather: SSPC-SP6.
4. Steel which is to receive spray on fireproofing or concrete encasement shall be re-cleaned in the field as required for proper adherence.

C. Shop Coat

1. Steel which is to be enclosed but not spray fireproofed shall be shop sprayed with an alkyd primer, not less than 2.5 mils nor more than 3.5 mils dry film thickness. Provide full coverage of joints, corners, edges, and exposed surfaces.
2. Steel which is to be exposed to view but protected from the weather shall be shop sprayed with zinc rich primer not less than 2.0 nor more than 3.5 mils dry film thickness, and top coated with epoxy based paint not less than 4.0 mils nor more than 6.0 mils dry film thickness. Top coating may be achieved by a single sprayed coat or 2 rolled and brushed coats.
3. New steel which is to be exposed to weather shall be cleaned to meet the requirements of SSPC SP 6, shop sprayed with zinc rich primer not less than 2.5 nor more than 3.5 mils dry film thickness (DFT), intermediate spray coated with epoxy based paint not less than 4.0 nor more than 6.0 mils DFT, and top coated with polyurethane paint not less than 3.0 nor more than 5.0 mils DFT.
4. Existing steel which will be permanently exposed to weather shall be cleaned to meet the requirements of SSPC SP-3 and coated twice with Carboline Rustbound Penetrating Sealer or Carboguard 954 followed by epoxy-based paint, for a total coating dry film thickness not less than 7.0 mils nor more than 15.0 mils dry film thickness. Test topcoat over existing coatings to verify compatibility. If total system dry film build excess 15.0 mils, including existing paints, then removal of this high thickness must be conducted.
5. Apply to dry surfaces only, when surface temperatures are at least 5°F above dew-point, by brush, spray, or roller, thoroughly and evenly, in strict accord with manufacturer's instructions for every detail of handling.
6. Apply second coat of the approved primer, in a darker shade, to surfaces inaccessible to painting after assembly or erection.
7. Protect machined surfaces with an approved rust-inhibiting coating that is readily removable prior to erection.

D. Concrete Contact Surfaces

Paint steelwork at least two inches into the area in contact with concrete, where applicable.

2.05 GALVANIZING

A. General

Galvanize the following members:

1. All angles supporting exterior masonry or exposed to the weather, including shelf, arch, relieving angles.

2. All connections between the above angles and the supporting structural member, including WT's, hangers, clip angles, hardware, etc.
 3. All exterior steel supporting mechanical equipment (dunnage steel) and any other steel members indicated on Drawings.
 4. All other steel exposed to weather and not painted.
- B. Cleaning and Surface Preparation
1. Hardware (bolts, nuts, etc.): Clean and leave free of mill scale before galvanizing.
 1. Clean all steel first in accordance with SSPC-SP1 if needed.
 3. Steel members: Clean in accordance with SSPC-SP8 before hot-dip galvanizing.
 4. Steel members: Clean in accordance with SSPC-SP10 before zinc metallizing. Surface shall have a 3-4 mil anchor pattern. Moisture cannot be present on steel and temperature cannot be less than 5°F above the dew point. Thermal spray must be applied within 4 hours of blasting.
- C. Shop Coat - Hot-dip Galvanizing – Provide for galvanized items not to have finish paint coat.
1. Galvanize hardware in accordance with ASTM A153.
 2. Galvanize steel shapes in accordance with ASTM A123. Apply zinc coating as per Thickness Grade specified in ASTM A123.
- D. Shop Coat – Zinc Metallizing – Provide for galvanized items to have finish paint, which includes all items exposed to public view, including lintels, and other items shown on Drawings or specified herein.
1. Thermally spray material at a rate of 4-5 mils DFT. Sprayed coating shall be free of lumps, blisters, and loosely adhering particles.
 2. After material has cured, apply shop coats of paint. Refer to Section 09900 for second two coats of the epoxy paint system.

2.06 SOURCE QUALITY CONTROL

A. Testing

1. General

- a. Structural steel work is subject to all tests required by the Special Inspection requirements of the 2009 NJ-IBC.
- b. Cooperate with the Testing Laboratory in making all required tests.

2. Welding of Critical Joints

- a. All welded joints that are critical to the integrity of the structure, and require non-destructive testing to assure the adequacy of the critical weld, are indicated on the Drawings.
- b. To insure general weld quality of less critical groove and butt welds, a quality control program may be required to check the welds by non-destructive testing. The Drawings specify whether non-destructive testing is required and, if necessary, the method of inspection.

B. Inspection

1. Testing Laboratory

- a. The Contractor will engage an Independent Testing Laboratory or Special Inspection Agency classified by the State to assist in the inspection of steel fabrication and conduct tests at the mill, shop, or foundry. The laboratory will assist in checking erection tolerances and provide shop and field testing required for all structural steel work, including metal deck and studs.
- b. The Testing Laboratory will be responsible to and under the supervision of a Special Inspector.

2. Special Inspector

The Contractor will assign, under the requirements of Section BC 1704.3 of the 2009 NJ-IBC, a Special Inspector classified by the State to supervise the Work listed above under "Testing Laboratory".

3. Notification:

- a. Notify the Engineer and State before beginning fabrication of the structural steel and supply laboratory with copies of agreements, approved drawings, approved prints of all shop details, etc., and all necessary information relating thereto. Do not ship material to job site until after inspection and approval by the Testing Laboratory.
- b. Contractor shall be responsible for providing the Testing Agency, The State and Engineer with proper notice of the initiation of each phase and portion of work requiring testing or inspection. Written notice of commencement date shall be provided at least 5 working days prior to the start of shop work and the start of fieldwork. Subsequently, Contractor shall give a minimum of 24 hours verbal notice of work, or completion of work as applicable, requiring inspection and/or testing.

4. Discretionary Inspections: No mill, shop, foundry, or field inspection, such as is above provided for, shall be held to prohibit or preclude inspection of such

materials during delivery and erection at the building by such other persons as the State shall direct.

5. Shop Inspection and Testing: Work performed at fabrication plants shall be subject to inspection and testing as follows:
 - a. The Testing Agency shall review the fabricator's quality control program and make a written report of such.
 - b. Each piece of fabricated steel shall be examined for straightness, alignment and proper conformance to details on accepted shop drawings. Camber shall be measured at midpoint of all members for which camber is called for on the Drawings.
 - c. Mill certificates for all steel shall be examined.
 - d. Manufacturer's certifications for all bolting materials to be used in the shop shall be checked and lot numbers on containers shall be verified to match certificates.
 - e. High strength bolts and bolting operations shall be tested and inspected in accordance with this Section.
 - f. Welds and welding operations shall be tested and inspected in accordance with this Section.
 - g. Surface preparation and painting of all steel members where blast cleaning is specified shall be inspected. When requested by the Engineer, dry film thickness of paint layers shall be measured.
 - h. Stud welding operations shall be inspected and tested in accordance with AWS D1.1 Sections 7.7 and 7.8.
6. Field Inspection and Testing: Work performed in the field shall be subject to inspection and testing as follows:
 - a. Testing Agency shall verify that all steel pieces and connections are installed completely and properly in the correct location and manner in accordance with accepted shop drawings.
 - b. Lot numbers on containers of all bolting materials shall be verified to match submitted manufacturer's certifications. Manufacturer and grade markings on all components of bolt assemblies shall be verified.
 - c. High strength bolts and bolting operations shall be tested and inspected in accordance with this Section.
 - d. Welds and welding operations shall be tested and inspected in accordance with this Section.

e. Steel exposed to the weather shall be inspected to verify that paint has been properly touched up at damaged or scratched areas.

7. Welding: Inspection and testing of welds and welding operations shall be performed in accordance with AWS D1.1 Section 6 by the Testing Agency using AWS Certified Welding Inspector.

a. Testing Agency shall verify:

1) Welding materials and equipment conform to the Contract Documents and AWS requirements and are used in correct positions and procedures.

2) Size, length and location of all welds, and correct and appropriate processes are used.

3) Welds are only made by welders certified by AWS for applicable process and position.

4) At appropriate intervals, performance of individual welders and preparation and fit up of joints.

b. All welds shall be visually inspected. Acceptance criteria shall be per AWS D1.1 Section 8.15.1 or 10.17.1 as applicable.

c. Fifty percent of all full and partial penetration welds, whether made in the shop or field, shall be ultrasonically tested, for 100% of their length, in accordance with AWS D1.1 Section 6 Part C and Section 8.15 or 10.17 as applicable.

1) If testing discloses a large ratio, in the opinion of the Engineer, of unacceptable welds, the required percentage shall be increased to 100% by the Engineer.

2) If, in the opinion of the Engineer, the testing consistently discloses acceptable welds, the percentage of tested welds may be reduced by the Engineer to a minimum of 25%.

d. Fifty percent of all fillet welds, for 100% of their length, shall be tested by dye penetrant (ASTM E165) or magnetic particle (ASTM E709) method. Acceptance criteria shall be per AWS D1.1 Section 8.15 or 10.17 as applicable.

1) If testing discloses a large ratio, in the opinion of the Engineer, of unacceptable welds, the required percentage shall be increased to 100% by the Engineer.

2) If, in the opinion of the Engineer, the testing consistently discloses acceptable welds, the percentage of tested welds may be reduced by the Engineer to a minimum of 25%.

e. Welds which are not satisfactory or which are found to be defective by the Testing Agency shall be cut out and replaced by a satisfactory weld at no additional cost or delay to the State.

8. High Strength Bolting: High strength bolts and bolting operations shall be tested and inspected as specified herein and in accordance with the RCSC Specification, Section 9.

a. Storage and Handling: The Testing Agency shall verify that bolting materials are properly stored and protected and at time of installation, are clean and free of rust and thread damage.

b. Assembly: The Testing Agency shall verify that the proper bolting assembly is installed by checking size and grade of bolt, type and grade of nut, location and number of flat washers, and location, orientation and type of direct tension indicator (if used).

c. Snugging: The Testing Agency shall verify that all bolts in a connection are properly snugged in accordance with RCSC Specification procedures and requirements of this Section before final tensioning of any bolt in a connection.

d. Calibration: The Contractor shall provide a tension-measuring device (Skidmore Wilhelm or similar), with proper calibration certification, at the jobsite at all times when bolts are being tensioned. At the start of work, when requested by the Engineer, and whenever deemed appropriate by the Testing Agency, installation procedures shall be confirmed by tensioning a representative sample of bolts in the tension measuring device. A representative sample shall consist of not less than three bolts of each size, grade, length and producer being used. Installation procedures shall achieve a tension not less than that given in Table 4 of the RCSC Specification within 10 seconds from a snug tight condition.

e. Twist off Bolts: Twist off type bolts shall be inspected by observing installation procedures and by verifying that the splined end of every bolt shank has been properly broken off by the wrench chuck.

f. Direct Tension Indicators: Bolts installed with direct tension indicators shall be inspected by observing installation procedures and by measuring the average residual gap of the DTI on every bolt in accordance with the manufacturer's recommendations.

g. Turn of nut Installation: Bolts installed by the turn of nut method shall be inspected by measuring torque with a calibrated wrench. At the beginning of work, when deemed appropriate by the Testing Agency, whenever conditions such as lubrication or surface dirt change, and when a new or different manufacturer's material is being used,

an inspecting torque shall be established. This shall be done by tensioning 5 bolts of each grade, diameter and manufacturer in a Skidmore Wilhelm device to a tension not less than 105% of the minimum required and measuring torque with a properly certified calibrated wrench. The high and low values shall be discarded and the middle three averaged to establish an inspecting torque for each grade, diameter and producer. A minimum of 10 percent of the bolts, but not less than 2, in every connection shall be inspected. The Contractor shall provide the Skidmore Wilhelm device, a calibrated wrenches, scaffolding and laborers as needed to perform such procedures at times requested by the Testing Agency.

h. Verification Procedures: If the Testing Agency reasonably suspects that any bolts may not be properly tensioned, due to relaxation as a result of improper snugging or any other reason, the arbitration inspection method of the RCSC Specification, Section 9(b), shall be used, except that all bolts in the connection in question shall be checked. The Contractor shall provide a Skidmore Wilhelm device, calibrated wrench, a laborer and scaffolding as required to safely and properly perform such verification.

i. Laboratory Testing: High strength bolting materials shall be randomly tested throughout the project at times and in quantities chosen by the Engineer.

1) Tension tests of full size bolts shall be performed to determine the proof load and ultimate tensile strength in accordance with ASTM F606 using Method 1, Length Measurement.

2) Rockwell hardness of bolts shall be determined on the wrench flats after removal of surface material in accordance with ASTM F606. The reported hardness shall be the average of three hardness readings.

3) Rockwell hardness of nuts shall be determined on the bearing face in accordance with ASTM F606.

4) Surface hardness of hardened washers shall be determined in accordance with ASTM F606.

5) In addition the surface hardness, the core hardness of 5/16 inch thick washers shall also be determined in accordance with ASTM F606.

6) Direct tension indicators shall be tested in accordance with ASTM F959.

7) If requested by the Engineer, chemical properties and dimensional tolerances of bolting materials may also be tested.

5. Reports:
 - a. Shop and field reports, including shipments, will be submitted by the Testing Laboratory to the State, Architect and Engineer weekly as the work proceeds at the shop or job site. A final report will be submitted by the Testing Laboratory when work is completed at the shop, and again when work is completed in the field. The Special Inspector reserves right to reject material not in compliance with specified requirements at any time.
 - b. When any test or inspection reveals deficient or non-conforming work, Testing Agency shall notify The State and Engineer immediately by means of a written report specially and clearly marked to show deficient areas of work. Furthermore, the Testing Agency shall provide a table of all known members, noting when each piece was shop inspected, field inspected, any deficiencies and when the deficiencies were corrected. This table is to be provided to the State and Engineer with the weekly submission of daily reports.
6. Corrections: Correct deficiencies in work which inspections and tests have indicated to not be in compliance with requirements. Pay for additional tests, at own expense, necessary to reconfirm any non-compliance of original work and as necessary to show compliance of corrected work.
7. Contractor's Responsibility:
 - a. Inspection and acceptance or failure to inspect shall in no way relieve the Contractor or the mill and shops from their responsibility to furnish satisfactory material strictly in accordance with Drawings and Specifications.
 - b. If, due to errors by the Contractor or failure to perform his work in accordance with the Contract Documents, the Engineer must perform additional design or drafting work or review proposed solutions, the Contractor shall, through the State, reimburse the Engineer in accordance with the Engineer's current fee schedule plus out of pocket expenses incurred.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and that erection may proceed. Notify the Engineer, Architect and The State in writing of conditions that adversely affect the Work. Do not proceed with erection until conditions have been corrected. Beginning of installation means the erector accepts existing conditions.

3.02 ERECTION

A. General

1. Erection shall conform to Section BC 2205.6.4 of the 2009 NJ-IBC and AISC 360.
2. All work shall be erected plumb, square, and true to lines and levels in strict accordance with the structural requirements of the building.
3. Provide all machinery, apparatus, and staging required for the erection of steelwork in a thoroughly safe and efficient manner. Install, maintain and remove, without injury to other Work, such temporary bracing, scaffolding, etc. as may be necessary or required. Care shall be taken that no part of the structure is overloaded during construction.
4. Arrange for deliveries of material to facilitate the rapid and continuous progress of operation, but the site or streets adjacent to same shall not be used for the storage of material unless absolutely necessary and then only with special permission of the State and other authorities having jurisdiction.
5. Employ a Licensed Professional Engineer and Land Surveyor to ensure accurate erection of the steel.
6. Do not alter or cut structural members without written approval of the Engineer of Record.

B. Temporary Shoring and Bracing

Contractor shall be solely responsible for stability and safety of the structure during the construction process. This responsibility includes any and all engineering for cranes, methods and sequences of erection, and temporary storage of materials such as metal decking.

1. Provide temporary bracing as required in order to resist safely all imposed vertical and horizontal loads during construction and to maintain correct alignment. Design of temporary shoring, bracing and guying is the Contractor's sole and complete responsibility, including all details of installation and removal, methods, sequence and timing. Remove temporary members and their connections after structure is completed.
2. Anchor bolts as shown in the Drawings are intended for requirements of the fully completed structure. Anchor bolt requirements for erection purposes and loadings shall be determined by the Contractor.

C. Anchors Bolts

1. Furnish to the concrete and brick masons anchor bolts and other connectors required for securing structural steel to the foundation and other in-place concrete work, together with instructions, templates, etc. necessary for setting them.

Anchor bolts are to be surveyed and any approved modifications made prior to placement of columns.

2. Tighten anchor bolts after support members have been positioned and plumbed. Cut off protruding edges of wedges or shims flush with edge of base or bearing plate prior to packing with grout.

D. Base and Bearing Plates

1. Clean concrete and masonry bearing surfaces of loose and bond-reducing materials.
2. Set loose and attached base plates and bearing plates for structural members on shims and other adjusting devices, such as leveling plates, within specified tolerances. Elevations of shims and leveling plates shall be surveyed and adjusted to correct elevation prior to placement of column or beam. Plates are to have grout holes.

E. Field Assembly

1. Erect structural frames accurately to lines and elevations indicated. Align and adjust members forming a part of a complete frame or structure before permanently fastening.
2. Fastening of compression splices and joints shall be performed after the abutting surfaces have been brought uniformly into contact. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Contact area shall be within tolerances listed in this section.
3. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
4. Level and plumb individual members of the structure within specified tolerances. Do not tighten structure until surveys verify that structure is within allowable tolerances.
5. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
6. Splice members only where indicated and accepted on shop drawings.

F. Bolting

1. General: Bolting procedures shall meet all of the requirements of the RCSC Specification and those given herein.
 - a. Bolts, nuts and washers, at time of tightening, shall be clean, rust free

- and free from thread damage.
- b. Impact wrenches shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt within 10 seconds.
2. Acceptable Methods of Installation: All ASTM A325 and A490 bolts shall be fully tensioned to the minimum values given in Table 4 of the RCSC Specification unless specifically permitted otherwise by the Engineer in writing.
 - a. Bolts shall be tensioned using one of the following methods, as defined by the RCSC Specification and requirements herein, within the limitations given:
 - 1) Twist off type bolts, for diameters not exceeding one inch.
 - 2) Direct tension indicators.
 - 3) Turn of nut, provided that every bolt in every connection is marked with white or yellow keel after snugging and prior to final tightening ("match marking"). Turn of nut may not be used for bolts larger than one inch diameter.
 - b. ASTM A307 bolts shall be tightened using full manual effort on a suitable wrench. After installation, score threads to prevent nuts from loosening.
 3. Snugging: Regardless of the installation method being used, connections shall be properly "snugged" prior to final tensioning of any bolt in the connection. Snug tight is defined as the condition where all plies of the connection are in firm contact. Snugging of bolts shall progress systematically from the most rigid part of the connection to the free edges. Impact wrenches shall be used on larger connections if manual effort on spud wrenches is not sufficient to bring plies together.
 4. Twist off Type Bolt Installation: Connections shall be properly snugged prior to tensioning of any bolt, which breaks the splined tip. A hardened washer shall be provided under the nut.
 5. Installation with Direct Tension Indicators: Tensioning methods, number, thickness, location, orientation and type of washers, procedures and measurements shall be in strict accordance with the manufacturer's latest printed instructions.
 - a. DTI's shall be provided in addition to all other washers required.
 - b. Impact wrenches used shall be those recommended by the DTI manufacturer for the grade and size of bolt being installed and shall be in good repair and sufficiently supplied with compressed air.

- c. Protrusions of the DTI shall bear only against the underside of the bolt head or against a hardened 3/16-inch thick hardened washer, as applicable.
 - d. Bolts larger than one-inch diameter shall be lubricated with Johnson's Stick Wax 140 on threads and face of turned element prior to tightening.
 - e. Connections shall be properly snugged prior to final tensioning of any bolt, which flattens the protrusions of the DTI.
 - f. In calibration procedures, the DTI need only indicate a tension of 100 percent of the minimum specified tension and not 105 percent as required by Section 8(d)(4) of the RCSC Specification.
6. Installation by Turn of Nut: Installation shall be in strict accordance with the RCSC Specification and the additional requirements given herein.
- a. A hardened washer shall always be provided under the bearing face of the turned element (nut or bolt head).
 - b. Bolts shall be properly snugged and match marked prior to final tensioning of any bolt in a connection.
 - c. During tightening of bolts, the unturned element shall not be allowed to rotate. The unturned bolt element shall be held without rotation using the correct size spud wrench or other suitable correct size of open end, closed end or socket wrench.
7. Oversized and Slotted Holes: Washers, plate washers and/or continuous bars shall be provided for ASTM A325 and A490 bolts in accordance with Paragraphs 7(c)(3) thru 7(c)(7) of the RCSC Specification.
8. Reuse of Bolts: ASTM A490 bolts and galvanized ASTM A325 bolts, if completely or partially untorqued, shall not be reused. ASTM A325 bolts may be reused only with specific written acceptance by the Engineer.
9. Field Modifications or Corrections: Unfair holes shall not be enlarged by burning or drifting alone. Enlarge holes where necessary and permitted by flame piercing and reaming or by reaming alone or by other means accepted by the Engineer. Holes after enlargement shall be true round holes normal to the surfaces joined. Increase bolt size to fill enlarged and reamed holes.
10. Galvanized Bolts: Galvanized bolts shall be provided wherever the connection is exposed to the weather.
- a. Bolt threads and the face of the turned element shall be lubricated with Johnson's Stick Wax 140 prior to installation.
11. For ASTM A307 or A325 bolts, hardened washer shall be installed under the turned element. For ASTM A490 bolts, hardened washer shall be installed under

the head and nut.

G. Erection Holes

Fill erection boltholes on exposed to view members with plug welds and grind smooth.

H. Welding

1. General: Welding processes and materials shall comply with AWS D1.1 and any additional requirements specified herein.

2. Quality Control and Certifications: Quality of all welds shall conform to AWS D1.1 Article 7.7 or 8.15 or 10.17 as applicable for the type of weld and specified method of inspection.

a. All welds shall be visually inspected by the welder who made the weld.

b. Welds shall only be made by welders with AWS certification, and any local building code license if required, for the type of weld, welding process and position of the weld being made.

c. Field welds shall be subject to the same acceptance criteria as shop welds.

d. Cracking or incomplete penetration shall be cause for rejection of each weld possessing such defects, regardless of other acceptance or rejection criteria.

e. Base metal containing gross discontinuities, before or after welding, or lamellar tearing after welding, shall be repaired in accordance with accepted procedures or shall be discarded and replaced.

f. The Contractor shall comply with the requirements of AWS Article 6.6.

3. Materials and Processes: Welding materials and processes shall be selected from those specified herein and shall conform to accepted welding procedure specifications.

a. Complete and partial penetration welds shall be made using only AWS prequalified procedures following all requirements for joint preparation, fit up, orientation, etc.

b. Welding electrodes or flux contaminated by deleterious substances or moisture shall not be used and shall be removed promptly from the work location. Low hydrogen electrodes which cannot be used promptly after opening of hermetically sealed containers shall be stored in electric holding ovens at 250oF (minimum).

4. Preheating: Welding shall be performed on material preheated to a temperature above the dew point, regardless of other preheating requirements.

a. Joints in which material is two inches or more in thickness shall not have the weld interrupted after operation has started, unless at least $\frac{2}{3}$ of its size, for its full length, has been completed without an interruption of more than one hour. Welding may be interrupted for longer periods, provided the preheat temperature is maintained for full length of joint for the entire time welding is interrupted.

5. Miscellaneous:

a. Sizes of fillet and partial penetration welds shall equal or exceed minimums required by the AISC Specification regardless of all other requirements.

b. All backing bars shall be continuous across the entire length of the weld.

c. Slag shall be removed from all welds for inspection.

d. Use automatic stud welding systems in strict accordance with the manufacturer's instructions to weld all studs and deformed anchor bars installed in the shop. Prepare structural steel surfaces as recommended by the stud shear connector or anchor bar manufacturer. Fillet welding shall be used for repair welding only. All welding ferrules shall be broken and removed to allow visual inspection of the stud welds. All weld repairs to stud welds shall be made to the extent required by AWS D1.1.

e. Exposed exterior structural steel shall have all joints seal welded.

f. Welding of ASTM A6 Group 4 and 5 rolled shapes spliced in tension shall conform to AISC specification Section J1.7.

g. Concrete reinforcing bar couplers welded to structural steel shall be installed in strict accordance with the manufacturer's instructions and AWS D1.1.

h. Shop weld TFE slide bearings by controlled fillet welding so as to produce distortion free bearings accurately located and aligned. Erect and assemble slide bearing joints with uniform contact over at least 75 percent of the joint with no separation greater than 0.02 inch.

I. Lintels and Relieving Angles

1. Erect all exterior steel lintels and relieving angles connected (by hangers, clips, bolts or otherwise) to the structural steel work.

J. Flame Cutting

Flame cutting in field of members to correct fabrication errors is to be avoided and to be done only upon approval of the Engineer of Record based on the method proposed. Roughness cannot exceed 1000 microinches. Repair of surfaces shall be by mechanical grinding. Where field cut openings are approved by the engineer, openings are to be cut with a mechanically guided torch after which all edges are to be ground smooth with a proper radii at corners. Required reinforcing is to be placed prior to cutting opening.

K. Field Touch-Up: Field touch up shall be provided at all blocked areas and points of damage, including bolts and welds installed after coating.

1. Painted Members: Touch up shall be power tool cleaning to SSPC SP 3. For one coat treatment apply one coat of zinc rich primer. For two coat treatment apply one coat of zinc rich primer and one coat of epoxy based paint. For three coat treatment apply one coat of zinc rich primer and two coats of polyurethane paint.
2. Galvanized Members: After erection, clean and paint all damaged areas to the galvanizing, welds, and areas adjacent to welds with the galvanizing repair paint. Touch up for galvanized steel shall be power tool cleaning to SSPC SP 3 and painting with cold galvanizing compound. For galvanized members to be painted, finish painting is specified in Section 09900 and shall be the final two coats of the epoxy paint system.

L. Field Modifications and Corrections: Field modifications and/or correction of fabrication or detailing errors shall not be made without the prior acceptance of field work drawings by the engineer.

1. Bolt holes shall not be cut or enlarged with a gas torch. Use of drift pins is not allowed.

3.03 TOLERANCES

- A. Erection tolerances shall be in accordance with "Code of Standard Practice for Steel Buildings and Bridges" and AISC Specification, except where more restrictive tolerances are indicated on the drawings or in C below.
- B. Contractor shall employ a licensed Surveyor experienced in surveying steel building frameworks and report all discrepancies to the Engineer. Contractor shall not proceed with erection until acceptable corrections have been made. Contractor's steel surveys shall establish permanent bench marks as necessary, shall check elevations of bearing surfaces and locations of anchor devices and shall provide data during the course of the Work and a final survey showing the E W, N S and elevation position of the work points of each steel frame, truss and other major member as compared to theoretical location. Such surveys shall be submitted for record at the completion of steel erection and at times requested by the Engineer.

- C. The following overall maximum deviations (tolerances) from theoretical are permitted:
- a. Column location @ base plate: 1/2"
 - b. Base Plate, bearing plate and column splice elevation: +1/8"
 - c. Column Plumbness: in or out 3/4" in column length, 1/4" for total structure height
 - d. Beam or girder elevation: +1/2"
 - e. Lintel elevation: +1/16"
Lintel location: +1/4"
 - f. In lieu of the criteria given in Section M.4.4 of the AISC Specification, fit of finished compression splices shall be as follows: At least 65 percent of the contact area shall be in uniform bearing about the centroid of the bearing surface, with no separation greater than 0.02 inches, except locally at flange toes or corners which may be separated 0.03 inches without need for corrective measures.

3.04 FIELD QUALITY CONTROL

- A. Cooperate with the Special Inspector and the Testing Laboratory performing Special Inspection testing.
- B. Contractor shall furnish Testing Agency with a complete set of Construction Documents and Specifications, along with one copy of each accepted shop drawing bearing the Engineer's review stamp, mill test certificate and manufacturer's certification. Provide reasonable office space to Testing Agency at fabrication plants and at the site. Provide Testing Agency personnel with convenient and safe access to the work and all reasonable assistance necessary to permit effective inspection and testing work.
- C. As per Section BC 1704.3, the Special Inspector will inspect erection of the structural framework and test field bolting and welding as listed in Part 2 of this Section.
- D. The Contractor shall engage an engineer licensed in the state of New Jersey to check tolerances and inspect the erection.
- E. Contractor's Surveys

Provide surveys of items listed below. Surveys are to indicate the actual location and elevation and the deviation from theoretical. Highlight those numbers that exceed permissible tolerances. Surveys are to be submitted in a timely manner in order for corrections to be made prior to installation of the next item in sequence (e.g. anchor bolt and base plate survey prior to column installation), including placement of concrete. The following items are to be surveyed:

- 1. Anchor bolt location

2. Elevation of bottom of base plates (top of shims or leveling plate).
3. Elevation of lowest column splice.
4. Location (x,y, & radial) and plumbness of columns.
5. Elevation of steel members taken at approximately 4 members from each platform.
6. Elevation and location of lintels prior to installation of supported masonry.

3.05 CLEANING

- A. Structural steel or portions of such to receive sprayed fireproofing shall be clean of dust, grease, oils, loose material, and any other matter which would impair the adhesion of the fireproofing material to the steel.

NEXT PAGE

LIST OF SUBMITTALS

SUBMITTAL	DATE SUBMITTED	DATE APPROVED
Product Data:	_____	_____
1. Primer paint, repair paint		
2. Stud shear connectors		
3. Expansion/adhesive anchors		
4. Zinc metallizing		
Shop Drawings:	_____	_____
1. Job standards		
2. Erection drawings		
3. Steel shop drawings		
4. Calculations		
5. DVD/CD rom of final approved drawings		
Certificates:	_____	_____
1. Bolt test reports		
2. Welders qualifications & license		
3. Material listing		
4. ICC Certification for Mechanical/Adhesive Anchors		
Qualifications	_____	_____
1. Fabricator		
2. Erector		
3. Detailer/Engineer		
4. Zinc Metallizer		
Surveys:	_____	_____
1. Anchor bolt and base plate		
2. Column splice elevation		
3. Column plumbness		
4. Bottom of beams before concrete placement		
5. Bottom of beams after concrete placement		
Test Reports:	_____	_____
Zinc metallizing and epoxy coating		

END OF SECTION

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Shelf angles.
3. Metal ladders.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance of Aluminum Ladders: Aluminum ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304 and Type 316L.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- F. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- G. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- H. Zinc-Coated Steel Wire Rope: ASTM A 741.
 - 1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- I. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: As indicated.
 - 2. Material: Galvanized steel, ASTM A 653/A 653M, structural steel, Grade 33, with G90 coating.
- J. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- K. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- L. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- M. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099123 Interior Painting."
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches from ends and corners of units and 24 inches o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.
- D. Prime shelf angles located in exterior walls with zinc-rich primer.
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3.
 - 2. Comply with OSHA Standard No. 1910.27 for fixed ladders.
- B. Steel Ladders:
 - 1. Space siderails 18 inches apart unless otherwise indicated.
 - 2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
 - 3. Rungs: 1-inch- square steel bars.
 - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 5. Provide nonslip surfaces on top of each rung.
 - 6. Galvanize ladders, including brackets.

2.9 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.10 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Galvanize loose steel lintels located in exterior walls.
- C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.11 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.

2.13 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer unless indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 055119 - METAL GRATING STAIRS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes industrial-type, straight-run stairs with steel-grating treads and railings attached to metal grating stairs.

1.2 ACTION SUBMITTALS

- A. Product Data: For metal grating stairs.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments.
- C. Delegated-Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs and railings.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Load: 100 lbf/sq. ft..
 - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
- C. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: 1.5.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- E. Wire Rod for Grating Crossbars: ASTM A 510.
- F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- G. Cast-Abrasive Nosings: Cast iron, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both.

2.3 FASTENERS

- A. Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
- B. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 4 welds: good quality, uniform undressed weld with minimal splatter.

- C. Fabricate joints that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Industrial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
 - 1. Fabricate stringers of steel plates or channels.
 - a. Provide closures for exposed ends of channel stringers.
 - 2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements indicated.
 - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.
- C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
 - 1. Fabricate treads and platforms from welded or pressure-locked steel grating with openings in gratings no more than 5/16 inch in least dimension.
 - 2. Surface: Plain.
 - 3. Finish: Shop primed.
 - 4. Fabricate grating treads with cast-abrasive nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

2.7 STAIR RAILINGS

- A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings."
 - 1. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
 - 2. Connect posts to stair framing by direct welding unless otherwise indicated.

2.8 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- B. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.2 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055119

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Steel pipe and tube railings.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Manufacturer's product lines of mechanically connected railings.
 2. Railing brackets.
 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Pipe and Tube Railings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Wagner, R & B, Inc.
 - b. Julius Blum and Co.
 - c. McNichols.
 - d. Approved equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

- A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.4 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
- B. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 FABRICATION

- A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- B. Form work true to line and level with accurate angles and surfaces.
- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- D. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- E. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- F. Form changes in direction by bending or by inserting prefabricated elbow fittings.

- G. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- H. Close exposed ends of railing members with prefabricated end fittings.
- I. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- K. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
 - 1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

2.8 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize steel railings, including hardware, after fabrication.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

3.2 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members.

3.3 ATTACHING RAILINGS

- A. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
 - 5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
 - 6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.4 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055213

SECTION 055313 - BAR GRATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes metal bar gratings and metal frames and supports for gratings.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Clips and anchorage devices for gratings.
 - 2. Paint products.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For gratings, including manufacturers' published load tables.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. BarnettBates Corporationated Design: Engage a qualified professional engineer, as defined in .
- B. Fisher & Ludlow; a NUCOR Company
- C. Ohio Gratings, Inc.
- D. Approved Equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Floors: Uniform load of 125 lbf/sq. ft. or concentrated load of 2000 lbf, whichever produces the greater stress.
 - 2. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft..
 - 3. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft..
 - 4. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. or concentrated load of 8000 lbf, whichever produces the greater stress.
 - 5. Limit deflection to L/360 or 1/4 inch, whichever is less.

- B. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

- 1. Component Importance Factor: 1.5.

2.3 METAL BAR GRATINGS

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual" and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

- B. Welded Steel Grating:

- 1. Bearing Bar Spacing: 7/16 or 1/2 inch o.c.
 - 2. Bearing Bar Depth: 1-1/2 inches.
 - 3. Bearing Bar Thickness: As required to comply with structural performance requirements.
 - 4. Crossbar Spacing: 4 inches o.c.
 - 5. Traffic Surface: Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive.
 - 6. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.

2.4 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

- B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

2.5 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

- B. Post-Installed Anchors: Torque-controlled expansion or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.7 FABRICATION

- A. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- B. Fit exposed connections accurately together to form hairline joints.

2.8 GRATING FRAMES AND SUPPORTS

- A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
 - 1. Unless otherwise indicated, fabricate from same basic metal as gratings.
 - 2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.
- B. Galvanize steel frames and supports in the following locations:
 - 1. Exterior.
 - 2. Interior.

2.9 STEEL FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- B. Fit exposed connections accurately together to form hairline joints.
 - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Attach toeplates to gratings by welding at locations indicated.

- D. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055313

SECTION 057000 – ORNAMENTAL METAL RESTORATION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Work of this section shall include but is not limited to the protection and restoration of the cast iron, brass, and bronze ornament as noted on the Contract Drawings.
- B. Restoration of the metals may include but is not limited to:
 - 1. Disassembly of metal ticket window screens.
 - 2. Material replication and replacement of damaged or missing brass or bronze elements
 - 3. Replacement of missing or damaged fasteners for all metals,
 - 4. Coating removal from cast iron elements
 - 5. Corrosion removal from all metals
 - 6. Cleaning and refinishing brass and bronze
 - 7. Cleaning and repainting cast iron as noted on Contract Drawings.

1.2 REFERENCED SECTIONS:

- A. Section 040140 Interior Masonry Restoration
- B. Section 042116 Interior Brick and Tile Restoration
- C. Section 060140 Architectural Woodwork Restoration

1.3 REFERENCES:

- A. Materials and work shall conform to the latest editions of reference specifications listed below, specified herein and to all applicable codes and requirements of local authorities having jurisdiction, whichever is more stringent.
 - 1. The National Association of Architectural Metal Manufacturers (NAAMM).
 - 2. American Society for Testing and Materials (ASTM).
 - 3. SSPC-PA 1 “Painting Application Specification,” Steel Structures Painting Council – “Shop, Field and Maintenance Painting, Steel Structures Painting Manual,” Vol. 2.

4. National Park Service Preservation Briefs: "The Maintenance and Repair of Architectural Cast Iron," Preservation Brief #27, Preservation Assistance Division, NPS, 1991.
5. *Metals in America's Historic Buildings: Uses and Preservation Treatments* published by the U.S. Department of the Interior, National Park Service, Preservation Assistance Division.
6. Materials shall conform to governing regulations regarding the content of volatile organic compounds.

1.4 JOB CONDITIONS:

- A. All chemical materials shall be safe in use and shall not violate City, State or Federal environmental safety regulations.
- B. Perform all work of this Section in accordance with all City, State and Federal regulations regarding the transportation, storing, handling, application, removal and disposal of the products involved.
- C. Confirm surface temperature of iron surfaces prior to painting or installation of filler compounds. Do not paint or use filler compounds if surface temperature falls below or rises above that recommended by the painting manufacturer.
- D. Materials shall only be used at the manufacturer's recommended temperature allowances as outlined in the manufacturer's product data sheets.

1.5 QUALITY CONTROL:

- A. Ornamental Metals Restoration Specialist: The Contractor or Subcontractor who shall perform the work specified in this section must be classified by the State.
- B. The Contractor or Subcontractor shall maintain a steady work crew consisting of skilled craftspeople who are experienced with the materials and methods specified and familiar with the design requirements, and a foreman who has acceptable experience in metal restoration. The Contractor or Subcontractor shall confirm that all workers under his/her direction fully understand the requirements of the job. The Contractor/Subcontractor shall allow for inspection of all work areas by Resident Engineer following completion of the work.
- C. The Architect reserves the right to visit the facilities of the Subcontractor at any time when the work is in progress. All shop and field materials and workmanship shall be subject to inspection by the Architect and his representatives at all times. Such inspections do not relieve the Contractor from obligations to provide materials conforming to all requirements of the Contract Documents.
- D. Contractor shall replace all broken, lost, stolen and damaged cast iron and associated metal work resulting from repair, removal, transportation, cleaning or storing at no expense to the State.

- E. In acceptance or rejection of this work, no account shall be taken for incompetence on the part of the contractor.
- F. Confirm specified dry mil thickness of applied primer with standard equipment recognized by the industry for determining the thickness of painted coatings.

1.6 SUBMITTALS:

- A. Product Data: Submit all Manufacturers' technical data for all products to be used in this project. Submittal shall include instructions for use, application and all MSDSs.
- B. Restoration Program. Submit a written program for each phase of the restoration process including protection of the surrounding materials on the building and the site during operations. Describe in detail materials, methods and equipment to be used for each phase of the restoration work.
- C. If alternate methods and materials to those specified are proposed for any phase of the metal restoration work, provide a written description. Provide evidence of successful use on comparable projects and demonstrate its effectiveness for use on this project.
- D. Shop Drawings
 - 1. Shop Drawings shall be complete submissions for approval.
 - 2. Where applicable, verify field dimensions and include them on shop drawings showing exact locations of bronze or brass elements as well as shapes and dimensions for pieces requiring replacement.
 - 3. Provide reproducible copies of approved shop drawings for State's Representative's use.
 - 4. Shop drawings required within two weeks for review by Architect.
- E. Containment and disposal plans for coating removal in accordance with all applicable codes for lead abatement, if required.
- F. Coating removal plan for any abrasive media blasting on cast iron, including:
 - 1. Detailed work plan describing abrasive coating removal equipment, proposed blasting media, proposed psi, method of containment, and collection.
 - 2. Work Samples of proposed blasting media.
 - 3. Manufacturer's data on blasting equipment and blasting media.
- G. Mock-ups

1. Complete one (1) mock-up of the corrosion removal and cleaning for bronze. The mock-up if approved can be incorporated into the finished work. If the mock-up is not approved, a new mock-up will be produced until it is approved by the Architect or Architect's Representative.
2. Complete one (1) mock-up of the corrosion removal and cleaning for brass. The mock-up if approved can be incorporated into the finished work. If the mock-up is not approved, a new mock-up will be produced until it is approved by the Architect or Architect's Representative.
3. Complete one (1) cast iron coating removal test consisting of 2-3 paint removal products and methods to determine the most successful product or method for removal of painted coating. Products and methods may consist of chemical paint removers or abrasive cleaners. Submit list of products and methods to Architect prior to testing.
4. Complete one (1) mock-up of the coating and corrosion removal for cast-iron. The mock-up, if approved can be incorporated into the finished work. If the mock-up is not approved, a new mock-up will be produced until it is approved by the Architect or Architect's Representative.
5. Produce a mock-up of the wax finish over the antiqued bronze finish. The mock-up if approved can be incorporated into the finished work. If the mock-up is not approved, a new mock-up will be produced until it is approved by the Architect or Architect's Representative.
6. No test panels shall be made until the methods and locations are approved by the Architect or the Architect's Representative.
7. The Architect or the Architect's Representative will be present during the creation of all test panels and mock-ups. Do not proceed with the work unless the Architect or Representative is present. Notify the Architect not less than forty-eight (48) hours in advance.
8. All procedures, dwell times, and materials are subject to modification by the Architect or the Architect's Representative during the testing process. The Architect or the Architect's Representative shall choose products to be used for cleaning based on the results of the test panels. Modifications of sequence, chemical dilution, substitute reagents, and equivalent procedures shall be executed at no additional cost to the State or impact to the schedule.
9. Repeat demonstrations and testing procedures until the Architect's or the Architect's Representative's requirements are satisfied.
10. Allow waiting period of duration indicated, but not less than seven (7) calendar days, after completion of sample cleaning to permit study of sample panels for negative reactions.

11. After the completion of the testing phase, and before general cleaning begins, prepare mock-up panels in the station, as indicated, where directed by the Architect or the Architect's Representative. Obtain the Architect's or the Architect's Representative's written acceptance of visual qualities before proceeding with the work.

1.7 SAMPLES:

- A. Submit bronze coupon with proposed restoration bronze finish. Bronze in bronze coupon submitted is to match the existing bronze.
- B. Submit samples of replacement bronze hardware, anchors and fasteners. Profile of fasteners must match original. No ferrous metals are to be used.
- C. Submit samples and color cards of cast iron finish color matching existing finish.
- D. Tagging: Samples shall be tagged with the name of the project and referenced specification.
- E. Two weeks from date received shall be allowed for thorough examination of the samples by the Architect.
- F. Not returnable: Samples are not returnable, nor included in quantities listed for a project.

PART 2 - PRODUCTS

2.1 PRODUCT QUALITY:

- A. All materials, accessories, and other related fixture parts shall be new and free from defects which in any manner may impair their character, appearance, strength, durability or function. They shall be effectively protected from any damage or injury from the time of fabrication to the time of delivery and until final acceptance of work.
- B. All products used in the Work of this Section shall be the highest available quality.

2.2 CLEANING PRODUCTS:

- A. Solvents: Use the lowest toxicity solvent possible.
 1. Denatured Alcohol: E.Z. Alcohol, Pure 180 proof denatured alcohol, as manufactured by E.E. Zimmerman Co., Pittsburgh, PA 15238, or approved equal.
 2. Mineral Spirits: As manufactured by Ashland Chemical, Inc., Carteret, NJ. Or approved equal.
 3. Paint Thinner: 100% petroleum distillate, mineral spirits, U.S. Paint Thinner, as manufactured by Recochem Inc., Montreal, Quebec, or approved equal.
 4. Turpentine: Pure gum spirits of turpentine meeting requirements of ASTM D-13.

- B. Paint Removal:
 - 1. Dumond Peel Away 7
 - 2. Dumond SmartStrip Pro
 - 3. Prosoco SafStrip
 - 4. Prosoco SafStrip 8
 - 5. Cathedral Stone MasonRE S-301
 - 6. or approved equal.
- C. pH neutral detergent such as Orvus WA Paste, or approved equal.
- D. Water for cleaning shall be clean, potable, and free of oils, acids, alkalis, salts and other organic matter.
- E. Wax: microcrystalline wax.
- F. Surface pH meter or pH testing strips available from Talas Online (www.talasonline.com), or approved equal.

2.3 TOOLS:

- A. Wood scrapers.
- B. Felt pads.
- C. Super Fine bronze steel wool, #0000
- D. Soft natural-bristle brushes.
- E. Clean, soft lint free cloths.
- F. Vacuum with HEPA filter.

2.4 ABRASIVE CLEANING EQUIPMENT:

- A. Cast iron corrosion removal equipment
 - 1. Sandblasting machine capable of achieving and maintaining a constant pressure. Pressures used shall be those approved during the mock-up phase.
 - 2. Abrasive necessary to achieve the approved sandblasted finish.

2.5 PAINT

- A. Primer: At minimum, an alkyd rust-inhibitive primer, Tnemec Series 10 or approved equal should be used. Two coats must be applied. A high performance zinc rich primer could also be used but it requires a cleaner surface.
- B. Finish Coat: Alkyd enamel, urethane or approved equal. The Contractor shall provide color to match existing finish color as per approved color samples.

PART 3 - EXECUTION

3.1 GENERAL:

- A. A thorough and careful inspection must be made of the bronze before the work is started. Any defects or anomalies must be brought to the attention of the Architect and State prior to the commencement of the work.
- B. Provide products as indicated.
- C. Ensure substrates are in suitable condition to receive the Work of this Section. Protect adjacent materials and surfaces from damage during the Work of this Section.

3.2 CHEMICAL PAINT REMOVAL PROCEDURES

- A. General:
 - 1. Comply with all Federal, state, and local VOC regulations.
 - 2. Where any manufacturer listed makes more than one grade of each material specified, use the highest grade of each type whether or not the material is mentioned by trade name in these specifications.
 - 3. Follow manufacturer's instructions regarding preparation of surfaces, mixing, applying, drying, etc. In case of conflict with this specification, the manufacturer's specifications govern.
- B. Apply paint remover in accordance with manufacturer's directions. Use application methods best suited for the type of material being applied: gel, paste or liquid.
- C. Apply gel, paste, semi-paste or liquid to dry surfaces 1/8" to 1/4" thick, using a corrosion resistant, plastic trowels or non-metallic brushes. Work paint remover well into crevices. Ensure that the paint remover is applied in an even coat.
- D. Allow remover to remain on the surface for time specified by manufacturer or until all paint is dissolved; whichever is the least amount of time. Do not leave surfaces until it dries. If surfaces are left unattended, prevent pedestrians from contact with the remover.

- E. If remover dries on the surface, mist the surface with water and allow chemical to remain on the surface another 15 minutes until softened. If leaving on the surface for several hours, a light polyethylene film or other moisture resistant material can be used to cover the remover on the surfaces. Press the polyethylene film against the remover so that it adheres. Tape or seal the edges of the polyethylene film.
- F. Carefully remove the chemical remover and dissolved paint coatings by lifting, making sure the substrate is not scraped or gouged. A plastic scraper must be used. Corrosion resistant tools can only be used for this removal. No metal is to be used. Remove as much residue from surfaces as possible.
- G. If small amounts of residue or paint remain, reapply chemical following the manufacturer's instructions.
- H. Multiple applications of the paint remover may be required to remove all of the paint coatings.
- I. Allow treated surfaces to thoroughly dry. Before applying any new surface coating, check cleaned surfaces again with pH strips that have a range from 1-14. to ensure that surfaces are neutral.
- J. The Architect must certify that the surfaces treated as the work of this section have been adequately cleaned and neutralized, prior to final acceptance of this work.
- K. Waste Disposal:
 - 1. Solid, liquid or semi-solid wastes generated through the use of a paint remover or stripper may be defined for Federal Standards under EPA's Resource Conservation and Recovery Act (RCRA) of 1976 as "solid waste". The waste is classified "hazardous" if it is determined to be corrosive, toxic, or both. All current Federal, state, and local regulations must be stringently followed regarding containment, transportation, and disposal of hazardous waste.
 - 2. Contractor shall obtain and maintain all applicable permits for this job.

3.3 ABRASIVE PAINT AND CORROSION REMOVAL PROCEDURES

- A. General:
 - 1. Operate machinery in accordance with manufacturer's recommendations and approved mock-up.
 - 2. Provide suitable containment to protect pedestrians as well as adjacent materials from blasting media and paint.
- B. Following abrasive cleaning, remove all residual loose paint, corrosion, and scale from ironwork to remain in place with wire brushes. Sand smooth using vacuums on the sanders

to contain paint dust. Take all other necessary precautions to avoid releasing lead dust into the air.

3.4 BRONZE AND BRASS CLEANING:

- A. Clean all bronze and brass surfaces using pH neutral detergent, felt pads and super-fine steel wool, and clean water to remove all corrosion product and residues from the surface of the bronze. Surface should have uniform, smooth appearance free from abrasions or discoloration in accordance with approved Mockups.
- B. Dry surfaces using clean cloths and protect surfaces to maintain dry conditions until surfaces can be finished with protective wax coating. Surface must be clean and dry prior to application of wax coating.

3.5 REPLACEMENT OF MISSING OR DAMAGED ELEMENTS:

- A. Fabricated elements must match the existing elements in size, shape, and finish.
- B. Remove damaged elements taking care not to damage adjacent materials.
- C. Cut new elements or trim to fit.
- D. Attach new elements securely with approved anchors or fasteners.

3.7 APPLICATION OF HOT-WAX COATING:

- A. Hot wax all bronze and brass surfaces with a microcrystalline wax for a protective coating. Thoroughly coat surface until the coating is even and well-adhered. Gently buff surface, dry coat, and re-buff.

3.8 FIELD PAINTING

- A. General:
 - 1. No painting shall be done when the air is dust-laden or when weather and temperature conditions are unsuitable. Exterior painting shall not be done in damp or rainy weather, nor when the temperature is below 50° F or above 80° F.
 - 2. All work shall be done in a workmanlike manner and by skilled mechanics. All paint shall be evenly spread, smoothly flowed on, and shall be free from defects. No paint shall be applied until preceding coat is thoroughly dry and hard. Finish surfaces shall be uniform.
 - 3. In general and unless otherwise specified, exterior oil paints shall be allowed to dry at least 72 hours between coats.

4. Paint and finish materials shall be free from skins, lumps and foreign matter when used, and pigmented fillers and other materials shall be kept well stirred while materials are being applied.
- B. Surface Preparation: Thoroughly clean and dry all metal surfaces before applying primer. Prepare metal surfaces as follows:
1. Abrasive blast all metal to SSPC SP-6 “Commercial Blast Cleaning” Standard. Remove all dust and grease and prime immediately.
 2. In areas where abrasive blasting is not practical, the Contractor may use power tool cleaning with precautions taken to ensure that no lead dust is released into public spaces. The Contractor is to notify the Architect and the Architect’s approval prior to proceeding
 - a. Prepare metal for painting to SSPC SP-11 “Hand Tool Cleaning” standard, remove all dust and prime immediately.
- C. Finish coatings: All primer coatings must be dry and clean prior to application of finish coatings.
- D. Remove all corrosion and touch up with two coats of primer prior to applying two coats of paint.

3.9 SITE CLEAN UP

- A. Keep the site clean and remove all debris to ensure clean painted surfaces.
- B. As needed, use natural bristle brush with water. Use of muriatic acid or any acid-based masonry cleaners is prohibited.

END OF SECTION

SECTION 057330 - DECORATIVE METAL GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel and iron decorative gates.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of railings assembled from standard components.
 - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.
- C. Samples: For each type of exposed finish required.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For post-installed anchors, from ICC-ES.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.

2.2 METALS, GENERAL

- A. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.3 STEEL AND IRON

- A. Tubing: ASTM A 500/A 500M (cold formed) or ASTM A 513.

- B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.4 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
 - 2. Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
 - 3. Dissimilar Metals: Type 316 stainless-steel fasteners.
- B. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
 - 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

- A. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.

1. Fabricate items of material, size, and dimensions indicated. Preassemble items in shop to the greatest extent possible. Design components to allow for expansion and contraction for a minimum ambient temperature range of 100 degrees F.
2. Form metal work to required shapes and sizes, with true lines, angles and curves. Provide necessary rebates, lugs, brackets, flanges, fasteners, and anchors for assembly and installation. Use concealed fasteners where possible.
3. Provide welds behind finished surfaces without distortion or discoloration on exposed side. Clean and dress welds on exposed and contact surfaces.
4. Mill joints to tight, hairline fit. Cope or miter corners. Form joints exposed to weather to exclude water penetration.
5. Where cutting, welding, and grinding are required for proper shop fitting and jointing, restore finishes to eliminate evidence of such corrective work.

2.7 STEEL AND IRON FINISHES

- A. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." or SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- B. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
- C. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
 1. Color: As selected by Architect from manufacturer's full range to match existing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set gates accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- D. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members.

- E. Anchor railing ends to concrete and masonry with flanges connected to railing ends and anchored to wall construction with anchors and bolts.
- F. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION 057300

SECTION 060140 – ARCHITECTURAL WOODWORK RESTORATION

I. PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Work of this section shall include but is not limited to the protection and restoration of the wood trim, doors, door frames, windows and window frames as noted on the Contract Drawings. "Restoration" shall include returning all doors and windows to operable status.
- B. Treatment shall include assessment of the operability of all doors and windows.
- C. Restoration of the woodwork may include but is not limited to Dutchman repairs, scratch and crack repairs, removal of fasteners and hardware, filling of holes, finish restoration, and material replication and replacement, as noted on Contract Drawings.

1.2 RELATED SECTIONS:

- A. Section 026000 Miscellaneous Hazardous Materials Removal
- B. Section 028501 Mold Remediation
- C. Section 040140 Interior Masonry Restoration
- D. Section 057000 Ornamental Metal Restoration

1.3 CITED STANDARDS:

- A. The Quality Standards, latest edition of the Architectural Woodwork Institute (AWI) shall apply to the work of this section. Except as otherwise indicated, provide "Premium Grade" work as defined in the above-referenced standard for all Architectural woodwork.
- B. All work shall comply with the United States Secretary of the Interior Standards for Rehabilitation and guidelines for Rehabilitating Historic Buildings, unless otherwise stated.

1.4 NOTED RESTRICTIONS:

(None noted)

1.5 QUALITY CONTROL:

- A. Restoration Specialist: The Contractor who will perform the work specified in this section must be classified by the State.

- B. Field Supervised Construction: Contractor shall notify Architect before beginning work. Obtain the Architect's approval of the installation of restored woodwork, before proceeding with the work.
- C. Materials shall conform to the latest edition of reference specifications applicable and specified herein and to applicable codes and requirements of local authorities having jurisdiction.
 - 1. Materials shall conform to governing regulations regarding the content of volatile organic compounds (VOC).
 - 2. Finishing materials and work shall conform to the Painting and Decorating Contractors of America (PDCA).
 - 3. The Contractor shall comply with relevant ASTM Standards for all materials.
 - 4. All wood restoration procedures shall be done in accordance with regulations, safety standards and in requirements of all federal, state and local authorities having jurisdiction over the work including but not limited to the applicable standards for protecting the public and control of pollutants and OSHA regulations for the protection of workers and the public.
- D. Mechanics: Contractor shall maintain a steady work crew consisting of skilled craftspeople that are experienced with the materials and methods specified. The Contractor shall confirm that all workers understand the job's requirements.
- E. Foreperson shall be present on site daily, and whenever work is being performed.

1.6 SUBMITTALS:

- A. Product Literature: Submit three (3) copies of manufacturer's latest published technical data including, installation instructions and general recommendations for each specified material and fabricated product. Include test reports and certificates substantiating the product's compliance with the specified requirements. Obtain approval before materials are delivered to the site.
- B. Methods of Protection: Prior to commencing the protection and restoration, the Contractor shall submit a written description of proposed materials and methods of protection for preventing damage to any adjacent material or finish during the protection, removal, restoration and installation of the woodwork.
- C. Method of Restoration: The Contractor shall submit a written description of proposed method for restoring each area of woodwork.
- D. Submit three (3) samples of new wood for repairs with and without restored finish for each area of refinishing as shown on drawings. Provide full range of color to be found in final finished product.
- E. Submit three (3) samples of new wool-blend felt for ticket windows.

- F. Timely submission shop drawings shall be submitted in reproducible form for all woodwork and shall be received no later than sixty days after award of Contract.
- G. Shop Drawings
 - 1. The Contractor shall submit complete shop drawings of all architectural woodwork to the Architect for approval. The Drawings shall include dimensioned elevations and sections as well as full size details of all typical members and joinery, types of materials, and shall show hardware and methods of securing and fastening members to adjacent work.
 - 2. Shop drawings shall clearly indicate any deviation from designs or details of the existing woodwork.
 - 3. All dimensional information contained in the drawings, whether numerical, tabular, or graphic is provided only for the information of the Contractor, and is not guaranteed. Contractor shall verify all measurements in the field.
 - 4. Drawings shall clearly show proposed modification and alterations of salvaged woodwork to be completed prior to reinstallation.
- H. Schedule: The Contractor shall submit a schedule of work to the Architect. The schedule shall show all salvaged woodwork, and include finishes, wood types, locations, dimensions, and types of repair or replacement of each element prior to reinstallation. The schedule shall indicate the time of completion of each task.

1.7 MOCK-UPS:

- A. Prepare one mockup at area(s) designated by Architect for each repair and replication type indicated in this Section unless otherwise indicated.
- B. Wood Putty Repairs: Provide three (3) samples of tinted wood putty for each type of wood finish.
- C. Finish Restoration: Prepare three (3) samples using materials and methods specified for each type of finish. The new finish shall match the original in color, transparency, and reflectance quality. Following any revisions requested by Architect, the approved sample shall form a quality standard for all further work.
- D. Dutchman Repair: Prepare one (1) Dutchman repair at base of door frame as indicated on drawings.
- E. All finish mock-ups will be a minimum of 1'-0" x 1'-0" except where specifically approved by the Architect.
- F. Mock-ups must be approved by Architect before the work may proceed. Provide additional sample panels, as may be required by Architect. The approved panels shall not be removed until so directed by Architect.

- G. No work will be accepted until it conforms in every respect to the finished sample.
- H. Protect mockups for the duration of the job. Samples and mockups submitted which are approved by Architect shall remain as a record at the worksite until the work is completed and approved by the Architect.
- I. Mock-ups may be incorporated into the finished work.

1.8 MATERIAL DELIVERY, STORAGE AND PROTECTION:

- A. All materials salvaged from the Site shall be stored to insure protection from loss, theft, or damage by the elements.
- B. Salvaged, repaired woodwork shall not be delivered to the site until ready to be installed.
- C. No kiln-dried materials shall be placed in the building unless the building is sufficiently dry.
- D. Deliver packaged material in original unbroken packages with the manufacturer's name, brand and material standard indicated plainly thereon.
- E. Store and handle all material in a manner as to prevent damage by water or water vapor.
- F. Replace all broken, lost and damaged adjacent material resulting from repair, removal, cleaning, and finishing of all woodwork under this section at no expense to the State.
- G. All Subcontractors are bound by the same requirements as the Contractor. Subcontractors shall not begin work unless approved by the Architect.
- H. Take all necessary precautions to protect all persons (whether engaged in the work of this Section or not) from all hazards of any kind associated with the work of this Section.
- I. Take all necessary precautions to protect all property and materials (whether subject to the work of this Section or not) from any harm or damage associated with the work of this Section.
- J. Perform all work of this Section in accordance with all Federal, State, and local regulations regarding the transportation, storing, handling, application, removal and disposal of the products involved.
- K. Take all necessary precautions to prevent fire and spread of fire.

II. PART 2 - PRODUCTS

2.1 BASIC REQUIREMENTS:

- A. The grades of all materials under this section shall be as defined by the rules of the recognized association of lumber manufacturers producing the materials specified. Wood

for millwork shall conform to, or exceed, the requirements of "Premium Grade, Class 1 " as established by Quality Standards or the Architectural Woodwork Institute (AWI) and shall be provided in the cuts and figure required to match existing wood. Where conflicts occur between these standards and this Specification, the more stringent requirement shall govern in each case.

- B. Lumber and finished woodwork throughout shall be of sound stock, thoroughly seasoned, free from all knots, and if new, kiln-dried to a moisture content not exceeding 6–11% for millwork.
- C. Work that is to be finished shall be free from defects or blemishes on surfaces exposed to view that will show after the finish coat of varnish or paint is applied. Any materials which are in any way defective and do not meet specifications for quality and grade, or are otherwise not in proper condition, shall be rejected.

2.2 CLEANING MATERIALS:

- A. Cleaning Pads: Scotch-Guard Red Pads, or approved equal.
- B. Cleaning Pads: 0000 steel wool, clean and free of contaminants and corrosion.
- C. Clean, lintless cotton rags and cheesecloth.

2.3 PUTTIES, ADHESIVES, AND FASTENERS:

- A. Fillers for holes and losses in wood: Pigmented oil base putty formulated specifically for use on wood. Provide "Color Putty." Mix different colors of putty to match color of finished wood.
- B. All glues shall be non-staining waterproof wood glues as manufactured by 3M Company, Pittsburgh Plate Glass Company, Borden Company, or approved equal.
- C. Provide all new screws to match existing.
- D. Provide new nails and brads to match existing
- E. For Felt installation use edge-glue, such as 3M Fast Bond 10, or approved equal.

2.4 FINISH MATERIALS:

- A. Solvents
 - 1. Denatured Alcohol: E.Z. Alcohol, Pure 180 proof denatured alcohol, as manufactured by E.E. Zimmerman Co., Pittsburgh, PA 15238, or approved equal.
 - 2. Mineral Spirits: As manufactured by Ashland Chemical, Inc., Carteret. NJ. Or approved equal.

3. Paint Thinner: 100% petroleum distillate, mineral spirits, U.S. Paint Thinner, as manufactured by Recochem Inc., Montreal, Quebec, or approved equal.
 4. Turpentine: Pure gum spirits of turpentine meeting requirements of ASTM D-13.
- B. The Contractor shall match the existing varnish colors for the benches using varnish available from Sherwin-Williams Co., or approved equal, as per approved mockup.

2.5 MISCELLANEOUS

A. Provide new wool-blend felt for ticket windows.

1. Felt shall be blend of wool and Teflon, with a minimum weight of 19oz. per yard of fabric.
2. Manufacturers:
 - a. Championship, LLC, 1001 Morse Avenue, Elk Grove Village, IL 60007. 1-800-323-2852.
 - b. Simonis Cloth, 1931 Industrial Drive, Libertyville, IL 60048. 1-800-746-6647.
 - c. Or approved equal.

III. PART 3 - EXECUTION

3.1 GENERAL:

A. Field Conditions

1. Take all necessary field measurements and verify all installation conditions prior to ordering and fabrication of material.
2. Existing Conditions and Documents: The Contractor shall visit the site and shall examine the drawings and specifications for the material of the various surfaces and the extent of repair work and finishes.
3. Contractor shall inspect each door and window for operability prior to beginning work.
4. Coordinate work with other trades as required during salvage and restoration operations.

B. Remove and label existing hardware and fixtures.

1. Remove all extraneous nails, staples, bolts, hooks, etc. from woodwork. Fill resulting holes, gouges and indentations, and sand smooth with approved filler material.

3.2 RESTORATION METHODS:

A. Coating Removal:

1. Remove existing polyurethane finish to bare wood using denatured alcohol and fine steel wool.
2. Prior to refinishing, remove all dust and residue from the surfaces using a vacuum and clean rags.

B. Crack and hole filling:

1. Replace all missing or otherwise defective wood in kind unless approved by Architect. Finished woodwork shall be fully intact and structurally sound.
2. Patch holes, indentations gouges, etc. using wax crayon touch up stick for holes less than 1/16" X 1/16" and wood filler for holes between 1/16" and 1" wide and 1/2" deep. For holes larger than 1" X 1" X 1/2" deep, use Dutchmen repairs.

C. Replacement and reattaching of missing or loose elements

1. Fabricate all new woodwork in the areas designated on the Drawings.
2. For damaged wood located behind bronze-clad windows, fabricate new woodwork once condition of wood substrate has been assessed by Architect or Architect's Representative.
3. New woodwork shall match the original wood species, grain and profile, as specified.
4. Attach elements with waterproof adhesive and secure with clamps until dry.
5. If warped or damaged wood cannot be straightened and secured, replace with new woodwork.
6. Finish the new woodwork to match the proposed finish on the original woodwork and millwork.

3.3 Dutchman Repairs

A. Repair deteriorated, spongy, split, or missing wood with Dutchman repairs where indicated on drawings. Use the following procedure for Dutchman repairs:

1. Neatly cut out defective materials and enough sound wood to bond Dutchman to sound substrate. Form a prismatic void in existing wood with square corners and

edges. Cut Dutchman to exactly fit void, with exposed portion matching original profile of woodwork, and grain of Dutchman parallel to original wood grain direction.

2. Secure Dutchman with waterproof adhesive and clamp in place until glue is set.
3. Where it is necessary to cut off an end of a component and install Dutchman, use a diagonal scarf joint for end-to-end joints.

B. Sand to smooth surface.

3.4 REFINISHING

A. General:

1. All surfaces shall be properly prepared to receive clear finishes, including thorough cleaning of all grime, grease, dirt, loose material and other substances that may interfere with proper adhesion of finish. All surfaces to be finished shall be dry. Allow several days for the wood surfaces to dry after stripping procedures.
2. The starting of the work under this section will be construed as acceptance of such surfaces as being satisfactory, and any defects to his work resulting from such accepted surface will be corrected by the Contractor at his own expense.
3. Remove all imperfections in the previous coat before the subsequent coat is applied.
4. Provide protection sufficient to protect adjacent work and materials.

C. Refinishing:

1. Apply a minimum of 2 layers of approved varnish in accordance with approved mockups.

3.5 FELT MATS

- A. Cut fabric to fit dimensions of felt cut-out on wood surface. Make sure edges are smooth.
- B. Apply smooth layer of adhesive to back of fabric (rough side)
- C. Install fabric and smooth out all ripples. Stretch fabric so that surface is taut.

END OF SECTION

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.
2. Plywood backing panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Provide dressed lumber, S4S, unless otherwise indicated.

- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- C. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.
 - 2. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.

2. Nailers.

- B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber of any species.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine, No. 2 or No. 3 grade; SPIB.
 - 2. Eastern softwoods, No. 2 or No. 3 Common grade; NELMA.
 - 3. Northern species, No. 2 or No. 3 Common grade; NLGA.
 - 4. Western woods, Standard or No. 3 Common grade; WCLIB or WWPA.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1,, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Power-Driven Fasteners: NES NER-272.
- C. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit.
- B. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- E. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 070150.19 - PREPARATION FOR REROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Re-cover preparation of roof areas indicated.
 - 2. Removal of base flashings.

1.2 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.
- B. Roof Re-Cover Preparation: Existing roofing system is to remain and be prepared for new roof installed over it.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Temporary Roofing Submittal: Product data and description of temporary roofing system. If temporary roof remains in place, include surface preparation requirements needed to receive permanent roof, and submit a letter from roofing manufacturer, stating acceptance of the temporary roof and that its inclusion does not adversely affect the roofing system's resistance to fire and wind or its FM Global rating.

1.4 INFORMATIONAL SUBMITTALS

- A. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Approved by warrantor of existing roofing system to work on existing roofing.
- B. Reroofing Conference: Conduct conference at Project site.

1.6 FIELD CONDITIONS

- A. The State will occupy portions of building immediately below reroofing area. Conduct reroofing so The State's operations are not disrupted. Provide The State with not less than 72 hours' notice of activities that may affect The State's operations.
 - 1. Coordinate work activities daily with the State and place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.
 - 2. Before working over structurally impaired areas of deck, notify The State to evacuate occupants from below affected area. Verify that occupants below work area have been evacuated before proceeding with work over impaired deck area.
- B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- D. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

PART 2 - PRODUCTS

2.1 INFILL AND REPLACEMENT MATERIALS

- A. Use infill materials matching existing roofing system materials unless otherwise indicated.

2.2 RE-COVER BOARDS

- A. Re-Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate; 1/4 inch thick.
- B. Fasteners: Factory-coated steel fasteners, No. 12 or No. 14, and metal or plastic plates listed in FM Global's "Approval Guide," designed for fastening re-cover boards to deck and acceptable to new roofing system manufacturer.

2.3 AUXILIARY REROOFING MATERIALS

- A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing and new roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Shut off rooftop utilities and service piping before beginning the Work.
- B. Protect existing roofing system that is not to be reroofed.
- C. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.
- D. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.

3.2 ROOF TEAR-OFF

- A. General: Notify Owner each day of extent of roof tear-off proposed for that day and obtain authorization to proceed.
- B. Remove aggregate ballast from roofing.
- C. Remove loose aggregate from aggregate-surfaced built-up bituminous roofing using a power broom.
- D. Remove pavers and accessories from roofing.
- E. Full Roof Tear-Off: Where indicated, remove existing roofing and other roofing system components down to the deck.
 - 1. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry. Remove unadhered bitumen, unadhered felts, and wet felts.
 - 2. Remove excess asphalt from steel deck. A maximum of 15 lb/100 sq. ft. of asphalt is permitted to remain on steel decks.
 - 3. Remove fasteners from deck or cut fasteners off slightly above deck surface.

3.3 DECK PREPARATION

- A. Inspect deck after tear-off of roofing system.
- B. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 or by pouring 1 pint of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane. Do not proceed with roofing work if moisture condenses under plastic sheet or if asphalt test sample foams or can be easily and cleanly stripped after cooling.

- C. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Architect. Do not proceed with installation until directed by Architect.
- D. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect. Do not proceed with installation until directed by Architect.

3.4 INFILL MATERIALS INSTALLATION

- A. Immediately after roof tear-off, and inspection and repair, if needed, of deck, fill in tear-off areas to match existing roofing system construction.
- B. Install new roofing patch over roof infill area. If new roofing is installed the same day tear-off is made, roofing patch is not required.

3.5 ROOF RE-COVER PREPARATION

- A. Remove blisters, ridges, buckles, and other substrate irregularities from existing roofing that inhibit new re-cover boards from conforming to substrate.
 - 1. Remove loose aggregate from aggregate-surfaced built-up bituminous roofing with a power broom.
 - 2. Broom clean existing substrate.
 - 3. Coordinate with Owner's inspector to schedule times for tests and inspections before proceeding with installation of re-cover boards.
 - 4. Verify that existing substrate is dry before proceeding with installation of re-cover boards. Spot check substrates with an electrical capacitance moisture-detection meter.
 - 5. Remove materials that are wet or damp.

3.6 BASE FLASHING REMOVAL

- A. Remove existing base flashings. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.
- B. Do not damage metal counterflashings that are to remain. Replace metal counterflashings damaged during removal with counterflashings specified in Section 076200 "Sheet Metal Flashing and Trim."
- C. When directed by Architect, replace parapet framing, wood blocking, curbs, and nailers to comply with Section 061053 Miscellaneous Rough Carpentry."

3.7 RE-COVER BOARD INSTALLATION

- A. Install re-cover boards over roofing with long joints in continuous straight lines and end joints staggered between rows. Loosely butt re-cover boards together and fasten to deck.
 - 1. Tape joints of re-cover boards if required by roofing manufacturer.

- B. Fasten re-cover boards to resist wind-uplift pressure at corners, perimeter, and field of roof specified in Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing."

3.8 DISPOSAL

- A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION 070150.19

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Containment lining waterproofing system.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

B. Shop Drawings:

1. Show locations and extent of waterproofing.
2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis-of-Design Product: The design for system products is based on the following:
 - 1. Tnemec Company, Inc. Kansas City, MO. 800-863-6321
- B. Subject to compliance with requirements, provide materials of the following manufacturers:
 - 1. BASF Corporation.
 - 2. Neogard.
 - 3. Tremco Incorporated.
 - 4. Sherwin Williams.
 - 5. Approved equal.
- B. System Products: Provide the following Containment Lining system:
 - 1. Epoxy Primer, filler, surfacer to surface and repair concrete substrate and fill bugholes and eliminate outgassing:
 - a. Series 218 MortarClad, to serve as primer, filler, surfacer on walls and floors at 1/16" average dft. 217 Mortarcrete for deep holes and spalls from 1/4" to 3" deep. 215 Epoxy surfacer for overhead patching, all by Tnemec Company, Inc.
 - 2. Series 262 Elasto-Shield Modified Polyurethane lining on walls and floors: Spray in 1 continuous coat or Brush /Roller applied modified polyurethane 2-3-coats as necessary to achieved. (Total dft 50-60 mils).
 - 3. Ceilings: Tnemec Series 22 Epoxoline 2 coats (Total dft 24 mils).

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the areas and conditions where resinous flooring is to be installed and Correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected by The Contractor in a manner acceptable to the Architect.

3.2 SUBSTRATE PREPARATION

- A. Allow concrete to cure approx. 28 days. Abrasive blast concrete to open up air holes, and provide a texture equivalent to ICRI- CSP 4-5. Where open air abrasive blasting is not allowed, use 3000 psi pressure washer with injected or Black Beauty aggregate. Or use hand and power tools as necessary including electric bush hammers, rotary Bush hammers to achieve a CSP 4-5

- B. If there are honeycombs or deep voids noticed after pulling forms, these voids should be filled, with 217 after the surface prep described above. Fill with 218 on ceiling.

3.3 INSTALLATION

- A. Primer/Surfacer for Walls and Floor: 218 Mortar Clad, modified water-based epoxy cement at approx, 1/16" to 1/8" max. The purpose of the 218 is to serve as a primer to adhere to the prepared concrete, prevent outgassing of air from the concrete, fill minor air holes and provide an overall smooth surface for application of the flexible waterproofing coating.
- B. Waterproofing for Walls and Floor: Tnemec 262 Elasto-Shield at 50-60 mils dft. 262 can be applied by special spray equipment on walls or in 2-3 coats by roller. 262 is applied to floor using squeegee in 1 coat.
- C. Ceiling: 1st Coat: 1 coat Series 22 Epoxoline, amine cured, 100% solids epoxy at 12-15 mils dft applied by roller or spray.
 - a. Touch Up: After cure of the 1st coat of Series 22, which is approx 24 to 36 hours, inspect surface of the Series 22 for any discontinuities. After application of the Series 22, which is normally supplied in an off-white color, minor misses are usually easy to detect. At this point, fill any minor pits, or discontinuities with 215, 100% solids epoxy filler/surfacer.
 - b. 2nd Coat: 1 coat Series 22, amine cured, 100% solids epoxy at 12-15 mils dft applied by roller or spray.

3.4. APPLICATION REQUIREMENTS

- A. Epoxy coatings need dry, warm, pollution-free environments in order to cure properly. Urethane coatings require dry environments.
- B. Temperatures inside the tanks should be at least 55 degrees F, if not warmer. In addition to heat, dehumidification is very important to prevent condensation and a condition called "amine blush" which is prevalent in high solids epoxy coatings, especially 100% solid epoxies.

3.2 PROTECTION

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071416

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mineral-wool blanket.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research reports.

PART 2 - PRODUCTS

2.1 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.2 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
 - 2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.
- C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - 5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
 - a. Exterior Walls: Set units with facing placed toward interior of construction.
 - b. Interior Walls: Set units with facing placed toward areas of high humidity.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION 072100

SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS
MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing system.
2. Roof insulation.
3. Roof pipe support system.

1.2 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For the following products:
1. Cap sheet, of color required.
 2. Flashing sheet, of color required.
 3. Aggregate surfacing material in gradation and color required.
 4. Walkway pads or rolls, of color required.

1.5 INFORMATIONAL SUBMITTALS

- A. Research/Evaluation Reports: For components of membrane roofing system, from ICC-ES.
- B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is FM Global approved for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Firestone Building Products.
 - 2. Johns Manville; a Berkshire Hathaway company.
 - 3. Siplast, Inc.
 - 4. Approved equal.
- B. Source Limitations: Obtain components including roof insulation for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
- B. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- C. Roofing System Design: Tested by a qualified testing agency to resist the uplift pressures indicated on the drawings.

- D. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 - 1. Fire/Windstorm Classification: Class 1A-90.
 - 2. Hail-Resistance Rating: SH.
- E. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 ROOFING SHEET MATERIALS

- A. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft..
- B. Base Sheet: ASTM D 4601, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.
- C. Base Sheet: ASTM D 4897/D 4897M, Type II, venting, nonperforated, heavyweight, asphalt-impregnated and -coated, glass-fiber base sheet with coarse granule surfacing or embossed venting channels on bottom surface.
- D. Glass-Fiber Base-Ply Sheet: ASTM D 2178, Type IV, asphalt-impregnated, glass-fiber felt.
- E. Roofing Membrane Sheet: ASTM D 6164/D 6164M, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric); smooth surfaced; suitable for application method specified.
- F. Granule-Surfaced Roofing Cap Sheet: ASTM D 6164/D 6164M, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric); granule surfaced; suitable for application method specified, and as follows:
 - 1. Granule Color: White.
- G. Metal-Foil-Surfaced Roofing Cap Sheet: ASTM D 6298, metal-foil-surfaced SBS-modified asphalt sheet (reinforced with glass fibers); suitable for application method specified, and as follows:
 - 1. Foil Surfacing: Copper.

2.4 BASE FLASHING SHEET MATERIALS

- A. Backer Sheet: ASTM D 4601, Type II, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.
- B. Backer Sheet: ASTM D 6164/D 6164M, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric); smooth surfaced; suitable for application method specified.
- C. Granule-Surfaced Flashing Sheet: ASTM D 6164/D 6164M, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric); granule surfaced; suitable for application method specified, and as follows:
 - 1. Granule Color: White.
- D. Metal-Foil-Surfaced Flashing Sheet: ASTM D 6298, glass-fiber-reinforced SBS-modified asphalt sheet (reinforced with glass fibers); metal-foil surfaced; suitable for application method specified, and as follows:
 - 1. Foil Surfacing: Copper.

2.5 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Asphalt Primer: ASTM D 41/D 41M.
- C. Roofing Asphalt: ASTM D 312, Type III or IV as recommended by roofing system manufacturer for application.
- D. Cold-Applied Adhesive: Roofing system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with roofing membrane and base flashings.
- E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- G. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve, color to match roofing.

2.6 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1278/C 1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate, 1/4 inch thick.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.7 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
- B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
- C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.8 INSULATION ACCESSORIES

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- C. Insulation Cant Strips: ASTM C 728, perlite insulation board.

2.9 WALKWAYS

- A. Walkway Cap-Sheet Strips: ASTM D 6164/D 6164M, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric); granule surfaced; suitable for application method specified, and as follows:
 - 1. Granule Color: White.

2.10 ROOF PIPING SUPPORT SYSTEM

- A. Roof pipe supports.
 - 1. PHP Systems Design
 - 2. Miro Industries, INC
 - 3. ERICO International Corporation (Caddy Pyramid)

4. Approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with roofing system manufacturer's written instructions.
- B. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.2 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.3 INSULATION INSTALLATION

- A. Nailer Strips: Mechanically fasten 4-inch nominal- width wood nailer strips of same thickness as insulation perpendicular to sloped roof deck at the following spacing:
 1. 16 feet apart for roof slopes greater than 1 inch per 12 inches but less than 3 inches per 12 inches.
 2. 48 inches apart for roof slopes greater than 3 inches per 12 inches.
- B. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 degrees.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- E. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- F. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft., and allow primer to dry.
 2. Set each layer of insulation in a solid mopping of hot roofing asphalt.
 3. Set each layer of insulation in insulation adhesive, firmly pressing and maintaining insulation in place.
- G. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
- H. Mechanically Fastened and Adhered Insulation: Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
 2. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt.
 3. Set each subsequent layer of insulation in insulation adhesive, firmly pressing and maintaining insulation in place.
- I. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck. Tape joints if required by roofing system manufacturer.
1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
 2. Apply hot roofing asphalt to underside, and immediately bond cover board to substrate.

3.4 ROOFING INSTALLATION

- A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing" and as follows:
1. Deck Type: N (nailable) and C (concrete or nonnailable).
 2. Adhering Method: L (cold-applied adhesive).
 3. Base Sheet: One, installed over sheathing paper.
 4. Number of Glass-Fiber Base-Ply Sheets: One.
 5. Number of SBS-Modified Asphalt Sheets: One.
 6. Surfacing Type: M (mineral-granule-surfaced cap sheet).
- B. Where roof slope exceeds 1/2 inch per 12 inches, install roofing membrane sheets parallel with slope.
- C. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

- D. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches and 6 inches, respectively.
- E. Install lapped base-sheet course, extending sheet over and terminating beyond cants. Attach base sheet as follows:
 - 1. Mechanically fasten to substrate.
 - 2. Spot or strip mop to substrate with hot roofing asphalt.
 - 3. Adhere to substrate in a uniform coating of cold-applied adhesive.
- F. Install glass-fiber base-ply sheets according to roofing system manufacturer's written instructions starting at low point of roofing system. Align glass-fiber base-ply sheets without stretching. Extend sheets over and terminate beyond cants.
 - 1. Embed each glass-fiber base-ply sheet in a continuous void-free mopping of hot roofing asphalt to form a uniform membrane without glass-fiber base-ply sheets touching.
- G. Install modified bituminous roofing sheet and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants.
 - 1. Unroll roofing sheets and allow them to relax for minimum time period required by manufacturer.
- H. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.
 - 1. Repair tears and voids in laps and lapped seams not completely sealed.
- I. Install roofing sheets so side and end laps shed water.

3.5 FLASHING AND STRIPPING INSTALLATION

- A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions.
- B. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane and 4 inches onto field of roofing membrane.
- C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
- D. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.
- E. Roof Drains: Set 30-by-30-inch- metal flashing in bed of asphaltic adhesive on completed roofing membrane. Cover metal flashing with roofing cap-sheet stripping, and extend a minimum of 4 inches beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.

3.6 WALKWAY INSTALLATION

- A. Walkway Cap-Sheet Strips: Install walkway cap-sheet strips over roofing membrane, using same application method as used for roofing cap sheet.

3.7 ROOF PIPE SUPPORT SYSTEM

- A. Install per manufacturer's written instructions.

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manufactured reglets and counterflashing.
 - 2. Formed roof drainage sheet metal fabrications.
 - 3. Formed wall sheet metal fabrications.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - 1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.
- C. Samples: For each exposed product and for each finish specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
- C. Preinstallation Conference: Conduct conference at Project site.

1.6 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; 2B (bright, cold rolled) finish.

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
 - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder:

1. For Stainless Steel: ASTM B 32, Grade Sn60 or Grade Sn96, with acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 1. Obtain field measurements for accurate fit before shop fabrication.
 2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

2.5 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Built-in Gutters: Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum

96-inch- long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.

1. Accessories: Wire-ball downspout strainer.
2. Fabricate from the Following Materials:

- a. Stainless Steel: 0.016 inch thick.

B. Splash Pans: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

2.6 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12-foot- long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch- high, end dams where flashing is discontinuous. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 5. Install sealant tape where indicated.
 6. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws and metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints as shown and as required for watertight construction.
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 2. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

- B. Built-in Gutters: Join sections with riveted and soldered joints. Provide for thermal expansion. Slope to downspouts. Provide end closures and seal watertight with sealant.
 - 1. Install underlayment layer in built-in gutter trough and extend to drip edge at eaves and under underlayment on roof sheathing. Lap sides minimum of 2 inches over underlying course. Lap ends minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with roofing nails. Install slip sheet over underlayment.
 - 2. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in adhesive material compatible with the roofing.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 076200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Penetrations in fire-resistance-rated walls.
 2. Penetrations in horizontal assemblies.
 3. Penetrations in smoke barriers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- B. Product test reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems bearing marking of qualified testing and inspection agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A/D Fire Protection Systems Inc.
 2. Grace Construction Products.
 3. Hilti, Inc.
 4. Approved equal.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 2. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.

- G. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- D. Install fill materials for firestopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."

2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

- A. All fire-stopping penetrations shall be inspected and accepted.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work Included:
 - 1. Sealants for exterior joints in vertical surfaces and nontraffic horizontal surfaces.
 - 2. Sealants for exterior joints in horizontal traffic surfaces.
 - 3. Sealants for interior joints in vertical surfaces and nontraffic horizontal surfaces.
 - 4. Sealants for interior joints in horizontal traffic surfaces.
 - 5. Other joints as indicated.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants, with proper industry standard aspect ratios, that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates. All elastomeric joint sealants shall be chemically compatible with their substrate assemblies. Provide primary and secondary seals at all interfacing conditions and assemblies.

1.4 SUBMITTALS

- A. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation including required primers, temperature and humidity limits, color availability and cure time.
- B. Schedule: Submit a Schedule of Joint Sealers to be used for the project. Include interior and exterior sealants applied in the field and, where appropriate, applied in the shop. For each sealant listed, include sealant type, applicable substrates, and sealant number (as indicated in the specification).
- C. Samples: Submit three (3) samples, 6-inch long illustrating sealant colors for selection.
- D. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, perimeter conditions requiring special attention, recommended backer rods, and requirements for curing.

1.5 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.

- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience, and approved by manufacturer.
- D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field-test their adhesion to joint substrates as follows:
 - 1. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - 2. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
 - 3. Test joint sealants by hand-pull method test or methods recommended in ASTM C 1193.
 - 4. Do not use sealants that fail to adhere to joint substrates during testing.
 - 5. Sealant joints in mockups of assemblies specified in other shall be tested in accordance with this Section.
- E. Preinstallation Conference: Conduct conference at Project site with Contractor, Architect, sealant manufacturer, sealant contractor, wall cladding contractor, curtain wall and window contractor to discuss sealant locations, colors, installation procedures, compatibility of sealants with substrates, co-ordination between trades and scheduling.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the site, in original unopened containers, clearly indicating manufacturer's name, brand name, and other identifying information.
- B. Materials shall be stored in a dry location, off the ground and in such a manner as to prevent freezing, damage and the intrusion of foreign matter.
- C. Materials which have become damaged or otherwise unfit for use during delivery, or storage, shall be replaced at the expense of the Contractor.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealers under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturers.
 - 2. When joint substrates are wet due to rain, frost, condensation, or other causes.
- B. Joint Width Conditions: Do not proceed with installation of joint sealers where joint widths are less than allowed by the joint sealant manufacturer for the application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.8 MOCK-UP

- A. Provide mock-up of sealant joints in conjunction with window, wall, and copings under provisions of Division 01 Section "Quality Assurance".
- B. Construct mock-up with specified sealant types and with other components noted.
- C. Locate where directed.
- D. Subject to Architect's approval mock-up may remain as part of the Work.

1.9 COORDINATION

- A. Coordinate the work with all sections referencing this section.

1.10 WARRANTY

- A. Division 01 Section "Warranties".
- B. Correct defective work within a five (5) year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve watertight seal, discolor, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 – PRODUCTS

2.1 MATERIALS, GENERAL

- A. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.2 HIGH PERFORMANCE EXTERIOR SEALANT

- A. Type JS-1: Silicone, One part, neutral cure; ASTM C920, Type S, Grade NS, Class 50, with movement capability of -50/+50%, Uses NT, G, A and O; ASTM C1184 for structural silicone sealants.

1. 795 Silicone Building Sealant; Dow Corning Corp. or Approved equal.
2. Color as selected by Architect, including standard and custom colors.

2.3 EXTERIOR SEALANT

- A. Type JS-2: Silicone, single component non-acid curing; ASTM C920, Type S, Grade NS, Class 100/50, with movement capability of -50/+100%, Uses T, NT, M, G, A and O. Fire Tests of Building Construction and Materials, UL 263 (ASTM E 119).

1. 790 Silicone Building Sealant; Dow Corning or Approved equal.
2. Color as selected by Architect, including standard and custom colors.

- B. Type JS-3: Not Used.

2.4 EXTERIOR EXPANSION JOINT SEALANT

- A. Type JS-4: Precompressed expanding foam sealant with integral low-modulus silicone coating. Provide one of the following:

1. Colorseal; Emseal Joint Systems, Ltd.
2. Approved equal.

2.5 EXTERIOR METAL LAP JOINT SEALANT

- A. Type JS-5: Butyl or Polyisobutylene, non-drying, non-skinning, non curing; ASTM C920, Grade NS, Class 12-1/2, Uses M, A, and O. Provide one of the following:

1. Chem-Calk 300; Bostik
2. Approved equal.

2.6 EXTERIOR HORIZONTAL TRAFFIC JOINT SEALANT

- A. Type JS-6A: Self-leveling polyurethane, two-part; ASTM C920, Type M, Grade P, Class 25, Uses M, and O with shore A hardness of 30-40. Provide one of the following:

1. Chem-Calk 550; Bostik
2. Permopol RC 270 SL; PRC
3. Urexpam NR 201; Pecora
4. Sikaflex 12SL; Sika Corp.
5. Sonolastic 2C SL; Sonneborn Building Products.
6. Approved equal.

2.7 EXTERIOR WEATHER JOINTS BETWEEN SIMILAR AND DISSIMILAR MATERIALS AND HORIZONTAL PEDESTRIAN TRAFFIC JOINTS

A. Type JS-6B: Elastomeric Compounds

1. Multi-Component Polyurethane (Sealant Type 1): ASTM C920, class and use as best suited for the intended purpose. Products meeting these requirements are:
 - a. "DYmeric" by Tremco.
 - b. "Dynatrol II" by Pecora Corp.
 - c. "Sonolastic NP II" by Sonneborn Building Products.
 - d. Approved equal.
2. Self-Leveling Traffic Bearing (Sealant Type 2): ASTM C920, self-leveling, two-part polyurethane compound, with a Shore A cured hardness of 35 plus or minus 5, complying with . Sealant shall have a joint movement capability of plus/minus 50 percent.
 - a. "Sonolastic 2C SL" by Sonneborn Building Products
 - b. "Sikaflex 12SL" by Sika Corp.
 - c. "Urexpand NR-201" by Pecora Corp.
 - d. Approved equal.

2.8 INTERIOR GENERAL PURPOSE JOINT SEALANT

- A. Type JS-7: Polyurethane, single component, non-sag; ASTM C920, Grade NS, Class 25, Uses M, G, and A. Provide one of the following:
1. Chem-Calk 900; Bostik
 2. Chem-Calk 550; Bostik
 3. Approved equal.

2.9 INTERIOR PAINTABLE JOINT SEALANT

- A. Type JS-8: Acrylic Latex, one-part, non-sag, mildew resistant; ASTM C834, Grade NS, Class 12-1/2, Uses M, G, and A. Provide one of the following:
1. Chem-Calk 600; Bostik
 2. AC-20; Pecora Corp.
 3. Acrylic Latex 834; Tremco
 4. Approved equal.

2.10 INTERIOR SANITARY SEALANT

- A. Type JS-9: Silicone, single component, mildew-resistant, Type M, Grade NS, ASTM C 920, Class 25, for sanitary applications.

1. 786; Dow Corning.
2. Silicone Sanitary 1700; General Electric Co.
3. Chem-Calk 1200 Bathroom Calk; Bostik.
4. Approved equal.

2.11 INTERIOR HORIZONTAL TRAFFIC JOINT SEALANT

- A. Type JS-10: Polyurethane, single component self-leveling; ASTM C834, Type S, Grade P, Class 25, Uses M, G, and A. Provide one of the following:
1. Chem-Calk 900; Bostik
 2. Approved equal.

2.13 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, of type, size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure.
- F. Compressible Rod (Filler Type 1): Types as shown, or as required for proper performance of the sealant in the specific joint, which is compatible with sealant, as recommended by sealant manufacturer. One of the following:
1. Closed Cell Polyethylene Foam Rod: One of the following:
 - a. "Tremco Joint Backing" (Tremco).
 - b. "Green-Rod Polyethylene Backer Rod" (Nomaco, Inc.).
 - c. "HBR Backer Rod" (Hercules, Inc.).
 - d. "Sonofam Back Rod" (Sonneborn Building Products).
 - e. Approved equal.

2. Open Cell Polyurethane Rod: "Denver Foam" as distributed by Pecora Chemical Corp. or Woodmont Products Inc.
- G. Preformed Sponge Rubber or Cork (Filler Type 2): ASTM D1752, Type I, II or III; type best suited for joint condition.
- H. Closed Cell Neoprene (Filler Type 3): ASTM D1056, Type S, Class SCE.
- I. Closed Cell Polyethylene (Filler Type 5): Not less than 3 psi for 25% compression resistance, highly resistant to petroleum oils and solvents, one of the following:
 1. "Expand-O-Foam" (Williams Products, Inc.).
 2. "Filler Foam Gasket FF-4" (Progress Unlimited Inc.)
 3. "Tremco Joint Backing" (Tremco)
 4. Approved equal.
- J. Preformed Bitumen Impregnated Foam (Filler Type JF07): Oxidized bitumen impregnated multi-directional 90% open-cell polyurethane foam, factory pre-compressed 20% into vacuum packed filler for removal prior to installation; "Emseal 20H" (Emseal Corp.). Provide with self adhesive backing when recommended by the manufacturer.
- K. Select shape and size of joint filler in consultation with the manufacturer for proper performance in the specific condition of use in each case.

2.14 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces and joint openings are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter which might impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfiguration.

3.3 INSTALLATION

- A. Joint widths shall be designed for anticipated movement but shall be a minimum of 3/8 inches wide.
- B. Perform installation in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- C. Perform installation in accordance with ASTM C1193.
- D. Perform acoustical sealant application work in accordance with ASTM C919.
- E. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- F. Install bond breaker where joint backing is not used.
- G. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- H. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- I. Tool joints concave unless otherwise indicated.
- J. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.
- K. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as follows:
 - 1. Perform 10 tests for the first 1000 feet (300 m) of joint length for each type of elastomeric sealant and joint substrate.
 - 2. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
 - 3. Test Method: Test joint sealants by hand-pull method or tests recommended in ASTM C 1193.
 - 4. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
 - 5. Inspect tested joints and report on whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively, whether sealants filled joint cavities and are free from voids, and whether sealant dimensions and configurations comply with specified requirements.
 - 6. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

7. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints.
- B. Evaluation of Field-Test Results: Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
- 3.5 CLEANING
- A. Clean adjacent soiled surfaces.
- 3.6 PROTECTION OF FINISHED WORK
- A. Protect sealants until cured.
- 3.7 SCHEDULE
- A. JS-1 - Exterior joints as follows:
1. Joints in stone panels.
 2. Joints in cast stone panels.
 3. Joints in metal panels.
 4. Butt joints for insulated glazing units.
 5. Structural silicone glazing to adhere insulated glazing units to mullions of curtain wall and ribbon windows.
 6. Joints between aluminum and metal panels or stone and cast stone.
- B. JS-2 - Control, Expansion, and Soft Joints in Masonry, and Between Masonry and Adjacent Work: Colors as selected by Architect.
- C. JS-1 or JS-2 - Exterior Joints for Which No Other Sealant Type is indicated. Colors as selected by Architect.
- D. JS-4 - Exterior Wall Expansion Joints: Colors as selected by Architect.
- E. JS-5 - Lap Joints in Exterior Sheet Metal Work: Colors as selected by Architect.
- F. JS-6 - Control and Expansion Joints in Paving: Colors as selected by Architect.
- G. JS -7 - Interior Joints for Which No Other Sealant is indicated: Colors as selected.
- H. JS-7 or JS-8 - In STC-Rated Walls, Between Metal Stud Track/Runner and Adjacent Construction, Between Outlet Boxes and Gypsum Board: Colors as selected by Architect.
- I. JS-9 - Joints between Plumbing Fixtures and Walls and Floors, and Between Countertops and Walls: Colors as selected by Architect.
- J. JS-10 - Control and Expansion Joints in Interior Concrete Slabs and Floors: Colors as selected by Architect.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Standard and custom hollow metal doors and frames.

- B. Related Sections:

- 1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
 - 2. Division 08 Section "Door Hardware".
 - 3. Division 09 Sections "Interior Painting" for field painting hollow metal doors and frames.

- C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

- 1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
 - 2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
 - 3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
 - 4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
 - 5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
 - 6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
 - 10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
 - 11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
 - 12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
 - 13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.

14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
 1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of anchorages, joints, field splices, and connections.
 6. Details of accessories.
 7. Details of conduit and preparations for power, signal, and control systems.
- D. Samples for Verification:
 1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C.
 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 3. Smoke Control Door Assemblies: Comply with NFPA 105.

- a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

- D. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CECO Door Products.
 2. Curries Company.
 3. Steelcraft.
 4. Or equal.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
- B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard vertical steel-stiffener core. Minimum 22 gauge steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers. Spaces between stiffeners filled with fiberglass insulation (minimum density 0.8#/cubic ft.).
 3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

- C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard vertical steel-stiffener core. Minimum 22 gauge steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers. Spaces between stiffeners filled with fiberglass insulation (minimum density 0.8#/cubic ft.).
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
 4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Manufacturers Basis of Design:
1. CECO Door Products Imperial Series.
 2. CECO Door Products Steel-Stiffened: Medallion Series.
 3. Curries Company Steel-Stiffened: 747 Series.
 4. Or equal.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames, with the exception of knock down types, with "closed and tight" miter seams continuously welded on face, finished smooth with no visible seam unless otherwise indicated.
 3. Frames for Level 3 Steel Doors (up to 48 inches in width): Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
 4. Frames for Level 3 Steel Doors (48 inches and up in width): Minimum 12 gauge (0.081-inch -2.7-mm) thick steel sheet.
 5. Frames for Level 2 Steel Doors: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 6. Manufacturers Basis of Design:
 - a. CECO Door Products SQ/SU/SR Series.
 - b. Curries Company M/G Series.

- c. Or equal.
- C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames, with the exception of slip-on drywall types, with "closed and tight" miter seams continuously welded on face, finished smooth with no visible seam unless otherwise indicated.
 - 3. Frames for Steel Doors: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 - 4. Frames for openings up to 48 inches in width: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.]
 - 5. Frames for openings 48 inches and wider in width: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.]
 - 6. Frames for Wood Doors: Minimum 16 gauge (0.053-inch-1.3-mm-) thick steel sheet.
 - 7. Manufacturers Basis of Design:
 - a. CECO Door Products BQ/BU/DQ/DU/BR/DR Series (Drywall Profile).
 - b. CECO Door Products SQ/SU/SR Series (Masonry Profile).
 - c. Curries Company C/CM/CG Series (Drywall Profile).
 - d. Curries Company M/G Series (Masonry Profile).
 - e. Or equal.
- D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
- E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
 - 3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.
 - 4. Windstorm Opening Anchors: Types as tested and required for indicated wall types to meet specified wind load design criteria.
 - 5. FEMA 361 Storm Shelter Anchors: Masonry T-shaped, wire masonry type, or existing opening type anchors.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 HOLLOW METAL PANELS

- A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 LOUVERS

- A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.
 - 1. Blade Type: Vision proof inverted V or inverted Y.
 - 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.
- B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.
 - 1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
 - 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.9 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
 - 2. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
 - 3. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jamb and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 081113

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material.
- D. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 tested according to the following test method:
 - 1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
 - 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
 - 1. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 - 2. Larsen's Manufacturing Company.
 - 3. Babcock-Davis.
 - 4. Nystrom, Inc.
 - 5. Approved Equal.
- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

- C. Fire-Rated, Flush Access Doors with Concealed Flanges:
 - 1. Basis-of-Design Product: KRP-450FR; Karp, Inc.
 - 2. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide frame with gypsum board beads for concealed flange installation.
 - 3. Fire-Resistance Rating: Not less than that of adjacent construction.
 - 4. Metallic-Coated Steel Sheet for Door: Nominal 0.040 inch, 20 gauge.
 - a. Finish: Factory finish.
 - 5. Frame Material: Same material, thickness 16 gauge, and finish as door.
 - 6. Hinges: Manufacturer's standard.
 - 7. Hardware: Tamper-proof locks to comply with the State's security standards.

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- E. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- F. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- G. Aluminum Sheet: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15; with minimum sheet thickness according to ANSI H35.2.
- H. Frame Anchors: Same type as door face.
- I. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
 - 1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder locks, furnish two keys per lock and key all locks alike.
 - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 - 1. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil for topcoat.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section “Hollow Metal Doors and Frames”.
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 80 - Fire Doors and Windows.
 - 4. NFPA 101 - Life Safety Code.
 - 5. NFPA 105 - Installation of Smoke Door Assemblies.
 - 6. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series
 - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Keying Schedule: Prepared under the supervision of the State, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. The State to approve submitted keying schedule prior to the ordering of permanent cylinders.
- D. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

- E. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and The State concerning both standard and electromechanical door hardware and keying.
 - 1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- D. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
 - 1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.

- b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
 - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
- 3. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Thresholds: Not more than 1/2 inch high.
- 4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.
 - a. Test Pressure: Positive pressure labeling.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.

3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to The State via registered mail or overnight package service. Instructions for delivery to the State shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive The State of other rights The State may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship

within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
 2. Faulty operation of the hardware.
 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
1. Ten years for mortise locks and latches.
 2. Five years for exit hardware.
 3. Twenty five years for manual surface door closers.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for The State's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

- B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
 - 1) Out-swinging exterior doors.
 - 2) Out-swinging access controlled doors.
 - 3) Out-swinging lockable doors.
 5. Acceptable Manufacturers:
 - a. Bommer Industries (BO).
 - b. Hager Companies (HA).
 - c. McKinney Products (MK).

- B. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.
1. Acceptable Manufacturers:
 - a. Bommer Industries (BO).
 - b. McKinney Products (MK).
 - c. Pemko Manufacturing (PE).

2.3 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. Cylinders: Original manufacturer cylinders complying with the following:
1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 5. Keyway: Match Facility Standard.
- D. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by The State. Incorporate decisions made in keying conference, and as follows:
1. Existing System: Master key or grand master key locks to The State's existing system.
- E. Key Quantity: Provide the following minimum number of keys:
1. Top Master Key: One (1)
 2. Change Keys per Cylinder: Three (3)
 3. Master Keys (per Master Key Group): Two (2)
 4. Grand Master Keys (per Grand Master Key Group): Two (2)
 5. Construction Keys (where required): Ten (10)

- F. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".
- G. Key Registration List: Provide keying transcript list to The State's representative in the proper format for importing into key control software.
- H. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
 - 1. Acceptable Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).
- I. Key Control Software: Provide one network version of "Key Wizard" branded key management software package that includes one year of technical support and upgrades to software at no charge. Provide factory key system formatted for importing into "Key Wizard" software.

2.4 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.
 - 1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) – ML2000 Series.
 - b. Sargent Manufacturing (SA) – 8200 Series.
 - c. Stanley Best (BE) – 40H Series.
- B. Lock Trim Design: As specified in Hardware Sets.

2.5 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
4. Dustproof Strikes: BHMA A156.16.

2.6 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 - a. Fire Exit Removable Mullions: Provide keyed removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions to be used only with exit devices for which they have been tested.
3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is not acceptable except in any case where the door light extends behind the device as in a full glass configuration.
5. Flush End Caps: Provide heavy weight impact resistant flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty trim with cold forged escutcheons, beveled edges, and four threaded studs for thru-bolts.

- a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets. Provided free-wheeling type trim where indicated.
 - b. Where function of exit device requires a cylinder, provide an interchangeable core type keyed cylinder (Rim or Mortise) as specified in Hardware Sets.
7. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices as Less Bottom Rod (LBR) unless otherwise indicated.
 8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.
1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
 - b. Sargent Manufacturing (SA) - 80 Series.
 - c. Von Duprin (VD) - 35A/98 XP Series.

2.7 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
 2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use.

Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 - a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
 - b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
 - c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
 - d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.
 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) - DC8000 Series.
 - b. Sargent Manufacturing (SA) - 351 Series.
 - c. Norton Door Controls (NO) - 7500 Series.

2.8 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Acceptable Manufacturers:

- a. Burns Manufacturing (BU).
- b. Hiawatha, Inc. (HI).
- c. Rockwood Manufacturing (RO).

2.9 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Acceptable Manufacturers:
 1. Pemko Manufacturing (PE).
 2. Reese Enterprises, Inc. (RS).
 3. Zero International (ZE).

2.10 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.11 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of the State occupancy.

3.7 DEMONSTRATION

- A. Instruct The State's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SCHEDULE

- A. The hardware sets represent the design intent and direction of the State and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. Manufacturer's Abbreviations:
1. MK - McKinney
 2. SA - Sargent
 3. RO - Rockwood
 4. RF - Rixson
 5. NO - Norton
 6. PE - Pemko

Hardware Schedule

Set: 1.0

Doors: 104

3 Hinge	as required	US26D	MK
1 Exit Device	12 43 8804 ETMZ LC	US32D	SA
1 Cylinder	compatible with facility's existing system	US26D	
1 Door Closer	7500 / P7500	689	NO
1 Door Stop	400 / 441CU	US26D	RO
3 Silencer	608		RO

Set: 2.0

Doors: 115

3 Hinge	as required	US26D	MK
1 Storeroom Lock	8204 LNMZ LC	US26D	SA
1 Cylinder	compatible with facility's existing system	US26D	
1 Door Closer	7500 / P7500	689	NO
1 Door Stop	400 / 441CU	US26D	RO
3 Silencer	608		RO

*Key required for entry. Inside always free.

Set: 2.1

Doors: 114

3 Hinge	as required	US26D	MK
1 Storeroom Lock	8204 LNMZ LC	US26D	SA
1 Cylinder	compatible with facility's existing system	US26D	
1 Surface Overhead Holder/Stop	8-336	630	RF
1 Door Closer	7500 / P7500	689	NO
1 Door Stop	400 / 441CU	US26D	RO
3 Silencer	608		RO

*Key required for entry. Inside always free.

Set: 3.0

Doors: ST3

3 Hinge	as required	US26D	MK
1 Exit Device	12 43 8816 ETMZ LC	US32D	SA
2 Cylinder	compatible with facility's existing system	US26D	
1 Door Closer	7500 / P7500	689	NO
1 Door Stop	400 / 441CU	US26D	RO
3 Silencer	608		RO

Set: 4.0

Doors: ST4

3 Hinge	as required	US26D	MK
1 Exit Device	12 43 8815 ETMZ	US32D	SA
1 Door Closer	7500 / P7500	689	NO
1 Door Stop	400 / 441CU	US26D	RO
3 Silencer	608		RO

Set: 5.0

Doors: 002

2 Continuous Hinge	MCK-25HD	CL	MK
1 Exit Device	16 43 NB8710 LC	US32D	SA
1 Exit Device	16 43 NB8706 ETMZ LC	US32D	SA
3 Cylinder	compatible with facility's existing system	US26D	

2 Door Closer	UNI7500	689	NO
1 Threshold	to architect detail		PE
1 Gasketing	290APK x 2891APK		PE
2 Sweep	18061CNB		PE
2 Astragal	18041CNB		PE

Set: 6.0

Doors: 111, 112

3 Hinge	as required	US26D	MK
1 Mortise Deadlock	4877 LC	US26D	SA
1 Cylinder	compatible with facility's existing system	US26D	
1 Push Plate	70C	US32D	RO
1 Door Pull	108	US32D	RO
1 Concealed Overhead Stop	6-X36	630	RF
1 Door Closer	7500 / P7500	689	NO
3 Silencer	608		RO

*Deadbolt by key both sides.

Set: 7.0

Doors: 113

6 Hinge	as required	US26D	MK
2 Exit Device	12 43 NB8706 ETMZ	US32D	SA
2 Door Closer	7500 / P7500	689	NO
2 Door Stop	400 / 441CU	US26D	RO
2 Silencer	608		RO

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Glass for windows.
 - 2. Glazing sealants and accessories.

1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Preconstruction adhesion and compatibility test report.

1.5 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.2 GLASS PRODUCTS, GENERAL

- A. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- B. Thickness: Where glass thickness is indicated, it is a minimum.

2.3 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Quality-Q3.

2.4 GLAZING SEALANTS

- A. General:
 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range to match existing.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer

rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

3.6 MONOLITHIC GLASS SCHEDULE

- A. Glass Type : Clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.

END OF SECTION 088000

SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Shaft-wall enclosures.
2. Chase enclosures.
3. Stair enclosures.
4. Horizontal enclosures.

1.2 SUBMITTALS

A. Product Data: For each gypsum board shaft-wall assembly indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Provide materials and construction identical to those of assemblies with fire-resistance ratings determined according to ASTM E 119 by a testing and inspecting agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Gypsum Company.
 2. BPB America Inc.
 3. G-P Gypsum.
 4. Lafarge North America Inc.
 5. National Gypsum Company.
 6. PABCO Gypsum.
 7. Temple-Inland Forest Products Corporation.
 8. USG Corporation.
 9. Approved equal.

2.2 GYPSUM BOARD SHAFT-WALL ASSEMBLIES, GENERAL

- A. Provide materials and components complying with requirements of fire-resistance-rated assemblies indicated.
 - 1. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.
 - 2. Provide auxiliary materials complying with gypsum board shaft-wall assembly manufacturer's written recommendations.

2.3 PANEL PRODUCTS

- A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
- B. Gypsum Liner Panels: Comply with ASTM C 442/C 442M.
 - 1. Type X: Manufacturer's proprietary liner panels with moisture-resistant paper faces.
 - a. Core: 1 inch thick.
 - b. Long Edges: Double bevel.
 - 2. Moisture- and Mold-Resistant Type X: Manufacturer's proprietary liner panels and with moisture- and mold-resistant core and surfaces; comply with ASTM D 3273.
 - a. Core: 1 inch thick.
 - b. Long Edges: Double bevel.
- C. Gypsum Base for Gypsum Veneer Plaster: As specified in Division 09 Section "Gypsum Veneer Plastering."
- D. Gypsum Board: As specified in Division 09 Section "Gypsum Board."

2.4 NON-LOAD-BEARING STEEL FRAMING

- A. Framing Members: Comply with ASTM C 754 for conditions indicated.
- B. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 - 1. Recycled Content: Provide steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
 - 2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized, unless otherwise indicated.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes specified in Division 09 Section "Gypsum Board" that comply with gypsum board shaft-wall assembly manufacturer's written recommendations for application indicated.
- C. Gypsum Base Joint-Reinforcing Materials: As specified in Division 09 Section "Gypsum Veneer Plastering."
- D. Gypsum Veneer Plaster: As specified in Division 09 Section "Gypsum Veneer Plastering."
- E. Gypsum Board Joint-Treatment Materials: As specified in Division 09 Section "Gypsum Board."
- F. Laminating Adhesive: Adhesive or joint compound recommended by manufacturer for directly adhering gypsum face-layer panels and gypsum-base face-layer panels to backing-layer panels in multilayer construction.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- H. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 - 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
 - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- I. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing), produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - 2. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
- J. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."

1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 GYPSUM BOARD SHAFT-WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated.
- B. STC Rating: 51, minimum.
- C. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
 1. Depth: As indicated.
 2. Minimum Base-Metal Thickness: As indicated.
- D. Runner Tracks: Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches long and in depth matching studs.
 1. Minimum Base-Metal Thickness: As indicated.
- E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dietrich Metal Framing; The System by Metal-Lite, Inc.
 - b. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
- F. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches, in depth matching studs, and not less than 0.0329 inch thick.
- G. Room-Side Finish: As indicated.
- H. Shaft-Side Finish: As indicated by fire-resistance-rated assembly design designation.
- I. Insulation: Sound attenuation blankets.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft-wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft-wall assemblies to comply with requirements specified in Division 07 Section "Applied Fireproofing."

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runner tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft-wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.2 INSTALLATION

- A. General: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:
 1. ASTM C 754 for installing steel framing except comply with framing spacing indicated.
 2. Division 09 Section "Gypsum Board" for applying and finishing panels.
- B. Do not bridge architectural or building expansion joints with shaft-wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.
 1. At elevator hoistway entrance door frames, provide jamb struts on each side of door frame.
 2. Where handrails directly attach to gypsum board shaft-wall assemblies, provide galvanized steel reinforcing strip with 0.0312-inch minimum thickness of base (uncoated) metal, accurately positioned and secured behind at least 1 gypsum board face-layer panel.
- D. Integrate stair hanger rods with gypsum board shaft-wall assemblies by locating cavity of assemblies where required to enclose rods.
- E. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- F. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- G. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- H. Control Joints: Install control joints at locations indicated on Drawings, while maintaining fire-resistance rating of gypsum board shaft-wall assemblies.

- I. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with ASTM C 919 requirements or with manufacturer's written instructions, whichever are more stringent.
- J. In elevator shafts where gypsum board shaft-wall assemblies cannot be positioned within 4 inches of the shaft face of structural beams, floor edges, and similar projections into shaft, install 1/2- or 5/8-inch- thick, gypsum board cants covering tops of projections. No recesses allowed (at steel beams especially).
 - 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft-wall framing.
 - 2. Where steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft-wall framing.
- K. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.3 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092116.23

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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.
- B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413.

2.2 FRAMING SYSTEMS

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: As indicated on Drawings.
2. Depth: As indicated on Drawings.

B. Slip-Type Head Joints: Provide one of the following in thickness not less than indicated for studs and in width to accommodate depth of studs:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.

- C. Firestop Tracks: Manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Trak Corp.; Fire Trak System.
 - b. Grace Construction Products; FlameSafe FlowTrak System.
 - c. Metal-Lite, Inc.; The System.
 - d. Approved equal.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width required. Provide blocking at points of attachment for small fixtures, toilet accessories and partitions, handrails, door stops, etc. Blocking shall be minimum of 6" wide 20 gauge (sheet metal gauge) galvanized sheet metal with a minimum wall thickness of 0.0356" (0.0400" nominal).
- E. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: As indicated on Drawings.
 - 2. Depth: As indicated on Drawings.
- G. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
- H. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Capable of sustaining a load equal to 5 times that imposed as determined by ASTM E 488.
 - a. Type: Postinstalled, chemical anchor or Postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Capable of sustaining, a load equal to 10 times that imposed as determined by ASTM E 1190.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, in size indicated on Drawings.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.
- F. Furring Channels (Furring Members):
 1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 2. Steel Studs and Runners: ASTM C 645.
 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.

2.4 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide asphalt saturated organic felt or foam gasket.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.3 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - 3. Do not attach hangers to steel roof deck.
 - 4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Interior gypsum board.
 2. Tile backing panels.
 3. Exterior wall sheathing.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Gypsum.
 2. CertainTeed Corp.
 3. Georgia-Pacific Gypsum LLC.
 4. Lafarge North America Inc.
 5. National Gypsum Company.
 6. PABCO Gypsum.
 7. Temple-Inland.
 8. USG Corporation.
 9. Approved equal.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

2.3 SPECIALTY GYPSUM BOARD

A. Gypsum Shaftliner Board, Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistant liner panels with paper faces.

1. Thickness: 1 inch.
2. Long Edges: Double bevel.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C-Cure; C-Cure Board 990.
 - b. Custom Building Products; Wonderboard.
 - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
 - e. Approved equal.
2. Thickness: As indicated.

2.5 EXTERIOR WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; GlasRoc.
 - b. G-P Gypsum Corporation; Dens-Glass Gold.
 - c. National Gypsum Company; Gold Bond e(2)XP.
 - d. Temple-Inland Inc.; GreenGlass
 - e. United States Gypsum Co.; Securock.
 - f. Approved equal.

2. Type and Thickness: Type X, 5/8 inch thick.

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.8 AUXILIARY MATERIALS

- A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing).
- D. Acoustical Joint Sealant: ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings as demonstrated by testing according to ASTM E 90.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

- E. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- H. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- I. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 096400 - WOOD FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Factory-finished wood flooring.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of floor assembly and accessory. Include plans, sections, and attachment details. Include expansion provisions and trim details.
- C. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hardwood Flooring: Comply with NWFA A500 for species, grade, and cut.
 - 1. Certification: Provide flooring that carries NWFA grade stamp on each bundle or piece.
- B. Maple Flooring: Comply with applicable MFMA grading rules for species, grade, and cut.
 - 1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.
- C. Softwood Flooring: Comply with WCLIB No. 17 grading rules for species, grade, and cut.

2.2 FACTORY-FINISHED WOOD FLOORING

- A. Solid-Wood Flooring: Kiln dried to 6 to 9 percent maximum moisture content; tongue and groove and end matched; with backs channeled.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anderson Hardwood Floors.
 - b. Armstrong World Industries, Inc.
 - c. Boen Hardwood Flooring Inc.
 - d. Carlisle Wide Plank Floors.

- e. Kentucky Wood Floors.
- 2. Finish: UV urethane.
 - a. Color: As selected by Architect from manufacturer's full range.

2.3 ACCESSORY MATERIALS

- A. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than 6.0 mils (0.15 mm) thick.
- B. Asphalt-Saturated Felt: ASTM D 4869/D 4869M, Type II.
- C. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.
- D. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer.
- E. Fasteners: As recommended by manufacturer, but not less than that recommended in NWFA's "Installation Guidelines."
- F. Thresholds and Saddles: To match wood flooring. Tapered on each side.
- G. Reducer Strips: To match wood flooring. 2 inches (51 mm) wide, tapered, and in thickness required to match height of flooring.
- H. Cork Expansion Strip: Composition cork strip.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Concrete Slabs:
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 80 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. Concrete Slabs:

1. Grind high spots and fill low spots to produce a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10-foot (3-m) straight edge.
2. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
3. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

- B. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines."

- B. Provide expansion space at walls and other obstructions and terminations of flooring of not less than 3/4 inch (19 mm).

- C. Vapor Retarder: Comply with the following for vapor retarder installation:

1. Wood Flooring Nailed to Wood Subfloor: Install flooring over a layer of asphalt-saturated felt.
2. Wood Flooring Nailed to Sleepers over Concrete: Install flooring over a layer of polyethylene sheet with edges overlapped over sleepers and turned up behind baseboards.
3. Wood Flooring Installed Directly on Concrete: Install a layer of polyethylene sheet according to flooring manufacturer's written instructions.

- D. Sound Control Underlayment: Install over vapor retarder according to manufacturer's written instructions.

- E. Solid-Wood Flooring: Blind nail or staple flooring to substrate.

1. Plank Flooring: For flooring of face width more than 3 inches (76 mm):
 - a. Hardwood: Install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring.
 - b. Softwood: Install no fewer than two countersunk nails at each end of each piece, spaced not more than 16 inches (406 mm) along length of each piece, in addition to blind nailing. Fill holes with matching wood filler.

3.4 FIELD FINISHING

- A. Machine-sand flooring to remove offsets, ridges, cups, and sanding-machine marks that are noticeable after finishing. Vacuum and tack with a clean cloth immediately before applying finish.
 - 1. Comply with applicable recommendations in NWFA's "Installation Guidelines."
- B. Fill open-grained hardwood.
- C. Fill and repair wood flooring defects.
- D. Cover wood flooring before finishing.
- E. Do not cover wood flooring after finishing until finish reaches full cure, and not before seven days after applying last finish coat.

3.5 PROTECTION

- A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.
 - 1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096400

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes rubber sheet flooring.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of flooring. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples: For each exposed product and for each color and texture specified in manufacturer's standard size, but not less than 6-by-9-inch sections.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 UNBACKED RUBBER SHEET FLOORING

- A. Product Standard: ASTM F 1859.
 - 1. Type: Type I (homogeneous rubber sheet).
 - 2. Thickness: As standard with manufacturer.
 - 3. Hardness: Not less than required by ASTM F 1859.
- B. Wearing Surface: Smooth.
- C. Sheet Width: As standard with manufacturer.

- D. Seamless-Installation Method: Chemically bonded.
- E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.
- C. Seamless-Installation Accessories:
 - 1. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
- D. Integral-Flash-Cove-Base Accessories:
 - 1. Cove Strip: 1-inch radius provided or approved by resilient sheet flooring manufacturer.
 - 2. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.
- E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient sheet flooring manufacturer's written recommendations, but not less stringent than the following:

- a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient sheet flooring until it is the same temperature as the space where it is to be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.2 RESILIENT SHEET FLOORING INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient sheet flooring.
- B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.
- C. Lay out resilient sheet flooring as follows:
- 1. Maintain uniformity of flooring direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
 - 3. Match edges of flooring for color shading at seams.
 - 4. Avoid cross seams.
- D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.
- E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.
- H. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
 2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless flooring. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.
- J. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.
1. Install metal corners at inside and outside corners.
- 3.3 CLEANING AND PROTECTION
- A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.
 - B. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.
 1. Apply two coat(s).
 - C. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION 096516

SECTION 099123 – INTERIOR PAINTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Provide labor, materials, equipment and services, and perform operations required for painting and related work as indicated on the drawings and specified herein.
- B. Work Included: The work of this section shall include, but not be limited to, the following:
 - 1. Painting of all exposed surfaces whether or not indicated on drawings or schedules as painted.
 - 2. Painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
 - 3. Painting of ductwork or other surfaces visible through registers, grilles, radiator or convector covers and other openings in painted spaces with flat black paint.
 - 4. Painting of exposed wood not finished under other sections.
 - 5. Painting of Primed Finish Hardware (USP), door checks, brackets, steel butts and like items.
 - 6. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.
 - 7. Hollow metal doors and frames.
- C. Related Work Specified Elsewhere
 - 1. Painting of exposed structural steel fabrications. See Section 051000 Structural Steel.

1.2 DEFINITIONS

- A. "Exposed", as used to define surfaces to be painted, shall mean surfaces exposed to view in any accessible space, area or enclosure including both sides of doors, panels, access doors and covers, and shall include exterior exposed surfaces.
- B. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.
- C. "Paint or Painting", as used herein, shall include various coating systems and materials such as primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

1.3 STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
 - 1. SSPC "Good Painting Practice".
 - 2. SSPC "Systems and Specifications".

1.4 SUBMITTALS

- A. Detailed Painting Schedule: Submit a "Detailed Painting Schedule" for review by the Architect. Prepare this schedule on the basis of the surfaces, types of paint materials, number of coats required, and list the brand name of the product of the manufacturer proposed for each use.
- B. Color Samples: Submit two (2) labeled 12 inch square samples for each color and texture to simulate actual conditions. Show various stages of finish on displays.

1.5 CLOSEOUT SUBMITTALS

- A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6 PRODUCT HANDLING

- A. Deliver paint materials to the job site in original containers and packages, bearing the manufacturer's labels, indicating name, type, brand, contents by volume, for pigment, vehicle and volatile constituents. Unless otherwise directed by the Architect, deliver paints ready-mixed. Order in advance in large enough quantities and in ample time to facilitate the Work.
- B. Store materials and equipment in a designated storage space on the site. Keep storage space neat, clean and accessible. Protect floors from paint spillage.

1.7 ENVIRONMENTAL CONDITIONS

- A. Do not paint when the air is dust-laden nor when weather and temperature conditions are unsuitable. Maintain temperatures within the building at a minimum of 60 degrees F during the painting and drying periods.

1.8 PROTECTION

- A. Place paint or solvent soaked rags, waste or other materials which might constitute a fire hazard in metal containers and remove from premises at the close of each day's work. Take every precaution to avoid damage by fire.

- B. Provide suitable coverings to protect surfaces not requiring painting.
- C. Remove or protect items such as hardware, hardware accessories, plates, lighting fixtures and similar items placed prior to painting. Reposition or remove protection upon completion of each space. Disconnect equipment adjacent to walls by workmen skilled in these trades to permit painting of wall surfaces; replace and reconnect after completion of painting.
- D. Maintain wrappings or other factory applied protection furnished with finish hardware (or other items provided by other trades) installed in areas where painting is required. If such protection is displaced or removed, replace before painting work continues and maintain for the duration of painting work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis-of-Design Product: The design for paint products listed in the paint and color schedule at the end of PART 3 is based on the following:
 - 1. Sherwin-Williams Co.
- B. Subject to compliance with requirements, provide "first line" materials of the following manufacturers:
 - 1. Sherwin-Williams Co.
 - 2. Benjamin Moore.
 - 3. PPG Industries.
 - 4. Approved equal.
- C. Use products of the same manufacturer for succeeding coats. Where primer is shop applied to steel, subsequent coats may be the product of another manufacturer provided the coatings are mutually compatible. Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates.
- D. Colors, textures and degree of luster will be as selected by the Architect. Tint prime and undercoats approximately to the shade of the final coat but with sufficient variation to distinguish them from the preceding coat. Proprietary names used to designate colors or materials are not intended to imply that products named are required or to exclude equal products of other manufacturers.
- E. Specular Gloss Range or other Glosses levels as on Finish Schedule)
 - 1. Ranges determined in accordance with ASTM D523:

a.	Sheen	Geometry/Degree	Gloss/Range
b.	Flat	85	Below 15
c.	Eggshell	60	5 to 20
d.	Semigloss	60	30 to 65

2. In locations where ambient temperature-humidity conditions encourage the ready formation of mildew, use paints with additional mildew inhibitive agent incorporated during the manufacturing process, of type and in concentration recommended by the paint manufacturer to withstand such mildew formation.

- F. Follow the OTC (Ozone Transportation Commission) regulations for allowable VOC Content.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION MEETING

- A. Prior to the start of the Work, and at the Contractor's direction, meet at the Project site to review methods and sequence of Work, special details and conditions, standard of workmanship, and other pertinent topics related to the Work. The meeting shall include the Architect, the Contractor, Contractor's project superintendent, painting subcontractor's superintendent, painting manufacturer's representative, and any other subcontractors whose work requires coordination with this work.

3.2 CONDITION OF SURFACES

- A. Examine the substrates, adjoining construction and the conditions under which the Work is to be installed. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. General

1. Prepare surfaces to receive paint; thoroughly clean of grime, grease, dirt, loose material and other substances that may interfere with proper adhesion of paint. Provide barrier coats over incompatible primers or remove and reprime. Paint dry surfaces only.
2. Remove or protect hardware, hardware accessories, plates, trim for mechanical work, machined surfaces, lighting fixtures and similar items in place and not to be finish painted. Disconnect and move equipment adjacent to areas scheduled to be painted. Reposition and reconnect items and remove protection upon completion of each space.
3. Fill dents, cracks, hollow places, open joints and other irregularities with a filler suitable for the purpose and, after setting, sand to a smooth finish.
4. Prime surfaces not more than 8 hours after cleaning.

B. Metals

1. Clean bare metal surfaces thoroughly of foreign matter such as mortar, plaster, grease, rust, scale and dirt before priming coat is applied. Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning", prior to any additional surface preparation specified. Remove rust and mill scale in accordance with SSPC SP-3 "Power Tool Cleaning". Where solder flux has been used, clean surface with solvent. Immediately after surface preparation, apply primer in accordance with manufacturer's instructions. Use painting methods which will result in full coverage and dry film

- thickness specified. After erection is completed, touchup heads of bolts, welded surfaces and other field connections with specified primer.
2. Shop Primed Ferrous Metal Surfaces: Remove grease and oil with a cleaner recommended for the purpose. Exercise care to prevent damage to shop coat. Touchup abraded or marred shop coats with paint used for priming.
 3. Zinc Coated (Galvanized) Surfaces: Remove grease and oil with a cleaner recommended for the purpose. Treat surfaces with a chemical compound such as a phosphoric acid wash. Rinse the chemical compound completely with clean, fresh water.
- C. Concrete and Masonry Surfaces: Delay painting on concrete or masonry surfaces as long as practicable within the limits of the Contract. Test surfaces for presence of alkali and neutralize as required. Test surfaces for moisture content and do not paint surfaces which exceed manufacturer's printed instructions. Remove grease, oil form release agents and efflorescence. Patch cracks and other blemishes to be covered by paint. Neutralize concrete surfaces which have received capillary waterproofing, utilizing materials and methods as recommended by the manufacturer and applicator of the capillary waterproofing.
- D. Gypsum Drywall: Repair minor cracks and holes with finishing compound, and sand smooth after drying.

3.4 WORKMANSHIP

- A. Apply paint in accordance with manufacturer's written instructions. Use applicator and techniques best suited for substrates and type of material being applied. Apply materials at not less than manufacturer's recommended spreading rate to establish a total dry film thickness as indicated or, if not indicated, as recommended by the manufacturer.
- B. Mix materials thoroughly; strain if necessary, before using. Do not adulterate ready-mixed materials except in accordance with the manufacturer's printed instructions. If no printed instructions appear on the container, obtain this information in writing from the manufacturer.
- C. Apply materials with care to a uniform and proper film thickness, showing no runs, holidays, sags, crawls or other defects. Apply with a minimum of brush marks. Finish surfaces shall be uniform in sheen, color and texture.
- D. Paint access doors, plates, bollards, railings, panel boxes, steel grilles, louvers, convector covers, registers, exposed prime painted hardware and the like in colors as selected. Paint interior surfaces of ducts or piping where visible through registers or grilles with a flat, non-specular paint type appropriate to surface to be painted. Do not paint nameplates on equipment.
- E. Do not paint heating elements and pipes while they contain heat. Keep them cold until after the final coat has thoroughly dried.
- F. Allow coats to dry thoroughly before succeeding coats are applied; allow a minimum of 24 hours between applications on any one surface unless otherwise specified by the manufacturer.
- G. Sandpaper undercoats on metal thoroughly and uniformly to provide a smooth, even surface for finish coats.

- H. Surfaces given a prime or body coat of paint under other Sections of these Specifications will not require such coats of paint under this Section.
- I. Furnish competent technical assistance by the paint manufacturer on the job to ensure proper application of material.
- J. When using paint with additional mildew inhibitive formulation, observe the procedures and precautions in the paint manufacturer's printed instructions for the use of this product.

3.5 SCHEDULE OF PAINTING

- A. Paint surfaces exposed to view in accordance with this Schedule of Painting, except as specifically shown or specified.
- B. Concrete Block:
 - 1 coat S-W PrepRite Block Filler or Loxon Block Surfacer.
 - 2 coats S-W ProGreen 200 Low VOC Semi-Gloss.
- C. Gypsum Board:
 - 1 coat S-W Harmony Low Odor Interior Latex Primer.
 - 2 coats S-W ProGreen 200 Low VOC Eg-Shel.
- D. Gypsum Board Ceilings:
 - 1 coat S-W Harmony Low Odor Interior Latex Primer.
 - 2 coats S-W ProGreen 200 Low VOC Flat.
- E. Ferrous Metals: (omit scheduled primer below for factory primed products, except for spot priming of bare metal)
 - 1 coat S-W DTM Acrylic Primer/Finish.
 - 2 coats S-W ProClassic Waterborne Interior Acrylic Semi-Gloss (for all colors, excluding deep dark colors) or 1 coat S-W DTM Acrylic Primer/Finish.
 - 2 coats S-W Waterbased Catalyzed Epoxy Semi-gloss (for deep dark colors).

3.5 SCHEDULE OF INTERIOR COLORS

- A. As selected by Architect from manufacturer's standard range.

3.6 CLEANING

- A. Remove paint spots, oil or stains upon adjacent surfaces not requiring painting and leave entire job clean.

END OF SECTION 099123

SECTION 102800 – TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Warm-air dryers.
2. Solid-polymer toilet compartments configured as urinal screens.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
- C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
1. Each type of material, color, and finish required for units, prepared on 6-inch- square Samples of same thickness and material indicated for Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- D. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.6 WARRANTY

- A. Warranty, Electric Hand Dryers: Provide a written warranty for a period of ten (10) years for the electric hand dryers against defects. Upon notification of such defects, make necessary replacements at the convenience of the State.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 WARM-AIR DRYERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Dryer, Inc.
 - 3. American Specialties, Inc.
 - 4. Bobrick Washroom Equipment, Inc.
 - 5. Bradley Corporation.
 - 6. Excel Dryer Corporation.
 - 7. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 - 8. World Dryer Corporation.
- B. Warm-Air Dryer:
 - 1. Basis-of-Design Product: XA5-974; as manufactured by World Dryer Corporation.
 - 2. Mounting: Surface mounted.
 - 3. Operation: Electronic-sensor activated with timed power cut-off switch.
 - a. Operation Time: 30 to 40 seconds.
 - 4. Cover Material and Finish: Cast iron, with enamel finish in color selected by Architect.
 - 5. Electrical Requirements: 115 V, 20 A, 2300 W.

2.2 SOLID-POLYMER UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Accurate Partitions Corporation.
 - 2. Bradley Corporation; Mills Partitions.
 - 3. General Partitions Mfg. Corp.
 - 4. Santana Products, Inc.
 - 5. Approved equal.
- B. Urinal-Screen Style: Wall hung.
- C. Screen Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Color and Pattern: As selected by Architect from manufacturer's full range to match existing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb.
- B. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

END OF SECTION 102800

SECTION 122113 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Horizontal louver blinds with aluminum slats.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For horizontal louver blinds, include fabrication and installation details.
 - 1. Motorized Operators: Include details of installation in headrails and include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

- A. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.
 - 1. Width: 1 inch.
 - 2. Thickness: Manufacturer's standard.
 - 3. Features:
 - a. Lift-Cord Rout Holes: Minimum size required for lift cord and located near back (outside) edge of slat to maximize slat overlap and minimize light gaps between slats.
 - b. Perforated Slats: Openness factor of 6 to 7 percent.

- B. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides.
 - 1. Manual Lift Mechanism:
 - a. Lift-Cord Lock: Variable; stops lift cord at user-selected position within blind full operating range.
 - b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.
 - 2. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.
 - a. Tilt: Full.
 - b. Operator: Corrosion-resistant steel rod.
 - 3. Manual Lift-Operator and Tilt-Operator Lengths: Manufacturer's standard.
 - 4. Manual Lift-Operator and Tilt-Operator Locations: Manufacturer's standard unless otherwise indicated.
 - C. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and has plastic- or metal-capped ends.
 - 1. Type: Manufacturer's standard.
 - D. Ladders: Reinforced vinyl tape, manufacturer's standard width.
 - E. Valance: Manufacturer's standard.
 - F. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
 - G. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.
 - H. Side Channels and Perimeter Light Gap Seals: Manufacturer's standard.
 - I. Colors, Textures, Patterns, and Gloss:
 - 1. Slats: As selected by Architect from manufacturer's full range.
 - 2. Components: Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color unless otherwise indicated.
- 2.2 HORIZONTAL LOUVER BLIND FABRICATION
- A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.
 - B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch. Length equal to head-to-sill dimension of opening in which blind is installed less 1/4 inch, plus or minus 1/8 inch.
2. Outside of Jamb Installation: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.
 1. Locate so exterior slat edges are not closer than 1 inch from interior faces of glass and not closer than 1/2 inch from interior faces of glazing frames through full operating ranges of blinds.
 2. Install mounting and intermediate brackets to prevent deflection of headrails.
 3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.
- B. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.
- C. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.

END OF SECTION 122113

SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-surface-material countertops and backsplashes.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

- A. Configuration: Provide countertops with the following front and backsplash style:
1. Front: Straight, slightly eased at top.
 2. Backsplash: Straight, slightly eased at corner.
 3. Endsplash: Matching backsplash.
- B. Countertops: 3/4-inch- thick, solid surface material with front edge built up with same material.
- C. Backsplashes: 3/4-inch- thick, solid surface material.

2.2 COUNTERTOP MATERIALS

- A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
- B. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. E. I. du Pont de Nemours and Company.
 - b. Formica Corporation.
 - c. Wilsonart International.
 - d. Approved equal.
 - 2. Colors and Patterns: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

END OF SECTION 123661

SECTION 14 01 20

OWNERS FORM OF VERTICAL TRANSPORTATION

MAINTENANCE CONTRACT AND SPECIFICATIONS

FULL COVERAGE

FOR

ONE (1) HYDRAULIC TYPE PASSENGER ELEVATOR

AT

CENTRAL RAILROAD OF NEW JERSEY (CRRNJ)

JERSEY CITY, NJ

DATE: December 30, 2014 (Revised Final)
November 13, 2014

VDA NO. 12138/AP

Elevator Contractor _____

DIVISION 14 – CONVEYING EQUIPMENT

14 00 00 Conveying Equipment

14 01 00 Maintenance of Conveying Equipment

14 01 20 – Maintenance of Elevators – Full Coverage Contract and Specifications

_____ (hereinafter called the Contractor)
shall furnish services to Central Railroad of New Jersey (CRRNJ) (hereinafter called the Purchaser) on one (1) direct in-ground hydraulic type passenger elevator located at Central Railroad of New Jersey (CRRNJ) **for duration of twelve (12) months after completion of the elevator repair project and acceptance by the Authority Having Jurisdiction.**

PART 1 - GENERAL CONDITIONS

1.1 CONTRACT INTENT

- A. The purpose of this agreement is to state and define the terms and conditions under which the Contractor shall provide full comprehensive maintenance and repair services for vertical transportation systems identified, and the terms and conditions under which the Purchaser shall compensate the Contractor for such services rendered.
- B. It is the intent of this Contract to ensure all requirements, procedures, tests, inspections, service practices, component repairs, equipment renewals, system adjustments, filing procedures and recording documentation as referenced, mandated or otherwise implied herein are all inclusive, and to guarantee the Purchaser the absence of a particular item of work, service or procedure shall not alleviate the Contractor of the sole responsibility to provide such labor, expertise, materials, equipment, services or other procedures applicable to the agreement and practical requirements unless same is specifically excluded, prorated or deleted herein.
- C. Minimum standards and requirements for services to be rendered shall be performed in accordance with the specifications and relative time periods. Where there is no specific requirement for a preventive maintenance procedure, the original equipment manufacturer (O.E.M.) standard shall be employed unless there is no relative documentation available. The absence of both a contract requirement herein and the O.E.M. design standard shall cause the contractor to engage the services of a qualified engineer to formulate the relative standards and incorporate same as an addendum to this agreement with the Professionals' Seal and Stamp.

1.2 DEFINITIONS OF TERMS

- A. The term “Purchaser” or “Owner,” as used herein, refers to the person, organization, corporation or other entity representing building ownership and the relative responsibilities under this contract.

- B. The term Purchaser's or Owner's "Agent," "Designee," "Representative" or references of similar import, as used herein, refers to any outside agent hired or retained by the Owner(s) for the purpose of providing management services that has been deemed a legal representative of the Owner(s) or any person designated by the Owner(s) as the legal representative of the Owner(s) for the purpose of coordinating and purchasing this contract.
- C. The term "Authority," "Governing Authority (GA)", "Authority Having Jurisdiction (AHJ)," or references of similar import, as used herein, shall mean the local government agency responsible for enforcement of vertical transportation safety codes and local laws or their designated representative, private inspection agency, consultant or other licensed designee.
- D. The term "Contractor," "Elevator Contractor" or "Vendor" as used herein, refers to any persons, partners, firm, corporation or officer (s) of such companies having an agreement with the "Purchaser / Owner" to furnish qualified labor and materials for the execution of the services and maintenance work described herein.
- E. The term "Subcontractor," as used herein, refers to any persons, partners, firm or corporation having materials and/or labor for the execution of the work herein described.
- F. The term "Consultant," as used herein, refers to VDA® (Van Deusen & Associates), Seven Penn Plaza, Suite 404, New York, NY 10001.
- G. The term "Agreement," "Contract" or "Contract Documents," as used herein, consists of this specific document, pages one (1) to twenty-two (22); and any alternates, addenda, or substitutions as may be referenced under exhibits or riders approved by the parties for the final execution of the Agreement.

1.3 ABBREVIATIONS AND SYMBOLS

- A. Abbreviations for associations, institutions, societies, reference documents and/or governing agencies, which may appear in the Contract Document, shall mean the following:

AIA	American Institute of Architects
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
BOCA	Building Officials and Code Administrators International, Inc. (Basic National Building Code)
A.H.J.	Authority Having Jurisdiction
G.A.	Governing Agency
NEC	National Electrical Code
OSHA	Occupational Safety and Health Administration

1.4 AGREEMENT COVERAGE

- A. The entire vertical transportation system(s) shall be maintained as hereinafter described, in accordance with the following detailed terms. Trained employees of the Contractor will use all reasonable care to keep the systems in proper adjustment and in safe operating condition, in accordance with all applicable codes, ordinances and regulations. The requirements are specified in the singular with the understanding that all provisions shall be applicable to all units indicated unless otherwise specified.

- B. The specifications are written in the singular with the understanding identical work, materials and equipment shall be provided for all vertical transportation units identified unless otherwise specified.
- C. With the exception of only those items specifically identified as being performed by others, the contract specifications are intended to include all engineering, material, labor, testing, and inspections needed to achieve work specified by the contract. Inasmuch as it is understood that any incidental work necessary to execute the agreement is also covered by the contract specifications, the contractor is cautioned to familiarize himself with the existing equipment and job site conditions. Additional charges for material or labor shall not be permitted subsequent to execution of the Contractual Agreement for work, services or procedures covered herein.
- D. Maintenance coverage shall include, but is not limited to, preventive services, emergency call-back services, inspection and testing services, repair and/or direct replacement component renewal procedures.

1.5 HOURS OF WORK

- A. All scheduled work shall be performed during regular working hours of the regular working day of the elevator trade, 8:00 A.M. to 4:30 P.M., Monday through Friday, except union designated holidays.
- B. Scheduled repairs and/or other major adjustment procedures necessitating removal of an elevator for an extended period of time must be scheduled through the Purchaser or Owner Designee.
 - 1. The Purchasers' Representative retains the right to have such work completed during overtime hours with the understanding the Contractor shall pay for the regular labor portion and the Owner's / Purchasers' extraordinary obligation is extra premium labor costs only.
 - 2. Emergency call-back services shall be provided twenty-four (24) hours per day, seven (7) days per week including weekends and holidays as further specified herein.

1.6 SOLE RESPONSIBILITY

- A. The maintenance work shall be performed only by Qualified Technicians and Mechanics directly employed and supervised by the Contractor, who are experienced and skilled in maintaining vertical transportation units similar to those to be maintained under this Contract and shall not be assigned or transferred to any agent or subcontractor without the express consent of the Owner's Designee or Purchaser.
- B. It is mutually agreed that the Contractor shall not be under any obligation hereunder to make any repairs or replacements except those incidental to the normal operation of the machinery, and that the Contractor is not required under this Contract to make repairs or replacements necessitated by reason of malicious damage, fire, including non-elevator component electrical fire, which are the result of causes beyond Contractor's control. All repairs, if necessitated by this paragraph, will be performed at a fee not to exceed the standard rate in effect at the time service is performed.

1. It is mutually agreed that the Contractor shall make any and all repairs or replacements damaged by Contractor's improper repair, negligent or willful acts or omissions.

1.7 COMPENSATION

- A. **Payment for services rendered for the first twelve (12) months after the project completion and acceptance shall be included in the base modernization/upgrading price.**
 1. **Payment for Emergency Call-back services shall be included in the fixed base lump sum price for services rendered twenty-four (24) hours per day, seven (7) days per week, without extra charge to the Purchaser / Owner.**

1.8 NOTICE BY AUTHORITY OR COMPANY TO REPAIR OR REPLACE

- A. The Contractor shall comply with all written recommendations of the governing authority or independent inspectors, consultants and insurance carriers employed by the Owner. However, Contractor is not required under this Contract to install new attachments or parts other and different from those now constituting the equipment, as recommended or directed by insurance companies, Government Authorities, or otherwise.

1.9 RECORD KEEPING

- A. A complete permanent record of inspections, maintenance, lubrication and call-back service shall be kept in the machine room or other designated location at the site of work. These records are to be available to Owner's Designee at all times. The records shall indicate the reason the mechanic was in the building, arrival and departure time, the work performed, etc., and these records will be property of the Owner. Record keeping requirements shall include Contractor assigned maintenance personnel and scheduled preventive maintenance procedures, inspections, tests and third party assisted examinations.

1.10 RECORD DRAWINGS

- A. Contractor shall provide and maintain two (2) complete sets of updated electrical wiring diagrams and control schematic drawings on file with the building and they are to become the property of the Owner for each group and/or individual system.

1.11 REPORTS BY CONTRACTOR

- A. The Contractor shall, at any time during the term of this Contract, upon written request of the Owner, render a report of inspections, repairs or replacements made by the Contractor at the premises herein, itemized as to parts installed or services performed and supply samples of lubricants, compounds, or other materials employed.
 1. Contractor shall prepare and issue all required forms and/or reports relative to examinations, tests and inspections as specified herein.

1.12 PRICE ADJUSTMENT

A. Labor Contracts and Overtime:

1. It is further understood and agreed that the Contractor shall furnish to the Owner in duplicate, a copy of his current labor contract and any subsequent labor contracts effective during the term of this Contract pertaining to his elevator maintenance personnel, and the Contractor further agrees to furnish any additional information concerning overtime charges to the Owner at any time upon request.

B. The Contractor shall be entitled to a review of his labor and material costs for the purpose of adjusting the maintenance fee thirty (30) days prior to the annual renewal date of this agreement each year.

C. Upon submission of proof, satisfactory to the Owner, that the Contractor's actual labor and/or material costs for performance of service have changed, the monthly price for service coverage shall be adjusted in an amount equal to the established variance based on the following formula:

1. Eighty percent (80%) of the current fee shall be used to represent the labor portion of the contract.
2. Twenty percent (20%) of the current fee shall be used to represent the material portion of the contract.

D. The current labor portion of the contract shall be increased or decreased by the percentage of increase or decrease of the current straight-time hourly rate for a mechanic, compared with same rate used for the previous year's labor portion of the agreement.

1. The initial base labor cost amount is \$_____. This represents the cost of the maintenance Mechanic's hourly wage with associated cost fringe benefits. (No additional overhead or profit.)

E. The current materials portion of the contract shall be adjusted based on the established monthly difference in the "Producer Commodity Prices for Wholesale Metals and Metal Products Index" as published by the United States Department of Labor, Bureau of Labor Statistics during the month within such adjustment occurs for comparison.

1. Using October 2014 as the base month, the material factor is 214.9.

F. Annual adjustments shall be effective the first day of the new contract and shall remain unchanged for the next twelve (12) months.

G. Notwithstanding anything to the contrary, the maximum annual increase shall not be more than five percent (5%) of the total contracted payment for the preceding contract year.

1.13 INSURANCE COVERAGE

A. The Contractor shall not commence work under this contract until it has been agreed to and obtained the following minimum insurance coverage:

1. The Contractor hereby agrees, to the fullest extent permitted by law, to assume the entire responsibility and liability for the defense of and to pay and indemnify the Owner, their agent and employees against any loss, cost expense, liability or damage and will hold each of them harmless from and pay any loss, cost, expense, liability or damage (including without limitation, judgment, attorney's fees, court costs and the cost of appellate proceedings) which the Owner incurs because of sickness, injury to or death of any person or on account of damage to or destruction of property, including loss of use thereof, or any other claim arising out of, in connection with, or as a consequence of the performance of the services or the furnishing of the equipment and supplies and/or any acts or omissions of the Contractor or any of its officers, directors, employees, agents, subcontractors, or anyone directly or indirectly employed by the Contractor for whom it may be liable as it relates to the scope of this contract.
2. The Contractor shall, before the commencement of any provisions of any services, file certificates, showing existence of such insurance with the Owner, and such insurance shall be subject to the Owner's approval as to the adequacy of protection and compliance with this Contract, and the satisfactory character of the Insurer. Such insurance shall be placed with Licensed and Admitted carriers to write insurance and do business in the State of New York. Licensed for Surplus is not acceptable.
3. The Owner agrees to give the Contractor notice within a reasonable time (Sunday and holidays excluded) of any accidents, alteration or change affecting the equipment covered by this contract and of any change of Ownership. It is understood and agreed that the Contractor will notify the Owner immediately when any equipment becomes unsafe or operating in a manner which might cause injury to anyone using said equipment and it is further understood and agreed that the Contractor will immediately remove any equipment from service when the equipment becomes unsafe or operating in a manner which might cause injury to anyone using said equipment.
4. The Contractor agrees to maintain such insurance as will fully protect the Contractor, Agent and the Owner of the building from any and all claims under worker's compensation act or employers liability laws, and from any and all other claims of whatsoever kind of nature for damage to property or for bodily injury, including death to anyone whomsoever, that may arise from the operations of the Contractor.
5. Prior to the commencement of operations, Contractor will purchase and maintain the following minimum insurance as will protect it, the Owner and the Owner's agents from any claim which may arise out of a result of Contractors operations under this service contract whether such operation shall be by the Contractor, its employees or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable:
 - a. Commercial General Liability Insurance on an Occurrence basis including:
 - 1) Bodily Injury, Property Damage including Personal Injury and death.
 - 2) Per Project" endorsement.
 - 3) Broad form property damage liability.
 - 4) Blanket Contractual Liability including contractual liability assumed by this contract.
 - 5) Independent Contractors Protective Liability coverage. The minimum limit for Comprehensive Liability insurance coverage shall be:
 - a) Each Occurrence: \$1,000,000
 - General Aggregate: \$2,000,000
 including "Per Project" endorsement Products & Completed

- Operations Aggregate: \$1,000,000
- b) Excess liability limits of not less than:
Each Occurrence: \$4,000,000
Coverage to follow form of underlying policies.
- c) Worker's Compensation Insurance - In accordance with the statutory limits.
- d) Employer's Liability Insurance – With a minimum limit of not less than:
Bodily Injury by Accident: \$1,000,000 each accident
Bodily Injury by Disease: \$1,000,000 each employee
Bodily Injury by Disease: \$1,000,000 policy limit
- e) Statutory State Disability Benefits Insurance covering all persons employed by the Contractor in connection with this contract.
- B. The foregoing insurance policies shall be primary to any other insurance which may be carried by the Owner and shall name Owner as additional insured with a specific policy endorsement as follows:
- Central Railroad of New Jersey (CRRNJ)
 - STV, Inc.
 - VDA® (Van Deusen & Associates)
- C. Certificates of Insurance evidencing such coverage shall be filed with the Owner prior to the commencement of the contract and renewal of insurance certificates shall be furnished prior to the expiration of any coverage herein.
- D. The policies shall contain a provision giving Owners at least thirty (30) day prior written notice of any change or cancellation of such insurance, in the event of cancellation of Non Payment of Premium, in which ten (10) day notice will be provided. This notice will be included on the Certificate of Insurance.
- E. All insurance must be with a licensed and Admitted (licensed for Surplus Lines is not acceptable) insurance carrier with and maintain no less than, A.M. Best's rating of "A-, size VII and shall be acceptable insurance carriers subject to the discretion of Owner.
- F. The Contractor agrees that the required insurance is not intended to limit the Contractor's liability in the event the Contractor is deemed to be negligent in causing bodily injury or property damage during the course of its operation.
- G. The Contractor will, at its own expense, maintain physical damage insurance in the amounts and against the perils desired by the Contractor on all property owned or rented by the Contractor. The Contractor hereby waives its rights of recovery against the owner for any damage or loss to property of any kind which is owned or rented by Contractor or for which the Contractor is liable.

1.14 CANCELLATION

- A. The Purchaser/Owner shall have the right to cancel this Contract upon at least thirty (30) days prior written notice to the Contractor of its election to do so without penalty for the following:
 - 1. Elective upgrading of apparatus awarded to another vendor.
 - 2. Substandard services and/or poor maintenance practices as confirmed by the Consultant or other qualified professional.
 - 3. Failure to comply with governing authority directives and/or citations.
 - 4. Cost analysis completed prior to expiration date.
- B. In addition to the rights provided in paragraph "A" hereunder, the Purchaser/Owner shall have the right to cancel this Contract immediately, upon the occurrence of any of the following contingencies: bankruptcy of the Owner or Contractor, mortgage foreclosure, condemnation, destruction, or transfer or conveyance of Title to the premises in which the subject equipment is located or the premises in which the subject equipment is located is rendered unusable in the opinion of the Purchaser/Owner.
- C. Cancellation of this agreement prior to the expiration date shall entitle the contractor to payment for services rendered up to and including the date of cancellation; and, the Purchaser shall not be responsible for any expenses or subsequent costs that may be incurred by the contractor as a result of an early cancellation or standard contract agreement expiration.

1.15 NOTICES

- A. All notices to be given under the contract shall be in writing and addressed to the party to be notified, postage prepaid, by registered or certified mail, return receipt requested, or by delivering the same in person to such party. All notices shall be deemed to have been given as of the date of delivery indicated on the return receipt or date of failure to deliver by reason of changed address of which no notice was given or refusal to accept delivery, or when personally delivered. Any party or person to whom notices are to be sent or given pursuant to the Contract may, by notice to all such other parties or persons mentioned herein, change its address for the giving of notices, provided, however, that a notice of change of address shall be deemed effective only when received by the addressee. Notices to be given hereunder shall be sent or delivered to:

Contractor:

Purchaser Designee/Owners' Representative:

STV, Inc.
205 West Welsh Drive
Douglassville, PA, 19518
Attn: David Ziskind

1.16 PAYMENT/TERMS

A. **This service will be furnished from the date of the repair project acceptance by Authority Having Jurisdiction for the period of one (1) year.** All replacement parts, repairs, adjustments and associated services, as specified herein, shall be supplied, installed, performed and conducted at the Contractor's sole cost and expense unless otherwise specified herein.

1. Automatic Renewal:

a. The Purchaser/Owner shall have the right to renew this agreement on a year-to-year basis upon expiration of the initial Contract period. All terms, conditions and provisions shall remain intact.

2. The Purchaser/Owner agrees to pay the Contractor on a monthly basis, the fee of _____ Dollars (\$ _____) during the term of this agreement, subject to price adjustments as specified herein.

a. Monthly invoices shall indicate the base monthly portions of the contract amount due under the agreement for maintenance services.

b. Any state or local tax charges, which may be applicable, are not included in the monthly fee indicated and shall be itemized on the monthly billing invoice statement accordingly.

c. Extraordinary work and/or other work, as approved by the Purchaser/Owner, shall be invoiced separately upon completion and acceptance of the work or other services performed.

1.17 NON-PAYMENT

A. The Purchaser/Owner may have the Contractor's work and systems' performance operations checked monthly to ensure the Contractor is performing in accordance with this Contract. If the work requirements are not maintained, the Purchaser/Owner will retain the monthly payment to the Contractor until the Consultant verifies that the work and/or operating performance is back to standard. If three (3) consecutive months of substandard maintenance is noted, the Owner has the right to immediately cancel the Contract without notice to the Contractor.

B. The Consultant, Purchaser and/or Owner's Designee may withhold approval for payment on any request to such extent as may be necessary to protect the Owner from loss on account of:

1. Negligence on the part of the Contractor to execute the work properly or failure to perform any provisions of the contract. The Owner, after three (3) days written notice to the Contractor, may, without prejudice to any other remedy, make good such deficiencies and may deduct the cost of the contract.

2. Claims filed or reasonable evidence indicating probable filing of claims due to the Contractor's failure to perform.
3. Failure of Contractor to make payments properly to subcontractors for material and labor used to fulfill contractual requirements.
4. Damage to the building as a result of work performed or another subcontractor's failure to perform.

1.18 ERRORS AND OMISSIONS

- A. Contractor shall notify the Purchaser and Consultant in writing regarding any necessary services, coverage or items which may have been omitted from the maintenance contract specifications and any irregularities, discrepancies or duplications that could affect the full comprehensive intent of the agreement.
 1. Any duplication of work or coverage is specified as a means of demonstrating the contract requirements, but such duplication if any, is not intended to expand coverage or increase requirements for such work or services and such duplication shall not increase costs or provide justification for extra or additional charge to the Purchaser.

1.19 LABOR LAWS

- A. The Contractor performing work under this contract shall comply with applicable provisions of all federal, state and local labor laws.

1.20 ASSIGNMENTS

- A. Neither party to the contract shall assign the contract or sublet it as a whole without the written consent of the other, nor shall the Elevator Contractor assign any payment due him or to become due to him hereunder without the previous written consent of the Owner.

1.21 FORCE MAJEURE

- A. Neither party shall be liable by reason of any failure or delay in the performance of its obligations due to strikes, riots, fires, explosions, acts of God, war, governmental action or any other cause which is beyond the reasonable control of such parties. The performance of such party shall be excused for such reasonable time as may be required to resume performance following cessation of such cause.

1.22 CONTRACTOR'S LICENSE

- A. If required by law, Contractor certifies that it is licensed in the state, municipality and/or local jurisdiction where the property is located to perform the elevator maintenance services pursuant to this Agreement, and that the license will be maintained current and valid for the Initial Term and any renewal term of this Agreement.

1.23 WAIVER

- A. A waiver by either party of any term or condition of this Agreement in any instance shall not be deemed or construed as a waiver of such term or condition for the future, or of any subsequent breach thereof. All remedies and rights of the parties contained in this Agreement shall be cumulative.

1.24 ATTORNEYS' FEES

- A. In the event litigation be commenced by either party hereto against the other in connection with the enforcement of any provision of this Agreement, the losing party shall pay all court costs and shall pay to the prevailing party all expenses incurred by the prevailing party in litigation, including attorneys' fees in a reasonable amount to be determined by the court. The amount so allowed as attorneys' fees shall be taxed to the losing party as costs of the suit, unless prohibited by law.

1.25 LIMITATION OF LIABILITY

- A. It is expressly understood and agreed by the Parties that Purchaser, its parent, subsidiaries and/or affiliates shall not be liable or responsible in any way for any loss of or damage or injury to any equipment as referred to in this Agreement or other personal property belonging to Contractor or any personnel of Contractor while in any area of the building; nor shall Purchaser, its parent, subsidiaries and/or affiliates be liable for any injury suffered by any personnel of Contractor while on or in the Owner's property. Personnel of Contractor shall make all necessary arrangements for the safety and security of such equipment and other personal property at all times.

1.26 AGREEMENT DESIGN

- A. It is agreed that this Agreement and any attachment and/or exhibits are contractual in nature and voluntarily entered into by both Parties as their free act and deed, acting in their individual judgment without reliance upon any statement or representation of the other party. This Agreement, any attachments and exhibits constitute the entire understanding, oral or written, between the Parties, and supersedes any and all prior discussions and/or agreement between the Parties. The parties agree that any alteration to any exhibits, attachments or addenda noted therein or herein, and attached hereto shall be null and void, unless made in writing by mutual agreement or Customer and Contractor. The Parties agree to execute whatever additional documents are deemed reasonably necessary to effectuate this transaction.
- B. Both parties have participated in the preparation of this Agreement, and have been afforded the opportunity to have this Agreement reviewed by legal counsel and/or other consultants of their choice. It is agreed that the normal rule of construction against the drafter shall not apply to the provisions of this Agreement.

1.27 SEVERABILITY AND REFORMATION

- A. This Agreement is binding upon the Parties, their respective successors, assigns and legal representatives. If a Court, having competent jurisdiction, determines that one or more of the provisions is invalid or unenforceable, the Court will have the right to modify same to the minimum extent necessary to make it valid and enforceable, with the rest of this Agreement remaining unaffected by such conclusion or reformation.

1.28 SURVIVABILITY

- A. The parties agree that it would cause an undetermined amount of damages to the other party if either fails to comply with any terms and conditions governing the handling of each other's confidential and proprietary information, or the representations, warranties and indemnifications agreed to under this Agreement and/or hereunder, all of which shall survive any early termination or expiration of this Agreement, and shall remain in full force and effect for the later of a period of one (1) year from the date of termination or expiration of this Agreement, or the date the Information is returned to whoever disclosed such information, after the date of termination or expiration of this Agreement.

PART 2 - PRODUCTS AND SERVICES

2.1 SCHEDULED PREVENTIVE MAINTENANCE LABOR

- A. Contractor shall provide scheduled systematic examinations, adjustments, cleaning and lubrication of all machinery, machinery spaces, hoistway and pit. The Contractor shall include a minimum of two (2) hours per month that is to be dedicated to routine preventive maintenance.

2.2 CLEANING

- A. The Contractor shall during the course of all examinations remove and discard immediately all accumulated dirt and debris from the car top and pit area. Prior to each annual anniversary date of this Agreement, Contractor shall thoroughly clean down the entire hoistway of all accumulated dirt, grease, dust and debris each year.

2.3 PAINTING

- A. The Contractor shall keep the exterior of the machinery and any other parts of the equipment subject to rust properly painted, identified and presentable at all times. Motor windings and controller coils shall be periodically treated with proper insulating compound. The machine room floor and all storage areas shall be painted annually with a good quality deck enamel.

2.4 INSPECTIONS / TESTS

- A. The Contractor shall conduct Safety, Efficiency and Maintained Conditions surveys, inspections and tests as follows:
1. Semi-Annual quality control evaluations by a qualified supervisor to ensure and confirm the services and procedures as specified herein are properly executed relative to maintenance and performance standards for the systems serviced.
 2. Mandated inspections and testing in accordance with ASME A17.1 Standards applicable per local law; filing of all procedures and payment of all relative fees per the Authority Having Jurisdiction (A.H.J.) and preparation of reports within the required time periods for the examination(s) rendered.
 3. If applicable, independent testing of Fire Emergency Operating Systems and/or Emergency Power System tests in accordance with local law requirements and ASME standards.
 4. The Owner retains the right to have these tests performed on a not-to-interfere basis at any hour of the day and any day of the week; and the cost for overtime work shall be limited to the premium labor portion for work performed on an overtime basis.

2.5 EMERGENCY CALL-BACK SERVICE (24 HOURS, 7 DAYS PER WEEK)

- A. Provide emergency call-back service which consists of promptly dispatching qualified employees in response to requests from the Owner or designated representative, by telephone or otherwise, for emergency adjustment or minor repairs on any day of the week, at any hour, day or night. If repairs cannot be made immediately, the mechanic shall notify the Owner's Representative as to the reason why and provide supplemental information regarding the restoration of services.
1. Call-back service in response to passenger entrapments shall be provided within one-half ($\frac{1}{2}$) hour during regular working hours and within one (1) hour during overtime periods.
 2. Call-back services for out-of-service units that have been secured by the Owner's Representative shall be provided within one (1) hour during regular working hours and within two (2) hours between 6:00 a.m. and 8:00 a.m. and 4:30 p.m. and 6:30 p.m. Monday through Friday, except holidays.
 3. Call-back services for out-of-service units that have been secured by the Owner's Representative shall be provided within three (3) hours at all other times not specified above in "1" or "2."
 4. Call-back services for non-essential system malfunctions that do not constitute an operational or other safety condition shall be provided during normal working hours of regular working days within four (4) hours of the request for service.

2.6 REPAIRS, RENEWALS, AND REPLACEMENTS

- A. Repairs, renewals, and replacements shall be made by the Contractor as soon as scheduled or other examinations reveal the necessity of the same, or when the Customer so advises the Contractor under the terms of this Agreement. It is understood and agreed that repairs,

renewals, and replacements shall be made in accordance with high standards of preventive maintenance practice and that the repair and renewals of parts made shall be equal in design, workmanship, quality, finish fit, adjustment, operation and appearance to the original installation and that replacements shall be new and genuine parts equal to those parts supplied by the manufacturer of the original equipment or its successor, and shall apply to the repair, renewal, or replacement of all mechanical, electronic, and electrical parts, including but not limited to the following:

1. Automatic door systems, power operated door systems and manual door/gate systems complete.
 - a. Power operator and engagement linkages.
 - b. Car door top track and hanger roller assemblies.
 - c. Car door track liners, eccentrics, stops, bumpers and related operating mechanisms for multiple speed or multiple panel doors.
 - d. Car gates, bottom guides, retainers, fire stops, gibs, entrance sills and threshold plates, gate handles and protection guards.
 - e. Electrical safety switches and activation mechanisms, door protective and/or retracting devices, and power door operators.
 - f. Electromechanical safety interlock assemblies, related operating mechanisms, clutch or other master system engaging devices, linkages, zoned locking devices, and self-closing devices.
2. Car frame, platform and car safety devices complete.
 - a. Crosshead, stiles, hitch plates, tie rods, supports and related structures.
 - b. Car guides, shoes, stands, spindles, gibs, rollers and tensioning devices.
 - c. Sub-platform, under car platform fireproofing, car sills with support cradles, load weighing devices, top/side exit access operating/safety hardware and electrical switches.
 - d. Car fans, blowers and cab ventilation systems.
3. Hoisting machinery, and rotating power drives with mounting supports and beams, raised platforms and weighted foundations and structures complete.
 - a. Worms, gears, shafts, couplings, drive sheaves, deflector sheaves, 2:1 sheaves, bearings, support/mounting apparatus, brake assembly, rotating elements and all associated castings, guards, retainers and hardware.
 - b. Integral and free standing brake units, drums, discs, pulleys, shoes, linings, pads, pins, sleeves, plungers, coils, caps, adjustment devices and hardware complete.
 - c. AC and DC motors, motor generators, rotating regulators and exciters; armatures, field coils, pole pieces, interpoles, commutators, brush riggings, brush holders, carbon brushes, stator windings, fan or other ventilation mechanisms, bearings, bushings, shafts, caps, packings, seals, junction boxes, leads, connectors and related wiring.
4. Controls, selectors, power drives, encoding devices with related wiring, conduit and circuitry complete.

- a. Relays, contactors, switches, capacitors, resistors, fuses, circuit breakers, overloads, power supplies, regulators, tach generators, arc shields, shunts, holders and hardware.
 - b. Circuit boards, transmitters, encoders, transformers, rectifiers, transistors, solid state switching devices, insulators, timing devices, suppressors, and computer apparatus.
 - c. Filters, fans, blowers, wiring, studs, terminal blocks, plug connectors, CRTs or other diagnostic devices, keyboards and printers.
 - d. Cabinets, isolation transformers, chokes, diagnostic tools, status indicators, solid state and hard wire circuitry.
5. Hoistway and pit equipment.
- a. Guide rails, fishplates, brackets, inserts and related hardware to include jack bolts or other special mechanisms for mounting and alignment.
 - b. Wire ropes, chains and cables used for suspension, compensation, safety and selector encoding with related hitch and connection hardware complete.
 - c. Corridor entrance top track and hanger rollers, toe guards, fascias, dust covers, sills, stops, bumpers, eccentrics, retainers, and bottom guides.
 - d. Electrical wiring and conduit, electrical traveling cables, electrical limits, slow-downs, activating cams, switches, vanes, inductors, tapes, readers, leveling and encoding systems complete with all related hardware and wiring.
 - e. Car buffers, stands, strikes, blocking, platforms, extension devices, mounting hardware and appurtenances.
 - f. Pit safety switches, cable tensioning devices, access ladders, light switches, lighting assemblies, bulbs and guards.
6. Operating and signal fixtures with electrical wiring.
- a. Car operating panels, push buttons, stop switches, audible signals, keyed or other control switches, visual signals, jewels and indicators with electrical wiring.
 - b. Car position indicators, riding lanterns, signal annunciators, visual and audible signals complete.
 - c. Corridor push button stations, hall lanterns, hall position indicators, keyed switches, access controls, electrical wiring and traveling cables complete.
 - d. Emergency lighting systems, emergency communication devices, and signal systems complete.
 - e. Corridor and lobby fixtures with remote controls and operational monitoring devices, starter panels, emergency power selectors, telltale panels, location indicators, security controls and monitors.
7. Hydraulic system components, including but not limited to, tanks, valves, pump, cylinder head, above ground piping, hoses, fittings, gauges, seals, O-Rings, filters, screens, packings, belts, recovery devices overflow devices, rescuator or other emergency operating and signal systems, above grade cylinder and plunger assemblies complete, mufflers, heaters and shut-off valves.
8. The following items of equipment are excluded: Main line power switches and fuses, car enclosure, car doors, hoistway enclosures, hoistway doors and door frames.

2.7 OBSOLESCENCE

- A. For the purpose of this contractual contingency, Component Obsolescence shall be defined as the inability to purchase and/or otherwise repair parts of the system no longer produced by the original equipment manufacturer or a third-party after market supplier.
- B. In the event equipment and/or a component part thereof, as covered under this agreement, cannot be replaced on a direct exchange basis or repaired using readily available components and labor, the condition shall be reported to the Owner designee with the following information:
 - 1. Alternative equipment or component parts renewal options for restoration of the system due to obsolescence.
 - 2. Procurement and installation time for restoration of system service.
 - 3. Any Local Law or safety code requirements that will be triggered by the alternative equipment or component renewal (i.e., including filing, tests and approvals).
- C. Payment for obsolescence work shall be based on the extra cost to the contractor only.
 - 1. Labor cost over and above the time necessary for standard equipment and component renewal or repair procedures.
 - a. Contractual hourly rate schedule as provided under Exhibit 'A' shall be used to compute the extraordinary labor charge if applicable.
 - b. Actual material extra cost to the contractor minus the value of the standard component replacement cost plus a maximum of five percent (5%) mark-up on the cost variance only.
 - c. At Owner's option, a lump sum extra cost price may be employed in lieu of time and material as indicated above.
 - 2. Subsequent to the Owners authorization to proceed with an alternative obsolescence repair and approval of the relative extra cost, if any, the contractor shall immediately perform such work and restore operating services.
- D. The Owner shall retain the right to competitively bid obsolescence repairs and replacements; and, such work as performed by another qualified contractor shall not diminish or otherwise alter the coverage provided under this agreement subject to the following:
 - 1. The maintenance contractor has the right to inspect work performed by others; and, when conditions warrant, reject obsolescence procedures that increase their contractual liability.
 - a. Should the contractor reject an obsolescence repair by others, a qualified third party consultant shall be commissioned to evaluate work and render a decision regarding the acceptability of the prevailing conditions.

2.8 SCHEDULED SERVICE PROCEDURES

- A. Maintenance requirements, in addition to scheduled and emergency repairs, renewals and testing, shall include but are not limited to:
1. Examination of wire ropes to maintain proper tensioning and legal bottom clearances on a monthly basis for shortening and adjusting ropes as required and performance of all reshackling procedures per ASME A17.1 standards and local laws in conjunction with maintenance of related slack cable devices, machine limits or other safety equipment.
 2. Examination, repair and replacement of all electrical wiring, traveling cables, conduits, connections and related apparatus extending from the main line power supply switch in the machine or other power supplies in hoistways.
 3. Maintenance of pit, hoistway and machine room lighting to include relamping, wiring and switch controls.
 4. Mandated inspections and relative labor requirements for third party examinations and/or test procedures as approved by the purchaser.

PART 3 - EXECUTION AND SUPPLEMENTAL REQUIREMENTS

3.1 PERFORMANCE TIMES, LEVELING AND CONTRACT SPEED (ELEVATORS)

- A. The control system shall be maintained to provide smooth acceleration and retardation. Contractor must maintain elevators in accordance with the original equipment manufacturer (O.E.M.) design performance specifications (including floor-to-floor times, door timing, rated speed, group supervisory system, etc.). The door close pressure must never exceed 30 pounds. The following performance schedule shall be adhered to:

1. Contract Speed: The contract speed shall be provided for up direction travel with full-capacity load in the elevator car. The speed in either direction under any loading condition shall not vary more than 5% of the contract speed.
2. In accordance with the ASME A17.1 Code, the elevators shall be maintained and adjusted to safely lower, stop and hold the car with a load of 125% of the rated capacity.
3. Leveling Accuracy: The elevator shall be adjusted to provide accurate leveling within 1/4" ± of the floor level without releveling regardless of load.
4. Door Operating Times:

Door Type	Opening	Closing
3'-0" side opening	2.3 sec.	4.9 sec.
Door dwell time for hall calls:		4.0 sec with Advance lantern signals
Door dwell time for hall calls:		5.0 sec without Advance lantern signals
Door dwell time for car calls:		3.0 seconds
Reduced non-interference dwell time:		1.0 seconds.

3.2 PARTS INVENTORY AND WIRING DIAGRAMS

- A. The Contractor shall maintain an inventory of spare parts at the site of the work for scheduled preventive maintenance procedures and common emergency call-back service repairs. Such parts shall include but are not limited to contacts, coils, solid-state boards, relays, resistors, timing devices, computer devices, interlock safety switch and linkage parts, bottom guides, door closers, fuses, bulbs, car guides and an assortment of hardware.
- B. The Contractor shall maintain and continually update wiring diagrams and control schematics to ensure "as built" documents remain on site and the property of the Purchaser per the maintenance agreement.

3.3 MATERIALS AND WORKMANSHIP

- A. All materials and parts are to be new and of the best quality of the kind specified. Installation of such materials shall be accomplished in a neat workmanlike manner. In case the Contractor should receive written notification from the Owner stating the presence of inferior, improper, or unsound materials or workmanship, the Contractor shall, within twenty-four (24) hours proceed to remove such work or materials and make good all other work or materials damaged thereby. If the Owner permits said work or materials to remain, the Owner shall be allowed the difference in value or shall, at its election, have the right to have said work or materials repaired or replaced as well as the damage caused thereby, at the expense of the Contractor, at any time during the Contract term; and neither payments made to the Contractor, nor any other acts of the Owner shall be construed as evidence of acceptance and waiver.

3.4 EQUAL OPPORTUNITY

- A. The Contractor shall maintain policies of employment as follows:
 - 1. The Contractor and all Subcontractors shall not discriminate against any employee or applicant for employment because of actual or perceived race, creed, color, religion, national origin, ancestry, alienage or citizenship status, age, disability or handicap, sex marital status, familial status, veteran status, sexual orientation, arrest record or any other characteristic protected by applicable federal, state and local laws. The Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their actual or perceived race, creed, color, religion, national origin, ancestry, alienage or citizenship status, age, disability or handicap, sex marital status, familial status, veteran status, sexual orientation, arrest record or any other characteristic protected by applicable federal, state and local laws. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

2. The Contractor and all Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to actual or perceived race, creed, color, religion, national origin, ancestry, alienage or citizenship status, age, disability or handicap, sex marital status, familial status, veteran status, sexual orientation, arrest record or any other characteristic protected by applicable federal, state and local laws.

B. EEO EMPLOYMENT PRACTICES AND COMPLIANCE

1. The parties hereto agree to voluntarily comply with the basic tenants of the Equal Employment Opportunity Requirements of Executive Order 11246, as amended by Executive Order 11375, Title VII of the Civil Rights Restoration Act of 1964, as amended, applicable state Fair Employment Practices Acts, and any other federal or state laws pertaining to equal employment opportunity, and that they will not discriminate against any employee or applicant for employment on the basis of actual or perceived race, creed, color, religion, national origin, ancestry, alienage or citizenship status, age, disability or handicap, sex marital status, familial status, veteran status, sexual orientation, arrest record or any other characteristic protected by applicable federal, state and local laws in matters pertaining to recruitment, hiring, training, upgrading, transfer, compensation or termination. In addition, Contractor agrees to indemnify and hold harmless Owner, its parent, affiliates, employees, agents, representatives, and any of its or their officers, directors, employees, agents, successors, or assigns, harmless from all loss, cost or expense, including reasonable attorneys' fees for any violation by Contractor, its employees, agents, representatives, or assigns of the rules and regulations set forth and enforced by the Immigration and Naturalization Services pursuant to the Immigration and Nationality Act, as well as the Illegal Immigration Reform and Immigrant Responsibility Act which obligation to indemnify shall survive the expiration or termination of this Agreement.
2. Contractor agrees to maintain comprehensive records of all services performed under this Agreement. These records will be available for inspection by Purchaser at anytime during regular business hours and upon 48 hours written notice.

3.5 PROTECTION OF WORK AND PROPERTY

- A. The Contractor shall continuously maintain adequate protection of all his work from damage and shall protect the Owner's property from injury or loss arising out of this contract. The Contractor shall make good any such damages, injury or loss, except such as may be directly caused by agents or employees of the Owner. The Contractor shall provide all barricades required to protect open hoistways or shafts per OSHA regulations. Such protection shall include any necessary guards or other barricades for employee protections during and after the maintenance procedure.

3.6 REPRESENTATION

- A. Contractor represents that it will (i) perform elevator maintenance services under this Agreement in accordance with acceptable industry professional and ethical standards, (ii) not proceed with performance of various aspects of the Services, unless pre-authorized ("Pre-approved Services") by the Purchaser's or Purchaser's Designee at the property, (iii) conduct any handling of Purchaser's Confidential Information in accordance with acceptable industry

professional and ethical standards, (iv) not represent to any third party that it has authority to sign, endorse or represent a contractual relationship with or in Purchaser's name, or enter into any agreement on behalf of Purchaser in connection herewith (unless expressly pre-authorized in writing by Purchaser), (v) safeguard the physical security of Purchaser's Confidential Information if it has access to or possession of such information, (vi) ensure that only "Authorized Representatives" of this Agreement, will have access to any of Purchaser's Confidential Information while rendering the Services, and that it will not be copied, or disseminated to anyone other than the Authorized Representative, and (vii) ensure that all of its employees, representatives, agents or assigns will not solicit any of Purchaser's employees for any purpose. The Parties agree that any alteration to any of the Addenda or Exhibits hereto shall be null and void, unless made in writing by mutual consent of the Parties. The obligations of Contractor set forth herein shall remain in full force and effect for the later of a period of one (1) year from the date of termination or expiration of this Agreement, or the date the Confidential Information is returned to whomever disclosed such information, after the date of termination or expiration of this Agreement.

In witness whereof, the parties hereto have executed this Agreement on the day and year written below.

CONTRACTOR _____

BY _____

TITLE _____

OWNER _____

BY _____

TITLE _____

DATE: This _____ day of _____ 20 _____

WITNESS _____

Exhibit "A" attached and made a part of this Agreement.

EXHIBIT "A"

SCHEDULE OF INITIAL BASE HOURLY RATES FOR CONTRACTOR'S PERSONNEL

VDA No. 12138	Contractors Hourly Base Cost including Fringe Benefits	Overhead and Profit Percentage	Straight Time Rate Hourly Selling Price	Premium Time Rate	*Time and one-half Rate Hourly Selling Price	**Double Time Rate Hourly Selling Price
Manager						
Supervisor						
Maintenance Mechanic						
Repair Mechanic						
Modernization Mechanic						
Helper						
Engineer						
Technician, Troubleshooter						
Foreman						
Other						

*Hours and Days of the Week that the Rate applies: _____

**Hours and Days of the Week that the Rate applies: _____

Central Railroad of NJ
Jersey City, NJ

14 01 20 - 22
vda no. 12138

Maintenance
12/30/14

DIVISION 14

SECTION 14 24 23

TECHNICAL SPECIFICATIONS FOR

ONE (1) HYDRAULIC PASSENGER ELEVATOR

AT

CENTRAL RAILROAD OF NEW JERSEY (CRRNJ)

JERSEY CITY, NJ

DATE: December 30, 2014 (Revised Final)
November 13, 2014

VDA NO. 12138/AP

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REQUEST FOR ELEVATOR BIDDER QUALIFICATIONS

1. Date _____
2. Firm Name _____
3. Address _____

- Telephone No. _____
4. Type of Company (Corporation, Partnership, Sole Proprietorship)

5. Type of elevator work in which you specialize (Check one)
 - a. New Installation _____
 - b. Renovation/Alteration _____
 - c. Maintenance _____
6. List all principals/officers with their titles and years of experience with this firm
 - a. _____
 - b. _____
 - c. _____
7. List trade association memberships
 - a. _____
 - b. _____
 - c. _____
8. Proposed Project Manager and Superintendent with years of experience
 - a. Project Manager _____
 - b. Superintendent _____
9. Recent Projects and References (List information for similar modernization projects started or completed within the last twelve [12] months in the same logistical area. References will be contacted to confirm their experience with your firm.)

- a. (1) Project _____
- (2) Owner _____
- (3) Contact Person _____ Tele No. _____
- (4) Scope of Work _____

- (5) Contract Amount _____

- b. (1) Project _____
- (2) Owner _____
- (3) Contact Person _____ Tele No. _____
- (4) Scope of Work _____

- (5) Contract Amount _____

10. List a minimum of two (2) additional similar modernization projects completed within the last four (4) years with contact names, telephone numbers, date of completion and other pertinent information in the same logistical area.

11. List maintenance service references for similar groups of elevator systems currently serviced by your company under a full comprehensive maintenance program in the same logistical area. Provide building address, contact name and telephone numbers. List number of elevator units in each contract.

a. _____

b. _____

c. _____

d. _____

e. _____

12. Shop Union affiliation (if any) _____

Field Union affiliation (if any) _____

13. a. Number of employees _____

b. Number of maintenance mechanics _____

c. Number of installation mechanics _____

d. Number of maintenance mechanics familiar with this type of elevator.

PREPARED BY: _____

TITLE: _____

(Duly Authorized Principal Officer)

DIVISION 14 – CONVEYING EQUIPMENT

14 24 23 – Hydraulic Passenger Elevators

PART 1 - GENERAL

1.1 SUMMARY AND DEFINITIONS

A. Related Documents

1. 14 24 23 - Hydraulic Passenger Elevators
2. 14 01 20 - Elevator Maintenance - Full Coverage Contract / Specifications for duration of twelve (12) months after completion of the elevator repair project and acceptance by the Authority Having Jurisdiction. Payments for services rendered shall be included in the base price.

B. Intent

1. This section includes Hydraulic passenger elevator.
2. The following outlines the scope of work covered in this Section for renewal/replacement and upgrading of one (1) existing direct in-ground type passenger elevator system, in accordance with ASCE/SEI 24-05 design requirements including but not limited to the following components: new in-ground hydraulic cylinder and jack; new hydraulic pump, motor, valve, oil heating/cooling system and controller to be relocated in the same machine onto a new higher level platform built by Others; new car and hoistway door equipment; new complete hoistway door entrance (frame and door) at L floor; new car and hall push button operating fixtures and new cab enclosure.:
3. Related equipment shall be designed, constructed, installed and adjusted to produce the highest results with respect to smooth, quiet, convenient and efficient operation, durability, economy of maintenance, and the highest standard of safety.
4. It is not the intent of these specifications to detail the construction and design of all parts of the equipment, but it is expected that the type, materials, design, quality of work and construction of each part shall be adequate for the service required, durable, properly coordinated with all other parts, and in accordance with the best commercial standards applicable and of the highest commercial efficiency possible.
5. Electric and magnetic circuits and related parts shall be of proper size, design and material to avoid heating and arcing, and all other objectionable effects which may reduce the efficiency of operation, economy of maintenance and/or net-useful life of the apparatus.
6. Minimum requirements for design, materials, etc., are for certain parts of the equipment. Equivalent requirements approved by the Consultant shall apply to such parts as are of special design, construction or material and to which the specified requirements are not directly applicable. These minimum requirements as a whole shall be considered as establishing proportionate general minimum standards for all parts of the equipment.
7. The Consultant may permit variations from the requirement of these specifications to permit use of the Contractor's standard equipment, provided such standard equipment is in every way adequate for the intended use and meets the full intent of these specifications. All such variations proposed by the manufacturer shall be called to the

attention of the Consultant and shall only be made if approved in writing prior to the award of the contract.

8. General requirements for design, materials and construction are intended primarily to apply to the heavy-duty and important parts of the equipment specifically mentioned and to other parts of similar duty and importance. Less important and light-duty parts may be of the standard design, materials and construction provided that, in the opinion of the Consultant, such standards are in accordance with the best commercial practice and are fully adequate for the purpose of use. All such variations shall be made only on the Consultant's written approval.
9. All equipment and component parts installed, supplied or provided under this contract shall be manufactured and distributed by a third-party, non-installer company servicing the vertical transportation industry.
 - a. Apparatus shall conform to the design and construction standards referenced herein, and shall be rated the best commercial grade suitable for this application.
 - b. Equipment and component systems shall not employ any experimental devices or proprietary designs that could hamper and/or otherwise prohibit subsequent maintenance repairs or adjustments by all qualified contractors.
 - c. Manufacturers of the apparatus shall provide technical support and parts replacements for their equipment and component systems for a minimum of twenty (20) years, and issue such guarantee of support to the purchaser with written certification naming the final Owner of their product(s) to ensure the apparatus or systems remain maintainable regardless of who may be selected for future service.
10. All equipment provided shall be factory and field tested with a history of design reliability and net-useful life established.
 - a. Contractor must be able to demonstrate the apparatus to be installed has been used successfully in a substantially similar manner under comparable conditions.
 - b. If the apparatus proposed differs substantially in construction, material composition, design, size, capacity, duty or other such rating from the equipment previously used for the same purpose by the manufacturer, the Consultant may reject the apparatus or require the vendor test and demonstrate the adequacy and suitability for this particular situation. Any necessary tests shall be performed at the sole expense of the Contractor with no prior guarantee of acceptance after the testing procedure.
11. The Contractor shall not use as part of the permanent equipment any experimental devices, proprietary design, components, construction of materials which have not been fully tried out in at least substantially similar or under comparable service, except as may be especially approved by the Consultant. If any important equipment or devices to be used on this installation differ substantially in construction, materials, design, size, capacity or duty from corresponding items previously used for the same purpose by the manufacturer, they shall pass such tests as the Consultant may require to fully show their adequacy and suitability. These tests shall be in addition to tests herein specified and shall be made at the expense of the Contractor.
12. Certain design limitations, tests, etc., are herein specified as a partial check of the adequacy of design, construction and materials used. These requirements do not cover all features necessary to ensure satisfactory and approved operation, etc., of the equipment.

13. It is understood, the entire system shall be designed, fabricated, modified and/or upgraded in full compliance with applicable local laws and code standards. The absence of a particular item or requirement shall not relieve the Contractor of the full and sole responsibility for such equipment, features and/or procedures.
14. With the exception of only those items specifically identified as being performed by others, the Specifications are intended to include all engineering, material, labor, testing, and inspections needed to achieve work specified by the Contract Documents. Inasmuch as it is understood that any incidental work necessary to complete the project is also covered by the Specifications, bidders are cautioned to familiarize themselves with the existing job site conditions. Additional charges for material or labor shall not be permitted subsequent to execution of the Contract.
15. Bidders must report discrepancies or ambiguities occurring in the Specifications to the Consultant for resolution prior to the bidding deadline, otherwise the Specifications shall be deemed acceptable in their existing form.

C. Abbreviations and Symbols

1. The following abbreviations, Associations, Institutions, and Societies may appear in the Project Manual or Contract Documents:

AHJ	Authority Having Jurisdiction
AIA	American Institute of Architects
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BOCA	Building Officials and Code Administrators International, Inc. - Basic National Building Code
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Agency
OSHA	Occupational Safety and Health Act

D. Codes and Ordinances / Regulatory Agencies

1. Work specified by the Contract Documents shall be performed in compliance with applicable Federal, State, and municipal codes and ordinances in effect at the time of Contract execution. Regulations of the Authority Having Jurisdiction shall be fulfilled by the Contractor and Subcontractors. The entire installation, when completed, shall conform with all applicable regulations set forth in the latest editions of:
 - a. Local and/or State laws applicable for logistical area of project work.
 - b. Building Code applicable to the AHJ.
 - c. Elevator Code applicable to the AHJ.
 - d. Safety Code for Elevators and Escalators, ASME A17.1 and all supplements as modified and adopted by the AHJ.
 - e. Safety Code for Elevators and Escalators, A17.1S supplement to A17.1 as modified and adopted by the AHJ for Machine Room Less installations (MRL).
 - f. Guide for Inspection of Elevators, Escalators, and Moving Walks, ASME A17.2.

- g. Safety Code for Existing Elevators and Escalators, ASME A17.3 as modified and adopted by the AHJ.
 - h. Guide for emergency evacuation of passengers from elevators, ASME A17.4.
 - i. National Electrical Code (ANSI/NFPA 70).
 - j. American With Disabilities Act - Accessibility Guidelines for Building and Facilities and/or A117.1 Accessibility as may be applicable to the AHJ.
 - k. ASME A17.5/CSA-B44.1 - Elevator and escalator electrical equipment.
 - l. ASCE/SEI 24-05 Flood Resistant Design and Construction
2. The Contractor shall advise the Owner's Representative of pending code changes that could be applicable to this project and provide quotations for compliance with related costs.

E. Reference Standards

- 1. AISC - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
- 2. ICC/ANSI A117.1 - Buildings and Facilities - Providing Accessibility and Usability for Physically Handicapped People.
- 3. ANSI/AWS D1.1 - Structural Welding Code, Steel.
- 4. ANSI/NFPA 80 - Fire Doors and Windows.
- 5. ANSI/UL 10B - Fire Tests of Door Assemblies.
- 6. APA - American Plywood Association.
- 7. ASTM A36 - Steel Supports and Reinforcement.
- 8. ASTM A139 - Electric-Fusion (ARC) Welded Steel Pipe (NPS 4 Inch and Over).
- 9. ASTM A276 - Stainless Steel Bars and Shapes.
- 10. ASTM A446 - Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
- 11. ASTM B36 (36M) - Bronze Sheet (alloy) UNS No.C2800 (Muntz metal).
- 12. ASTM B151 - Nickel Silver Extrusions.
- 13. ASTM B221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
- 14. ASTM B455 - Bronze Extrusions.
- 15. ASTM D1785 - PVC Pipe
- 16. ASTM D2466 - PVC Pipe Fittings
- 17. ASTM D2564 - Cement for PVC Pipe and Fittings
- 18. NEMA LD3 - High Pressure Decorative Laminates
- 19. ANSI/IEEE - 519-1992
- 20. ANSI/IEEE - Guide for Surge Withstand Capability (SWC) Tests
- 21. ANSI Z97.1 - Laminated/Safety Tempered Glass

1.2 PERMITS AND SUBMITTALS

A. Permits

- 1. Comply with the requirements of Division 01.
- 2. Prior to commencing work specified by the Contract Documents, the Contractor shall, at its own expense, obtain all permits or variances as may be required by the AHJ and provide satisfactory evidence of having obtained said permits and variances to both the Owner's Representative and Consultant.

3. File necessary drawings for approval of all Authorities Having Jurisdiction.
4. The Elevator Contractor shall undertake the necessary review and search procedure to identify open applications and/or outstanding violations for this property; and, close-out such applications and/or expunge such violations relative to the project scope as required for final acceptance by the AHJ.
 - a. Outstanding applications and violations must be indicated on the request for permit filing for this procedure to ensure such applications and/or violations are dismissed accordingly.
 - b. All relative costs shall be included in the base bid proposal with the understanding that corrective actions are covered under the specified scope of work.

B. Submittals

1. Prior to beginning the work, the Contractor shall submit and have approved copies of layout drawings, shop drawings and standard cuts. These items shall include:
 - a. A plan view of the hoistway and machine room
 - b. Elevation of the pit
 - c. All accessories.
2. The Consultant and the Owner's Representative shall pass on the submittals with reasonable promptness and the Contractor shall be responsible to ensure that there will be no delay in their work or that of any other trade involved.
3. Approved filing and submittal requirements must be completed before equipment and related materials are ordered.
4. Copies of Department of Buildings' permits and/or governing authority's documents will be posted at the job site with copies issued to the Owner's Agent, Owner's Representative and Consultant.
5. Samples of wood, metal, plastic, paint or other architectural finish material applicable to this project shall be submitted for approval by the Owner's designee.
6. It shall be understood that approval of the drawings and cuts by Owner's designee, Architect and/or Consultant shall be for general arrangement only and does not include measurements which are the Contractor's responsibility or approval of variations from the contract documents required by the AHJ.
7. The Contractor shall prepare a record log and maintain all submittals, shop drawings, catalog cuts and samples.

C. Measurements and Drawings

1. Drawings or measurements included with the bidding material shall be for the convenience of the bidders only and full responsibility for detailed dimensions lies with the Contractor.
2. In the execution of the work on the job, the Contractor shall verify all dimensions with the actual conditions.
3. Where the work of the Elevator Contractor is to join other trades, the shop drawings shall show the actual dimensions and the method of joining the work of the various trades.

D. Substitutions

1. Requests for substitutions will be considered under the following time limitations and situations:
 - a. Not less than ten (10) calendar days before bids are due.
 - b. Work or equipment specified becomes unavailable through unforeseen events such as strikes, loss of manufacturer's plant through fire, flood or bankruptcy.
2. Requested substitutions will be reviewed and adjudged. Failure of the Consultant to raise objection shall not constitute a waiver of any of the requirements of the Contract Documents.
3. Request for substitutions shall include complete data with drawings and samples as required, including the following:
 - a. Quality Comparison - Proposed substitution versus the specified product.
 - b. Changes required in other work because of the substitution.
 - c. Effect on the construction schedule.
 - d. Cost Data - Resulting from the proposed substitution versus the specified product. The Contractor shall certify that the cost data presented is complete and includes all related costs under this Contract.
4. When proposing a substitution, the Contractor represents that:
 - a. They have investigated the proposed substitution and have determined that it is equal to or better than the product specified.
 - b. They will guarantee the substitution in the same manner as the product specified.
 - c. They will coordinate and make other changes as required in the work as a result of the substitution.
 - d. They waive all claims for additional costs as a result of the substitution, with the exception of those identified above under "cost data".
5. The Consultant will be sole judge of the acceptability of the proposed substitution.
6. The Consultant will have authority to approve or reject substitutions or to change the specified standards of quality. However, neither this authority to act under this provision nor any decision made in good faith, either to exercise or not to exercise this authority, shall give rise to any duty or responsibility of the Consultant to the Contractor, any Subcontractor, any Sub-Subcontractor, any of their agents or employees or any other persons performing the work or offering to perform the work.

E. Changes in Scope and Extra Work

1. The Owner may at any time make changes in the specifications, plans and drawings, omit work, and require additional work to be performed by the Contractor.
 - a. Each such addition or deletion to the Contract shall require the Owner and the Contractor to negotiate a mutually acceptable adjustment in the contract price, and, for the Contractor to issue a change order describing the nature of the change and the amount of price adjustment.

- b. The Contractor shall make no additions, changes, alterations or omissions or perform extra work except on written authorization of the Owner.
- c. Each change order shall be executed by the Contractor, Owner, and the Consultant.

F. Changes and Extra Work

- 1. The Owner may at any time make changes in the specifications, plans and drawings, omit work, and require additional work to be performed by the Contractor.
 - a. For such additional work to be performed hereunder, Owner shall pay Contractor on the basis of a mutually agreed to lump sum or cost thereof, and a mutually fixed or percentage fee.
 - b. The Contractor shall make no additions, changes, alterations or omissions or perform extra work except on prior written authorization of the Owner.

G. Keys

- 1. Upon the initial acceptance of work specified by the Contract Documents on each unit, the Contractor shall deliver to the Owner, six (6) keys for each general key-operated device that is provided under these specifications in accordance with ASME A17.1, Part 8 standards as may be adopted and modified by the AHJ.
- 2. All other keying of access or operation of equipment shall be provided in accordance with ASME A17.1 Part 8 as may be adopted and modified by the AHJ.

H. Diagnostic Tools

- 1. Prior to seeking final acceptance of the project, the Contractor shall deliver to the Owner any specialized tools required to perform diagnostic evaluations, adjustments, and/or programming changes on any microprocessor-based control equipment installed by the Contractor. All such tools shall become the property of the Owner.
 - a. Owner's diagnostic tools shall be configured to perform all levels of diagnostics, systems adjustment and software program changes which are available to the Contractor.
 - b. Owner's diagnostic tools that require periodic re-calibration and/or re-initiation shall be performed by the Contractor at no additional cost to the Owner for a period equal to the term of the maintenance agreement from the date of final acceptance of the project.
 - c. The Contractor shall provide a temporary replacement, at no additional cost to the Owner, during those intervals in which the Owner might find it necessary to surrender a diagnostic tool for re-calibration, re-initiation or repair.
- 2. Contractor shall deliver to the Owner, printed instructions, access codes, passwords or other proprietary information necessary to interface with the microprocessor-control equipment.

I. Printed Circuit Boards, Software Programs and Spare Parts

- 1. During the life of the equipment and subject to the term of the maintenance agreement, where revisions to firmware and/or software are issued by the control manufacturer or manufacturer of solid state and microprocessor based subsystems subsequent to the

beneficial use of the equipment, updates shall be provided so that the installation and spare circuit boards are current with respect to software and firmware versions.

2. Provide spare parts required for maintenance of the elevator equipment installed under this contract.
 - a. The spare parts shall be placed in new storage cabinets, located in the machine room, and become the property of the Owner.
 - b. Upon expiration of the contract, a complete set of spare parts as described below shall be turned over to the Owner and a receipt obtained.
 - c. The following is the absolute minimum requirement:
 - 1) Four (4) fuses of each size.
 - 2) One (1) complete hall lantern of each type.
 - 3) One (1) complete set of door protective device of each size.
 - 4) One (1) door lock of each type.
 - 5) Two (2) car door and two hall door sheaves of each type.
 - 6) Two (2) sets of door gibs for car and hall doors of each type.
 - 7) One (1) complete door closer of each type.
 - 8) One (1) hall call button assemblies.
 - 9) One (1) car call button assemblies.
 - 10) One (1) hall and position indicator of each type.
 - 11) Power supply of each size.

J. Wiring Diagrams, Operating Manuals and Maintenance Data

1. Comply with the requirements of Division 01.
2. Contractor shall deliver to the Owner, four (4) identical volumes of printed information organized into neatly bound manuals prior to seeking final acceptance of the project.
3. The manuals shall also be submitted in electronic format on non-volatile media, incorporating raw 'CAD' and/or Acrobat 'PDF' file formats.
4. Manuals, as well as electronic copies, shall contain the following:
 - a. Step-by-step adjusting, programming and troubleshooting procedures that pertain to the solid-state microprocessor-control and motor drive equipment.
 - b. Passwords or identification codes required to gain access to each software program in order to perform diagnostics or program changes.
 - c. A composite listing of the individual settings chosen for variable software parameters stored in the software programs of both the motion and dispatch controllers.
 - d. Method of control and operation.
5. Contractor shall provide four (4) sets of "AS INSTALLED" straight-line wiring diagrams in both hard and electronic format in accordance with the following requirements:
 - a. Displaying name and symbol of each relay, switch or other electrical component utilized including identification of each wiring terminal.
 - b. Electrical circuits depicted shall include all those which are hard wired in both the machine room and hoistway.
 - c. Supplemental wiring changes performed in the field shall be incorporated into the diagrams in order to accurately replicate the completed installation.

6. Furnish four (4) bound instructions and recommendations for maintenance, with special reference to lubrication and lubricants.
7. Manuals or photographs showing controller repair parts with part numbers listed.

K. Training

1. Prior to seeking final acceptance of the project, the Contractor shall conduct an eight-hour training program on-site with building personnel selected by the Owner.
2. The focus of the session shall include:
 - a. Instructions on proper safety procedures to utilize in assisting passengers that may become entrapped inside an elevator car.
 - b. Explain each control feature and its correct sequence of operation.
3. Control features covered shall include but, not be limited to:
 - a. Independent Service Operation.
 - b. Attendant Service Operation.
 - c. Emergency Fire Recall Operation - Phase I
 - d. Emergency In-car Operation - Phase II.
 - e. Emergency Power Operation.
 - f. Emergency Communications Equipment.
 - g. Emergency Hoistway Access and Rescue Features.

1.3 QUALITY ASSURANCE

A. Materials and Quality of Work

1. All materials are to be new and of the best quality of the kind specified.
2. Installation of such materials shall be accomplished in a neat manner and be of the highest quality.
 - a. Should the Contractor receive written notification from the Owner stating the presence of inferior, improper, or unsound materials or quality of installation, the Contractor shall, within twenty-four (24) hours, remove such work or materials and make good all other work or materials damaged.
 - b. Should the Owner permit said work or materials to remain, the Owner shall be allowed the difference in value or shall, at its election, have the right to have said work or materials repaired or replaced as well as the damage caused thereby, at the expense of the Contractor, at any time within one (1) year after the completion of the work; and neither payments made to the Contractor, nor any other acts of the Owner shall be construed as evidence of acceptance and waiver.

B. Mechanical Design Requirements (General)

1. The following typical requirements shall apply to all parts of the work where applicable and are supplementary to other requirements noted under the respective headings.
 - a. All bearings, pivots, guides, guide shoes, gearing, door hanger sheaves, door hanger tracks and similar elements subject to friction or rolling wear in the entire

elevator installation shall be accurately and smoothly finished and shall be arranged and equipped for adequate and convenient lubrication. Means shall be provided for flushing and draining the larger bearings and gear case. All oiling holes shall have dustproof, self-cleaning caps.

- b. Bearings of governor and governor sheaves and important supporting bearings of other parts in motion when the elevator is traveling shall, unless otherwise specified or approved, be of ball or roller bearing type or shall have renewable linings of bronze or babbitt metal.
- c. Bearings for brake levers and similar uses where the amount of movement under load is light and the wear negligible may be unlined.
- d. All plain bearings shall be liberally sized in accordance with the best commercial elevator usages which have proved entirely satisfactory on heavy-duty installations.
- e. Bearings of motors shall be arranged and equipped for adequate automatic lubrication. Ring or chain oilers, spring-fed grease cups and equivalent devices properly used in accordance with the best commercial elevator practice will be acceptable. Approved means shall be provided for visibly checking the amount of lubricant contained and for flushing and draining. Means shall also be provided for preventing leakage of lubricant when the reservoirs or grease cups are filled to proper levels.
- f. Ball and roller bearings shall be of liberal size and of a type and make which have been extensively and successfully used on other similar, heavy-duty elevator installations. They shall be fully enclosed. Loading, lubrication, support and all other conditions of use shall be in accordance with the recommendations of the bearing manufacturer based on previous extensive and satisfactory elevator usage.
- g. All armature spiders and similar items intended to rotate with their shafts shall be keyed and/or firm press or shrunk fit on the shafts. Set screw fastening will be permitted only for minor items not subject to hoisting loads and where means for field adjustment is required.
- h. All bolts used to connect moving parts, bolts carrying hoisting stresses and all other bolts, except guide rail bolts, subject to vibration or shock shall be fitted with adequate means to prevent loosening of the nuts and bolts. Bolts transmitting important shearing stresses between machine parts shall have tight body fit in drilling holes.
- i. All machine work, assembling and installing shall be done by skilled and experienced mechanics using first-class, modern equipment and tools. All work shall be thoroughly high grade in every respect. All parts will be manufactured to high precision standards so that wearing parts will be readily interchangeable with stock repair parts with a minimum of field fitting.
- j. All bearing and sliding surfaces of shafts, pins, bearings, bushings, guides, etc., shall be smoothly and accurately finished. They shall be assembled and installed in accurate alignment and with working clearance most suitable for the load, speed, lubrication and other conditions of use.
- k. Structural steel used for supporting and securing equipment and for the construction of car slings, etc., shall conform to the A.S.T.M. specification for Structural Steel for Buildings. Design stresses shall not exceed those specified in the local Building Code.
- l. Castings of motor frames, sheaves, gear casings, etc., shall be of the best quality metallurgically controlled, hard, close grained gray machinery cast iron, free from blow holes, sand holes, or shrinkage cracks, ground to remove overruns, sanded and machined so as to leave a finish suitable for its particular application. Surfaces

of sheaves and brake drums shall be entirely free from defects and shall show a hardness of not less than 220 Brinell.

C. Electrical Design Requirements (General)

1. The following typical requirements shall apply to all parts of the work and are supplementary to other requirements noted under the respective headings.
 - a. The design and construction of the motors shall conform to the requirements of these specifications and to the ASME Standards for Rotating Electrical Machinery with revisions issued to the first day when the work of this Contract was advertised.
 - 1) Motors shall operate successfully under all loads and speeds and during acceleration and deceleration.
 - 2) Motors shall be designed for quiet operation without excessive heat.
 - 3) Insulation on motor coils and windings and on all insulated switch, relay, brake and other coils shall conform to the requirements for Class "H" insulation, as defined in ASME Standards for Rotating Electrical Machinery. All motors shall be impregnated twice.
 - 4) Switches, relays, etc., on controller, starter and signal panels and similar items on other parts of the equipment shall be the latest improved type for the condition of use. They shall function properly in full accordance with the requirements of the machines controlled and with the specified operating requirements of the elevator. Any of these parts showing wear or other injurious effects during the guarantee period to the extent that abnormal maintenance is required or indicated shall be replaced with proper and adequate parts by the Contractor.
 - 5) Contacts in elevator motor circuits which are intended to be opened by governors or other safety devices shall be copper to carbon or other approved non-fusing type.
 - 6) Where required, controllers and other component parts of the installation shall be labeled in accordance with the latest codes and standards as adopted and/or otherwise modified by the AHJ.
 - 7) Electrical equipment, motors, controllers, etc., installed under this contract shall have necessary CSA/US or UL/US listing as may be required by the AHJ. Equipment shall be labeled or tagged accordingly.

D. Materials, Painting and Finishes

1. Two (2) coats of rust inhibiting machinery enamel shall be applied to exposed ferrous metal surfaces in the pit that do not have a galvanized, anodized, baked enamel, or special architectural finishes.
2. Two (2) coats of rust inhibiting enamel paint to the machinery located within the machine room as well as to the machine room floor.
3. Architectural metal surfaces of bronze or similar non-ferrous materials which are specified to be refinished, re clad and/or provided new, shall be sufficiently clear coated so as to resist tarnishing during normal usage for a period of not less than twelve (12) months after final acceptance by the Owner.

4. Identify all equipment including buffers, crosshead, safety plank, machine, controller, drive, governor, disconnect switch, etc., by 4" high numerals which shall contrast with the background to which it is applied. The identification shall be either decalcomania or stencil type.
5. Paint or provide decal-type floor designation not less than six (6) inches high on hoistway doors (hoistway side), fascias and/or walls as required by Code at intervals not exceeding 7'-0". The color of paint used shall contrast with the color of the surface to which it is applied.

E. Handicapped Requirements (ADAAG)

1. Locate door reopening devices at 5" and 29" above the finish floor when individual contact projection apparatus is employed.
2. Locate the alarm button and emergency stop switch at 35", and floor and control buttons not more than 48" above the finished floor. The alarm button shall illuminate when pressed for visual acknowledgement to user.
3. Provide raised markings in the panel to the left of the car call and other control buttons. Letters and numbers shall be a minimum of 5/8" and raised .03" and shall be in contrasting color to the call buttons and cover plate.
4. The centerline of the hall push button shall be 42" to 48" above the finished floor.
5. The hall arrival lanterns or cab direction lantern provided shall sound once for the "up" direction and twice for the "down" direction. Design and locate fixtures per Federal standards.
6. Provide floor designations at each entrance on both sides of jamb at a height of 60" above the floor. Designations shall be 2" high, raised .03" on a contrasting color background as selected by the Owner.
 - a. Use cast metal plates and polished numbers secured with tamper-proof hardware.
7. Provide an audible signal within the elevator to tell passenger that the car is stopping or passing a floor served by the elevator.
8. Where elevators operate at a speed greater than 200 fpm, provide a verbal annunciator to announce the floor at which the elevator is stopping where required by the AHJ.
9. Provide signal control timing for passenger entry/exit transitions per Federal standards.
10. Ensure sill-to-sill running clearances do not exceed 1-1/4" at all landings served.
11. Provide visual call acknowledgment signal for car emergency intercommunication device.

F. Qualifications

1. The work shall be performed by a company specialized in the business of manufacturing, installing and servicing conveying systems of the type and character required by these specifications with a minimum of ten (10) years experience.
2. Prior written acceptance is required for manufacturers other than those listed, before quoting this project. Requests for acceptance will not be considered unless they are submitted before bid date and are accompanied by the following information:
 - a. List of five (5) similar installations having exact equipment being proposed for this project arranged to show name of project, system description and date of completed installation.

- b. Complete literature, performance and technical data describing the proposed equipment.
- c. List of ten (10) service accounts by building name, building manager or owner, including phone numbers.
- d. Location of closest service office from which conveying system will be maintained.
- e. Location of closest parts inventory for this installation.

1.4 DELIVERY / STORAGE / HANDLING / COORDINATION

A. Delivery and Storage of Material and Tools

- 1. Comply with the requirements of Division 01.
- 2. Delivery, Storage and Handling:
 - a. Deliver materials to the site ready for use in the accepted manufacturer's original and unopened containers and packaging, bearing labels as to type of material, brand name and manufacturer's name. Delivered materials shall be identical to accepted samples.
 - b. Store materials under cover in a dry and clean location, off the ground.
 - c. Remove delivered materials which are damaged or otherwise not suitable for installation from the job site and replace with acceptable materials.
- 3. The Owner shall bear no responsibility for the materials, equipment or tools of the Contractor and shall not be liable for any loss thereof or damage thereto.
- 4. The Contractor shall confine storage of materials on the job site to the limits and locations designated by the Owner and shall not unnecessarily encumber the premises or overload any portion with materials to a greater extent than the structural design load of the Facility.

B. Work With Other Trades / Coordination

- 1. Coordinate installation of sleeves, block outs, equipment with integral anchors, and other items that are embedded in concrete or masonry for the applicable equipment. Furnish templates, sleeves, equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- 2. Coordinate sequence of installation with other work to avoid delaying the Work.
- 3. Coordinate locations and dimensions of other work relating to the equipment scheduled for installation including pit ladders, sumps, and floor drains in pits; entrance subsills; machine beams; and electrical service, electrical outlets, lights, and switches in pits and machine rooms, secondary levels, overhead sheave rooms and hoistways as it relates to the specific equipment.

C. Removal of Rubbish and Existing Equipment

- 1. On a scheduled basis, the Contractor shall remove from the job site all rubbish generated in performing work specified in the Contract Documents.
- 2. Any component of the existing elevator plant that is not reused under the scope of work specified in the Contract Documents shall become property of the Contractor and, as such, shall be removed from the premises at the Contractor's sole expense.

3. The Contractor agrees to dispose of the aforementioned equipment and rubbish in accordance with any and all applicable Federal, State, and municipal environmental regulations, and further accepts all liability that may result from handling and/or disposing of said material.

D. Protection of Work and Property

1. The Contractor shall continuously maintain adequate protection of all their work from damage and shall protect the Owner's property from injury or loss arising out of this contract.
2. The Contractor shall make good any such damages, injury or loss, except such as may be directly caused by agents or employees of the Owner.
3. The Contractor shall provide all barricades required to protect open hoistways or shafts per OSHA regulations. Such protection shall include any necessary guards or other barricades for employee protections during and after the modernization procedure.

1.5 RELATED WORK

A. Work By Elevator Contractor Included in the Base Bid

1. The following requirements shall be applicable based on prevailing conditions at the site of work and/or mandated modifications for code compliance.
 - a. Installation of new electrical conduit and power feeders between the load side of existing and new main line disconnect switches and new elevator control equipment.
 - b. Provide a standard railing conforming to Code on the outside perimeter of the car top on all sides where the perpendicular distance between the edges of the car top and the adjacent hoistway enclosure exceeds 300 mm (12 in.) horizontal clearance or as otherwise required by the Authority Having Jurisdiction.
 - c. Subsequent to the contract execution, the Contractor shall perform a Violation search and review of all open Applications in conjunction with the filing procedure. Subsequently, any and all outstanding Violations and/or open Applications shall be indicated on the Request for Permit; and such outstanding Violations shall be expunged and open Applications closed out as part of this filing procedure.
 - 1) If requirements and/or work necessary to satisfy outstanding Violation or Applications are not included in the contracted scope of work, the Elevator Contractor shall prepare an itemized listing with relative extra costs to cure the condition(s) and expunge and/or close out the Violation or Application for the Owners' and Consultants' review/approval prior to executing such work procedures.

B. Work By Others (General Contractor)

1. The following requirements shall be applicable based on prevailing conditions at the site of work and/or mandated modifications for code compliance.
 - a. Installation of new of new machine room platform in accordance with ASCE/SEI 24-05 design requirements.

- b. Installation of new main line power feed with related disconnect switch designed and located per local law requirements.
- c. Installation of auxiliary power feed with related distribution panels and disconnects designed and located per local law requirements.
 - 1) Voltage shall be 110 VAC with one 15 Amp circuit breaker or fuse for lighting of the individual elevator car enclosure.
 - 2) Circuit breakers and/or fused disconnects shall be lockable in the "OFF" position in accordance with applicable code.
- d. The top surface of any setback or projection in the hoistway that measures 2" or more in width shall be beveled at an angle of not less than 75 degrees from horizontal, constructed from prime painted 14 gauge cold-rolled steel and installed so as to conform with ASME A17.1 elevator safety code as modified by, and/or in addition to codes and standards accepted by the AHJ.
- e. Installation of new permanent lighting fixtures with protective guards and 110 volt duplex GFCI receptacles inside the machine room. Illumination shall be no less than 30 foot-candles at floor level. A light control switch shall be provided immediately adjacent to the machine room entrance door. Provide necessary receptacles as required by Elevator Contractor to supply power to auxiliary elevator equipment and/or remotely located monitors.
- f. Provide the elevator pit with a 110 volt GFCI duplex receptacle and a permanent lighting fixture equipped with protective guard. Illumination shall be no less than 10 foot-candles at pit floor level. A light control switch shall be provided and so positioned as to be readily accessible from the pit entrance door or ladder.
- g. Installation of hoistway and machine room smoke relief provisions in accordance with local laws.
- h. Provide the machine room with a self-closing, self-locking access door. Locking means shall be spring-type arranged to permit the doors to be opened from the inside without a key.
- i. Provide a smoke detector system meeting the requirements of A17.1 and/or the Local Governing Authority.
- j. Installation of fire emergency control interface provisions for automatic recall of the elevator(s) through operation of the fire detection system. Provisions shall be made for alternate designated fire recall landing with connection contingent on Codes recognized by the local governing authority. The interfacing contacts shall be wired to an electrical junction box located inside each elevator machine room for connection to the elevator control systems by the Elevator Contractor. Each wire shall be clearly labeled with its control function. Coordinate the type of interface required for the specific elevator control apparatus with the Elevator Contractor.
- k. Where sprinkler fire protective systems are provided inside any elevator hoistway, machine room or associated machinery space, provisions shall be made for the disconnecting of the main line power supply from the affected elevator prior to activation. This means of disconnect shall be manually reset in accordance with code.
- l. Installation of emergency power control interface provisions to signal the elevator control apparatus of a transfer from normal (utility) power to the building emergency (generator) power supply. Also, provide additional control interface to give advanced notification to the elevator control apparatus that the power source will transfer from emergency (generator) power to normal (utility) power.

Interfacing contacts shall be wired to an electrical junction box located inside each machine room for connection to the elevator control equipment by the Elevator Contractor. Coordinate the type of interface required for the specific elevator control apparatus with the Elevator Contractor.

- 1) On the line side of each main line disconnect switch, provide some means to absorb power that may be regenerated by the elevator hoist motor during emergency power operation.
 - 2) Normal Power/Emergency Power Control Signals consisting of two (2) dry contacts provided by others to function as follows:
 - a) One (1) dry contact normally open to make when Normal Power is available. (Logic state of dry contact is to be confirmed by the Manufacturer of the Elevator Control Equipment).
 - b) One (1) dry contact normally open to make when emergency power is available. (Logic state of dry contact is to be confirmed by the Manufacturer of the Elevator Control Equipment).
- m. Installation of HVAC provisions inside the machine room so as to maintain ambient temperature and humidity levels that are within the range specified by the microprocessor-control equipment manufacturers.
- n. Provide a class "ABC" fire extinguisher in electrical machinery and control spaces. Locate the extinguisher in close proximity to the access door.
- o. Provide necessary telephone wiring with connection to local telephone service for remote elevator monitoring and/or two-way voice emergency communications systems.
 - 1) Terminate the telephone wiring in junction boxes or standard phone jack terminals in the machine room.
 - 2) Coordinate the quantity and termination method of individual phone connections with the Elevator Contractor.
 - 3) Identify each phone line for connection by the Elevator Contractor to the appropriate elevator device(s).
 - 4) Telephone wiring, where required by applicable codes, shall be installed in conduit.
- p. Install the necessary sump pump and discharge piping and electrical receptacle for safe operation.
- q. Where the pit extends more than 3 feet below the sill of the pit access door, provide a permanent fixed metal ladder.
 - 1) Ladder shall extend no less than 48" above the sill of the access door. Handgrips shall extend from the ladder to a point no less than 48" above the sill of the access door where the ladder does not comply.
 - 2) The rungs shall be a minimum of 12" wide. Where prevailing conditions prevent a 12" wide rung, the rung may be reduced to no less than 9".
 - 3) The rungs shall be spaced 12" on center.
 - 4) A clear distance of no less than 4 ½" from the centerline of the rungs and handgrips to the nearest permanent object in back of the ladder shall be provided.

- r. Provide necessary signage and labels as may be required:
 - 1) Elevator identification labels using numerical designations on every elevator entrance.

C. Elevator Cab Enclosure Fan - New

- 1. Provide an exhaust type two-speed fan unit with cover grill, mounting accessories and necessary cab enclosure modifications.
 - a. Fan unit shall include self-lubricating motor with housing rubber mounted for sound vibration isolation.
- 2. Provide a key switch in the elevator cab enclosure for control of fan unit.
- 3. Provide necessary wiring and approved conduit to properly connect fan unit with power source and control key switch.

1.6 WARRANTY / MAINTENANCE SERVICES

A. Contract Close-Out, Guarantee and Warranties

- 1. The Contractor agrees to certify that work performed in accordance with the Contract Documents shall remain free of defects in materials and quality of work for a period of one (1) year after final acceptance of the completed project, or acceptance thereof by beneficial use on a unit by unit basis, which ever occurs first.
- 2. The sole duty of the Contractor under this warranty is to correct any non-conformance or defect and all damages caused by such defect without any additional cost to the Owner and within fifteen (15) days of notification.
- 3. The express warranty contained herein is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.
- 4. In the event the Contractor fails to fulfill its obligations defined herein, the Owner shall have the express right to perform the Contractor's obligations and to charge the Contractor the cost of such performance or deduct an equal amount from any monies due the Contractor.

B. Maintenance Coverage

- 1. The following maintenance coverage apply:
 - a. Long-Term Maintenance
 - 1) Long-term full comprehensive maintenance and related services shall be provided in accordance with Section 14 01 20, Owner's Form of Agreement issued with the modernization documents for subsequent services.
 - 2) Costs related to long-term maintenance shall be indicated on the bid form in the space provided.

1.7 ALTERNATES AND VALUE ENGINEERING:

The following alternatives are elective upgrades which constitute changes to the base scope of work specified. Pricing for each alternate upgrade is requested from the bidder with costs indicated in the appropriate space in the Request for Proposal (RFP). Contractor shall take into consideration, as part of the alternative pricing, alternate work that is required either in lieu of, or in addition to, work specified in the base scope and shall not duplicate costs.

PART 2 - PRODUCTS

2.1 ELEVATORS

A. Elevator No. 1

1. Quantity	One (1) Installed per ASCE/SEI 24-05 Design Requirements
2. Type	Direct In-ground Hydraulic Passenger
3. Capacity (lbs)	3,000
4. Speed (fpm)	150
5. Number of Landings	Three (3) at B, 2 & 3
6. Number of Openings	Three (3) at B, 2 & 3
7. Front Openings	Three (3) at B, 2 & 3
8. Rear Openings	None
9. Operation	Automatic Selective Collective
10. Control	New Microprocessor Based
11. Fireman's Service	New Per New NJ UCC
12. Machine Room, Pit Lighting and GFCI	New
13. Machine Type	Hydraulic
14. Machine Location	B Level Machine Room on New Raised Platform
15. Power Unit	New
16. Hydraulic Jack / Cylinder	New
17. Piping	New
18. Scavenger Pump	New
19. Rescuvator	New
20. Car Platform / Sling	New
21. Guide Rails	Reuse
22. Guides	New
23. Buffers	New
24. Car Door Size / Type	3'-4" X 6'-7" - Single speed side opening
25. Hoistway Door Size / Type	3'-4" X 6'-7" - Single speed side opening
26. Master Door Operator	New
27. Entrance Sills	New at B Floor; Reuse at 2 & 3
28. Tracks / Hangers / Interlocks / Closers	New
29. Top Emergency Exit	New
30. Keyed Access	New
31. Pit Ladder	New
32. Power Supply	New
33. Wiring and Traveling Cables	New

34.	CCTV	Provide Required Cabling Only
35.	Number of Push Button Risers	One (1)
36.	Hall Operating Fixtures	New
37.	Car Operating Fixtures	New
38.	Communication	New
39.	Door Protective Device	New
40.	Emergency Cab Lighting	New
41.	Cab Ventilation	New
42.	Car Enclosure	New
43.	Car Doors	New
44.	Car Flooring	New
45.	Car Sill	New

2.2 MANUFACTURERS

A. Pre-Approved Equipment Manufacturers

1. The following manufacturer's equipment and materials have been pre-approved for use on this project.
2. Other equipment not specifically mentioned shall be considered for approval on an individual basis.
 - a. Controller - GAL (GALaxy), Motion Control Engineering, Elevator Systems, Inc., Schumacher, Otis, Schindler, Thyssen/Krupp, KONE, Fujitec.
 - b. Tracks, Hangers, Interlocks and Door Operators - G.A.L., ECI, Moline Accessories Corporation, OEM equipment.
 - c. Fixtures - G.A.L., Adams, EPCO, Monitor, E-Motive USA, C.E. Electronics, Innovation, PTL, MAD, OEM equipment.
 - d. Door Protective Device - Janus, Adams, G.A.L., T.L. Jones, Tri-Tronics, OEM equipment.
 - e. Cabs/Entrances/Entrance Door Panels - Accurate Elevator Door Corp, EDI/ECI, National Cab & Door, Tyler, H&B, Columbia, Velis, Elite, Brice Southern, C.E.C., Dural, Globe-Van Dorn, Gunderlin, Premier, Prestige, Regency, Schumacher, OEM equipment..
 - f. Motors and Motor Generators - Imperial Electric, General Electric, Baldor, Reuland Electric, OEM equipment..
 - g. Guide Rails - AFD Industries, Monteferro.
 - h. Electrical Traveling Cables – Draka, James Monroe
 - i. Hydraulic Systems/Components - Canton, ECS Corporation, Elevator Equipment Corporation, Mongrain, Schumacher, OEM equipment..
 - j. Guide Shoes/Rollers – ELSCO, G.A.L., [OEM equipment.]
 - k. Intercommunications/Telephones - Webb Electronics, K-Tec, Ring, Star-Plus, Wurtec, Janus, approved equal.
3. Original Equipment Manufacturers may substitute their own branded equipment subject to the following:
 - a. All requirements of the specifications are met regarding performance, appearance, serviceability and support.

- b. A full stock of all regular and critical replacement parts required for this project are maintained at a facility within fifty (50) miles of the project site.
 - 1) Any parts not stocked at the above referenced facility shall be identified with the location of the nearest source and shall be available for next-day delivery upon demand.
- c. All parts and software shall be made available for purchase to a qualified elevator maintenance firm with one-business day delivery without direct Owner involvement.
 - 1) Provide details of parts supply facility and a list of current parts pricing for all major components required for the installation.
- d. All specialized tools, equipment, software, and passwords, required to maintain, repair, adjust the operation, and perform code mandated inspections are provided to the Owner as part of the base installation.
 - 1) Updates to these items shall be available via the parts supply facility referenced above.
- e. Technical support of the product(s) shall be available to the Owner's elevator service provider.

2.3 CONTROL FEATURES / OPERATION

A. Simplex Selective Collective Operation - New

1. Provide simplex selective collective operation from a riser of hall push button stations.
2. The registration of one or more car calls shall dispatch the car to the designated floors. The car shall also respond to registered hall calls in the same direction of travel. Car and hall calls shall be canceled when answered.
3. Stops in response to calls that are registered in either the car or corridor pushbutton stations shall occur in the natural order of progression in which the floors are encountered, depending on the direction of car travel, and irrespective of the order in which calls are registered.
4. When the car has responded to the highest or lowest call, and calls are registered for the opposite direction, the car shall reverse direction automatically and respond to those registered calls.
5. When the car arrives at its last stop and reverses direction of travel, all previously registered car calls shall be automatically cancelled.
6. When the car has responded to the highest or lowest call, and hall calls are registered for the opposite direction, the car shall reverse direction automatically and respond to those registered calls.
7. When the car arrives at a landing where both up and down hall calls are registered, it will answer the call in the direction of travel.
 - a. After a pre-determined delay, if no car call is registered, the car shall be assigned to respond to calls registered for the opposite direction. Car doors shall close immediately, re-open and respond to the call for the opposite direction.

- b. Hall lantern operation shall always correspond to direction of service.
8. When an empty car reverses direction at a landing with no hall calls, the doors shall not open and the hall lantern shall not operate.
 9. If the car has no car calls registered and arrives at a floor where both up and down hall calls have been registered, the car shall respond to the hall call corresponding to the direction of car travel. If, after making its stop, a car call is not registered and no other hall calls exist ahead of the car corresponding to its original direction of travel, the doors shall close and immediately reopen in response to the hall call for the opposite direction.
 10. The car shall maintain its original direction at each stop until the doors are fully closed to permit a passenger to register a car call before the car reverses its direction of travel.
- B. Attendant Service Operation - New
1. Arrange the elevator for operation with or without an attendant.
 2. The transfer from automatic to attendant operation shall be by means of a key operated switch in the car station.
 - a. Locate this switch behind a locked cover in the car station, which shall also contain an "up" and a "down" direction button and a "pass" button.
 - b. A service demand buzzer and up and down signal lights shall also be included in the car station.
 3. When the transfer switch is in the attendant position, the car shall answer calls normally except that the attendant, operating either the "Up" or the "Down" button, shall establish the direction of travel, close the doors and start the car after each stop.
 4. The car and landing door opening shall be completely automatic.
 - a. The doors shall remain open until a direction is initiated by the attendant.
 - b. If the button is released before the doors are fully closed and interlocked the doors shall reopen.
 - c. Continuous pressure on one of the direction buttons or the "pass" button shall cause the car to bypass corridor calls and respond only to pre-registered car calls in the direction of travel.
 - d. The bypassed calls shall remain registered to be answered by another car or by the same car on another trip.
 5. The up and down signal lights shall indicate that an unanswered corridor call is above or below the car and shall remain illuminated until all calls for that direction are answered.
 6. Operation of an "Up" or "Down" corridor push button shall momentarily sound the service demand buzzer in the car if it is stopped at a floor with its doors open.
 7. Announced calls by entering passengers shall be registered by the attendant.
- C. Independent Service Operation - New
1. The car operating station shall be equipped with a key-operated switch labeled "IND SER".
 2. Locate the switch in the locked access compartment.
 3. When placed in the "on" position the following shall occur:

- a. Group elevator - the elevator shall bypass corridor calls and travel directly to any floor chosen by registration of a car call. Hall calls shall remain registered for service by another elevator in the group.
 - b. Simplex elevator - existing hall call registrations shall extinguish and hall buttons shall remain inoperative as an indication to passengers that there is no elevator service.
- 4. During Independent Service Operation, the elevator doors shall remain open at any landing until the door close or car call registration pushbutton, is pressed and maintained until the doors are fully closed.
 - 5. If more than one (1) car call is registered, all registered car calls shall extinguish when the elevator stops in response to the first call.
 - 6. In case an elevator is operating on the Independent Service mode and the Fire Emergency Recall system becomes activated, the elevator shall automatically override Independent Service Operation and engage Phase I - Fire Emergency Recall Operation following a period of approximately forty-five (45) seconds.

D. Inspection Service Operation - New

- 1. Provide a key operated switch in the main car operating panel that, when turned to the 'ON' position, shall cause the elevator to be removed from service and placed in Inspection Service Operation.
- 2. Limited operation of the car shall be provided through pressing the Attendant Service up and down momentary push buttons (if provided) or the highest or lowest car call push buttons (if up and down buttons are not provided) in the main car operating panel only.
- 3. The car shall move at a speed not to exceed 150 feet per minute (0.75 meters per second) as per code with both the hall and car door panels in the closed and locked position.
- 4. The Inspection Service switch shall be keyed differently than other typical keys used in the operation of the elevator. Keying shall be in accordance with Security Group Classifications as required by applicable code.
- 5. The top of the elevator car shall be equipped with a control for limited operation of the car during repairs, maintenance and inspection conducted in the hoistway. The transfer of control to the top of car operating device shall cause that device to be the sole means of control for the elevator.
- 6. Power door operating equipment shall be rendered inoperative while the car is being operated in the Inspection Service mode with the exception of power closing of the door. The control system shall maintain closing power on the door while the elevator is moving under Inspection Service Operation.
- 7. The in-car Inspection Service switch shall be rendered ineffective when the top of car inspection control is activated.
- 8. Machine Room Inspection Operation and Inspection Operation with open door circuits shall be provided in accordance with A17.1 Safety Code where required or allowed by the AHJ.

E. Hoistway Access Operation - New

- 1. Provisions shall be made to allow access to the hoistway through the use of hoistway access switches.
- 2. Operating the access switch shall permit the car to move at a speed not to exceed 150 feet per minute (0.75 meters per second) as per code with the hall and car doors in the open position to obtain access to the top of the car.

3. The car shall automatically stop motion when the car top is level with the hoistway door sill.
4. The access key switch(es) shall be keyed differently than other typical keys used in the operation of the elevator. Keying shall be in accordance with Security Group Classifications as required by applicable code.
5. Access operation shall be disabled when top of car inspection operation is in effect.

F. Anti-Nuisance Operation - New

1. In the event car loading or operation is not commensurate with the number of car calls registered, all car calls shall be canceled.
 - a. The system shall monitor the door protection device to determine if passenger transfer exists.
 - b. If after the third stop a passenger transfer has not occurred, the system shall cancel all remaining car call registrations and resume normal operation by responding to assigned hall call demand.
 - c. The number of calls registered with no passenger transfer that will trigger anti-nuisance shall be adjustable. Initially set this threshold to 3 calls.

G. Out-of-Service Control Operation - New

1. The car operating station shall be provided with an unidentified key-operated switch, engraved with "ON" and "OFF" only, that shall remove the elevator from service when placed in the "ON" position and the car is not in motion.
2. In the event the key-switch is turned to the "ON" position while the elevator is in motion, the car shall proceed to the next call and be removed from service after leveling operations are completed and the doors have opened.
3. When engaged, the Out-of-Service Control feature shall cause the car door to remain open and the car call buttons rendered inoperative.
4. The elevator shall not respond to hall call assignments from dispatching systems when the Out-of-Service Control feature is active.
5. Phase I - Emergency Fire Recall Operation as well as Phase II - Emergency Fire Operation shall override this feature.

H. Fire Emergency Operation / New Jersey - New

1. Phase I - Emergency Recall Operation shall be provided for each car in accordance with ASME A17.1 code as modified under the applicable local or State law.
2. Each main or auxiliary car operating station shall be provided with an indicator light and warning buzzer, each of which shall become activated whenever Phase I Operation is engaged.
 - a. The warning buzzer shall cease to function once the car has completed the recall sequence and is positioned at the designated recall landing.
 - b. The indicator light shall remain illuminated as long as Phase I Operation is activated.
3. A three-position, key-operated switch shall be provided on the designated recall landing to manually activate Phase I Operation.

- a. When activated, Phase I Operation shall be arranged so that in order to reset normal service, all cars must first be returned to the designated recall landing, after which the Phase I key-switch must be turned to the "OFF" position.
 - 4. A "Standardized Fire Recall Key" shall be used in accordance with the applicable Chapter of the Public Law. This key shall be a Yale #3502.
 - a. Multiple elevators within a group or building that are not affected by the scope of work specified herein, shall be upgraded to the "Standardized Fire Recall Key".
 - b. The "Standardized Fire Recall Key" shall apply to both Phase I and Phase II Operation.
 - 5. Phase II - Emergency Recall In-Car Operation shall be provided for each car in accordance with ASME A17.1 code as modified under local or State law.
 - 6. Locate controls required for Phase II – In-Car Operation in a locked access cabinet in the main car operating panel.
 - a. The cover of the locked access panel shall be engraved as required by local or State law.
 - b. The locked access panel shall contain:
 - 1) Phase II key switch.
 - 2) Fire indicator light.
 - 3) Call cancel push button.
 - 4) Door open push button.
 - 5) Door close push button.
 - 6) Run/Stop switch.
 - 7) Other devices as may be required by local law.
 - c. Engrave the Fire Service Operating Instructions on the inside of the locked cabinet door.
- I. Low Oil Protection and Protective Device
- 1. Provide low oil protection operation and appropriate device(s) that will discontinue operation of the hydraulic elevator pump when:
 - a. The elevator stalls due to a low oil condition
 - b. Fails to reach the landing in the up direction
 - 2. Pressure Switch:
 - a. Where the top of the cylinder head is above the top of the tank, provide a pressure switch between the cylinder and the valve which shall be activated by the loss of pressure at the top of the cylinder, and control the operation of the elevator as required by Code.
 - 3. Provide an additional protective device that shall automatically return the elevator to the bottom landing, open the door and shut down the system.
 - 4. The protective device shall be an integral part of the control system.

J. Hydraulic Auto Lowering - New

1. Provide automatic battery powered lowering feature for the hydraulic elevator.
 - a. In the case of normal power outage, the elevator shall be automatically lowered to the Main Lobby level.
 - b. The door shall open automatically to discharge passengers.
 - c. The elevator shall remain parked with its door closed and door open button operative until normal power is restored.
2. The control panel shall be located in the machine room or be an integral part of the control system.
 - a. It shall include necessary batteries, solid-state controls, charger, monitor lights and a test button.
 - b. It shall be fed by a 120 volt, 20 Ampere branch circuit from the emergency power source, provided by Others.
3. Provide necessary circuitry within the controller to determine the difference between an "intentional" loss of power and an "actual" loss of power in order to prevent operation of the auto lowering unit when the main line disconnect has been opened for elevator servicing.
4. Provide necessary terminals for connection to an auxiliary switch in main line disconnect provided by others.

K. Door Operation / Power Car / Slide Hoistway - New

1. Car and hoistway doors shall be arranged to operate in unison without excessive noise or slamming in either direction of travel.
 - a. Door opening speeds of two (2) feet per second shall be provided in conjunction with closing speeds of 1.0 feet per second in accordance with governing code.
 - b. Door operation shall commence as the car stops level at the floor and the machine brake is applied. Pre-door opening shall not be permitted.
2. Door open and door close time shall be measured between the moment car door operation in either direction begins and the instant at which that cycle is completed.
3. When responding to either a car or corridor call, the amount of time that the elevator door remains stationary in the open position shall be adjustable up to sixty (60) seconds.
 - a. Door open dwell time for a corridor call shall be separate of that for a car call, and in both cases, dwell time shall be canceled whenever the car door protection device is momentarily interrupted by passenger transfers, followed by a reduced door open dwell time of approximately one (1) second (adjustable) after the door protection device is cleared of obstructions.
4. The operation of the door protective device by physical contact (mechanical safety-edge) or the interruption of one or more infrared light beams (dual or multi-beam non-contact) during the close cycle shall cause the immediate reversing of the doors to the full open position.

5. The door closing cycle shall be arranged so that, in the event the door protective devices become continually obstructed after the normal door open dwell time has expired, and following a time interval of approximately thirty (30) seconds (adjustable), a warning tone shall sound and the door closing cycle shall commence at reduced speed and torque per applicable Code requirements.
6. Each car operating station shall be provided with a "door open" and "door close" push button.
 - a. Pressure on the "door open" button shall cause doors in the full open position to remain so and doors engaged in the close cycle to reverse direction and assume the full open position so long as pressure remains applied to the button.
 - b. The "door open" buttons shall also control the open cycle during Phase II - Emergency In-car Operation.
 - c. The "door close" push button shall function on Independent Service, Attendant Service and Phase II - Emergency In-car Operation as well as during normal automatic operations.
7. Repeated attempts by the power door operator to open or close the door at any landing shall be monitored by the control system.
 - a. In the event the door fails to cycle properly after a preset (adjustable) number of attempts, the car shall either travel to the next stop or remove itself from service, depending upon whether the malfunction is in the open or close cycle.
8. Each hoistway door shall be provided with an automatic self-closing mechanism arranged so that the door shall close and lock if the car should leave the landing while the hoistway door is unlocked.
9. Car doors shall be arranged to prevent their being manually opened from inside the car unless the elevator is positioned within a floor landing zone.

2.4 MACHINE ROOM / SECONDARY EQUIPMENT

A. Control Equipment - New

1. Provide a microprocessor-based elevator control system.
2. Digital logic shall calculate optimum acceleration, deceleration and velocity patterns for the car to follow during each run.
3. Closed-loop distance and velocity feedback shall monitor the actual performance of the elevator car with the desired speed profile.
4. System operating software shall be stored in non-volatile memory.
 - a. Elevator control relays, contactors, switches, capacitors, resistors, fuses, circuit breakers, overload relays, power supplies, circuit boards, static motor drive units, wiring terminal blocks and related components shall be totally enclosed inside a free-standing metal cabinet with hinged access doors.
 - b. Mechanical ventilation or air conditioning of the cabinet shall be provided and shall be adequate to dispose of the full load heat losses without exceeding 40° C (104° F) ambient temperature.

- 1) Where integral air conditioners are not employed, control equipment cabinets shall be provided with forced air ventilation to prevent overheating of the electrical components housed therein.
 - 2) Where integral air conditioners are employed, control equipment cabinets shall be "NEMA 12" rated with no ventilation fans or slots.
- c. All electrical wiring inside the control equipment cabinet shall be performed in a neat manner with field wiring terminated at stud blocks provided inside the control cabinet.
 - d. Each wiring terminal shall be clearly identified according to the nomenclature used on the "as built" wiring diagrams. No more than two (2) field wires may be connected to any single terminal stud.
 - e. Spare wires shall be tagged according to their point of termination, bundled, and placed at the bottom of the control equipment cabinet.
 - f. Each electrical component within the cabinet shall be permanently identified with symbols, identical to those used on the "as-built" wiring diagrams.
 - g. A data plate that indicates the edition of the Code in effect at the time of installation and/or alteration shall be provided in accordance with applicable code and requirements of ASME A17.1 Code. The data plate shall be in plain view and securely attached on the mainline disconnect or on the controller.
 - h. Control equipment shall comply with requirements of all applicable Sections of the ASME A17.1 Code as approved and adopted by the AHJ.
 - i. The manufacturer's standard on-board "LCD" display shall be incorporated on the main processor board and/or otherwise incorporated in the controller cabinet. The "LCD" shall be capable of providing alpha-numeric characters to view the operational status of the elevator and/or group functions depending on the application. The display shall provide the user with necessary information for troubleshooting and reprogramming of the basic system parameters.
 - 1) Where the "LCD" is not an integral part of the controller and troubleshooting/reprogramming requires the use of a separate tool, the tool shall be maintained in the machine room and accessible to service personnel. This tool, along with all technical documentation for the correct use of the tool, shall remain the property of the Owner.
 - 2) Password protection of critical programming features is required to prevent accidental changes to life-safety and other non-typical control settings.
 - 3) Where a separate dispatch or group control panel is provided, a separate "LCD" display shall be provided to view group functions.

B. Controller/Dispatcher

1. The elevators shall have generic microprocessor based controller/dispatchers.
2. The controller shall be designed to control the acceleration, deceleration and stopping of the elevator and to prevent damage to the motor from overload or over current condition.
3. Arrange controls to prevent the operation of the elevator in case of phase reversal, phase failure or low voltage in the power supply.
4. Place controllers in a totally enclosed NEMA 1 enclosure with a self-supporting steel frame.
 - a. Provide hinged doors to facilitate service. Within each enclosure provide a locally controlled fluorescent light and a duplex GFIC receptacle.

- b. Provide natural or mechanical ventilation for the controller cabinets.
 - c. Equip the vent openings and exhaust fans with filters.
5. Mount equipment to moisture-resistant, noncombustible panels supported from the steel frame.
 6. Provide "noise filter" between hoistway wiring and controller/dispatchers to eliminate interference.
 7. Optically isolate communication cables between components.
 8. Provide a solid state starter for the pump motor.
 9. Wiring: Wiring on the units, whether factory or field wiring, shall be done in neat order, and all connections shall be made to studs and/or terminals by means of grommets, solderless lugs or similar connections. All wiring shall be copper.
 10. Terminal Blocks: Provide terminal blocks with identifying studs on units for connection of board wiring and external wiring.
 11. Marking: Identifying symbols or letters shall be permanently marked on or adjacent to each device on the unit, and the marking shall be identical with marking used on the wiring diagrams. In addition to the identifying marks, the ampere rating shall be marked adjacent to all fuse holders.
 12. Diagnostics: For diagnostic work, provide the elevator control system with its own built-in LED or LCD display unit or furnish a service tool.
 - a. When a fault is detected, the diagnostic system will record the fault code in a nonvolatile memory along with the location of the elevator and the time of day.
 - b. The display unit shall be used to retrieve this information on every car.
 - c. The fault information shall include, but not limited to:
 - 1) Elevator position, travel direction and mode of operation.
 - 2) Car and hall calls that currently exist within the system
 - 3) All safety circuits.
 - 4) Processor power supply and processor and Input/Output status.
 - 5) Door safety circuits.
 - 6) Door zone signals.
 13. In the event diagnostics and monitoring is accomplished via Field Service Tools, provide the required Field Service Tools with related control system appurtenances for diagnostic evaluations, system monitoring and field adjustments.
 - a. Provide instructions for proper use of such diagnostic tools and/or equipment with all coding and other operational requirements.
 - b. Maintain and calibrate the diagnostic tools, and update the associated instructions and other related documents under the service agreement.
 - 1) Should the agreement be cancelled for any reason by either party, maintenance and updating of diagnostic tools shall be provided to the Owner at the Contractor's cost without the need to purchase or lease additional diagnostic devices, special tools or instructions from the original equipment provider.
 - 2) The Owner may request field and technical instructions be provided by the original installation contractor or manufacturer for proper servicing by other qualified elevator company personnel.

- 3) The established cost plus profit, as previously specified, shall be applicable for the life of the system.
 - a) If the equipment for fault diagnosis is not completely self-contained within the controllers but requires a separate detachable device, that device shall be furnished to the Owner as part of this installation.
 - b) Such device shall be in possession of and become property of the Owner.

14. Microprocessor Documentation

- a. Provide and/or obtain complete information on systems' design, component parts, installation and/or modification procedures, adjusting procedures and associated computer conceptual logic circuitry and field connection.
 - b. Provide microprocessor upgrading and/or modifications to programs that have been assigned to enhance the operation of the equipment for a period of 10 years after project approval.
15. Selector: A floor selector shall be part of the controller microprocessor. Position determination in the hoistway may be through fixed tape in the hoistway or by sensors fitted on each driving machine to encode and store car movement. Design the mechanical features and electrical circuits to permit accurate control and rapid acceleration and retardation without discomfort.
16. Provide an automatic stopping device and self-leveling system to insure that the car lines up with each landing served with a tolerance of no more than plus or minus 1/4" for all elevators under all conditions of load for both "up" and "down" travel.
- a. The automatic self-leveling system shall correct for overtravel or undertravel and rope stretch.

C. Control Cabinet Air-Conditioning - New

1. Provide the control cabinet with a thermostatically controlled and integrally mounted air-conditioning unit.
 - a. Design and size the unit based on the individual heat dissipated in the controller to ensure the internal cabinet temperature remains below 35° C for minimized electronic heat related failures.
 - b. Enclosure shall be sealed at all ports of entry including access door, cable or other wiring circuitry inlets and outlets.
 - c. The air intake shall be equipped with a renewable filter element and sized to provide required air exchanges.
 - d. Provide the system with a supplemental drainpipe and collection pan with commercial evaporator in the event prevailing conditions generate excess condensation (waste water).
 - e. Provide a minimum of six (6) air filters for maintenance of the system.
 - f. Provide associated electrical power supply, control and grounding in accordance with local law requirements.
 - 1) Power for the unit shall be obtained through elevator main line feeders with voltages modified as required as part of the power-end of the controller.

- 2) Devices necessary to obtain required power shall be provided by the controller manufacturer.
- 3) No external power supplies shall be required.

D. Equipment Isolation - New

1. Provide effective sound isolation between machines, secondary deflector sheaves, solid state motor drive units and filters, from building structure to reduce noise transmission to occupied spaces and elevators and elevator cabs.
2. When operating per plans and specifications, the elevator equipment shall not generate noise levels in excess of NC-40 in occupied tenant spaces and shall be free of pure tones. For the purposes of this specification, a pure tone shall be defined as a sound level in any one-third octave band which is greater than 5 dB above both adjacent one-third octave bands, in the range 45 to 11,200 Hz.
3. Provide the following as a minimum:
 - a. Resiliently isolate the entire elevator/secondary deflector integral unitized base from the elevator machine room floor slab by means of effective neoprene-in-shear isolators having a minimum static deflection of 3/8".
 - b. Isolate the transformers and reactance units from the building structure by means of approved neoprene-in-shear isolators having a minimum static deflection of 3/8".
 - c. Solid state rectification units shall be mounted on 3/4" thick minimum, neoprene-in-shear pad isolators and an effective electrical filter/reactance limiting electrical noise shall be provided.
 - d. Use flexible conduit with ground wire for motor, machine, drive, governor and position/velocity transducer connections.

E. Sound Reducing Protection - New

1. When operating in accordance with plans and specifications, the elevator equipment shall not generate noise levels in excess of NC-40 in occupied tenant spaces and shall be free of pure tones.
 - a. For the purpose of this specification, a pure tone shall be defined as a sound level in any one-third octave band which is greater than 5 dB above both adjacent one-third octave bands, in the range 45 to 11,200 Hz.
2. Provide the following treatments as a minimum.
 - a. Mount sound insulating panels, manufactured of reinforced 16 gauge steel panels with a 1" thick 1-1/2 lbs. core of fiberglass affixed to interior, on all four open sides of the power unit frame to isolate airborne noise from belt driven motor-pump assembly.
 - b. Install a minimum of two sound isolating couplings in the oil line in the machine room between pump and jack.
 - 1) Each coupling shall consist of two (2) machined flanges separated by two (2) neoprene seals to absorb vibration and to positively prevent metal-to-metal contact in the oil line.
 - 2) Build coupling in such a manner that they will be absolutely blow-out proof.

- c. Install an oil-hydraulic muffler in oil line near power unit.
 - 1) The mufflers contain pulsation absorbing material inserted in a blow-out proof housing.
 - 2) Rubber hose without blow-out proof features will not be acceptable.
- d. Provide sound reducing vibration isolation elements at all support points of elevator controllers and pump units.
 - 1) The elements shall be similar to double deflection neoprene-in-shear mounts, as manufactured by Mason Industries.
 - 2) All bolts through isolation elements, where necessary, are to incorporate resilient washers and bushings.
- e. Locate the power unit at least 1" from any walls.
- f. Use flexible conduit with ground wire for pump unit connections.

F. Hydraulic Power Unit / Motor - New

- 1. Provide a self-contained power unit which includes:
 - a. Structural steel outer base
 - b. Tank support
 - c. Oil tight drip pan
 - d. Floating inner base to prevent metallic contact for mounting the motor pump assembly.
 - e. Sound isolation panels to enclose the unit and reduce airborne noise.
- 2. Provide a reinforced overhead oil reservoir with a tight fitting tank over the oil control unit which includes:
 - a. An oil fill strainer with air filter
 - b. An oil level gauge assembly
 - c. A self-cleaning strainer in the suction line.
- 3. The pump shall be for oil hydraulic elevator service with positive displacement screw type design for steady discharge with minimum vibration.
- 4. The drive shall be directly driven by a submersible pump depending on the HP requirements of the system.
 - a. The use of submersible pumps having more than a 40 HP motor is unacceptable.
- 5. Pump drive motor control shall utilize solid state motor starter circuitry to provide reduced current starting and maximum protection of the motor.
- 6. The oil control unit shall be of the manufacturer's own design but shall include relief, safety check, start and slow down valves.
 - a. Use lowering and leveling valves for drop away speed, lowering speed, leveling speed and stopping speed to insure smooth down starts and stops.

- b. Provide a valve for manual lowering of the elevator car in event of power failure and for use in servicing and adjusting the elevator mechanism.
 - c. Design the tank shut-off valve for isolating oil in the power unit tank to ensure each of servicing and adjusting the elevator mechanism without removing oil from the tank.
 - d. All valves shall be accessible for adjustment without removing the assembly from the oil line.
7. Manufacture the unit to operate under 600 psi (for submersible units) working pressure.
 8. Provide the manufacturer's standard oil cooler sized and designed to maintain a maximum oil temperature of 125 degrees F in a machine room conditioned to operate at a maximum ambient temperature of 95 degrees F.
 9. Provide a thermostatically controlled heater in the oil tank to maintain proper operating oil temperature.

G. Hydraulic Piping - New

1. Provide all necessary pipes and fittings to connect the power unit to the jack.
 - a. Use minimum Schedule 80 steel pipe.
 - b. Provide a shut off valve in the machine room for maintenance service.
2. For remote machine rooms, run the hydraulic pipe in a trench provided by others.
 - a. The pipe shall be welded and wrapped with a protective tape coat.
 - b. Enclose the pipe in a schedule 40 PVC sleeve which shall run from the machine room to the hoistway.
3. The oil pipe and conduit shall be overhead above suspended ceiling.
 - a. Exact location must be coordinated with other trades.
 - b. For pipe hangers use spring hangers Type 30 of Mason Industries, Inc. or approved equal.
 - c. Provide neoprene isolation pads between the pipe and the hangers.
4. Adequately support the full run of pipe with isolation type support.
5. Elevator manufacturers may use flexible hydraulic lines with proper fastenings for seismic consideration in place of the specified Schedule 80 steel pipe.
6. Elevator manufacturers must provide a list of relative projects where flexible lines have been utilized prior to acceptance.
7. Where flexible hose and fitting assemblies, and flexible couplings are used for hydraulic connections, flexible hose and fitting assemblies shall:
 - a. Not be installed within the hoistway, nor project into or through any wall.
 - b. Installation shall be accomplished without introducing twist in the hose, and shall conform with the minimum bending radius of SAE 100 R2 type, high pressure, steel wire reinforced, rubber covered hydraulic hose specified in SAE J517.
 - c. Have a bursting strength sufficient to withstand not less than 10 times the working pressure.
 - d. Be permanently marked indicating:

- 1) Manufacturer of the hose and fittings
- 2) Type of hose and fitting
- 3) Minimum factory test pressure
- 4) Minimum bending radius of the hose
- 5) Date of installation
- 6) Inspection procedure
- 7) Name of elevator contractor

H. Hydraulic Mainline Oil Strainer - New

1. Provide a mainline hydraulic oil strainer of the self-cleaning, compact type, equipped with a 40 mesh element and installed in the oil line.
2. Design the strainer for maximum system working pressure.

I. Hydraulic Oil Cooler - New

1. Provide a thermostatically controlled industrial standard oil-air heat exchanger, sized and designed to maintain a maximum oil temperature of 100 degrees F.
2. The oil cooler shall contain the following components mounted on a unit-frame:
 - a. A heat exchanger.
 - b. A three-phase motor driving a screw pump to circulate the oil through the heat exchanger.
 - 1) The screw pump motor shall operate from a power source matching the main power unit pump motor thereby eliminating the need of a separate power feeder.
 - c. A low-noise cooling fan designed to obtain the maximum cooling capacity of the unit.
3. Provide a separate disconnect for the oil cooler pump and fan to facilitate servicing.
4. The maximum noise level of the oil cooler assembly shall not exceed 50 dBa.

2.5 HOISTWAY EQUIPMENT

A. Guide Rails / Inserts / Brackets – New for Replacing Lower Section From Pit area to 1st Floor – Optionally the Entire Hoistway

1. Provide machined, standard size steel “T” section guide rails with tongue and grooved joints for the car and counterweight. Use not less than 15.0 pound car rails.
2. The car guide rails shall be as follows:
 - a. At operating speeds of 350 fpm and below: Savera Super Line, Monteferro S or approved equal.
3. Use not less than 3/4" thick machined steel fishplates to form rail joints. Connect rails to fishplate with four (4) bolts.
4. The section modulus and moment of inertia of the fishplates shall not be less than that of the rail. Connect rails to fishplate with four (4) bolts.

5. For concrete and concrete block hoistways furnish rail brackets and provide inserts and an insert location drawing to Construction Manager or General Contractor.
6. Brackets shall be used to support the rails from the hoistway framing and/or inserts.
 - a. The rails shall be attached to the brackets by heavy clamps or clips.
 - b. Bolting or welding rails to brackets shall only be allowed in certain instances.
 - c. Do not attach brackets to the top flange of hoistway framing steel.
7. Provide rail backing where the vertical distance between support framing is greater than 14'-0" and no intermediate support framing is shown on the drawing.
8. All guide rails shall be erected plumb and parallel to a maximum deviation of 1/8 inch (plus or minus 1/16 inch).
9. Provide oversized steel members and brackets for the rails where the distances exceed the manufacturer's standard dimensions.
10. Provide rail backing and connect rails to top and bottom of structural members as shown on structural drawings where the vertical distance between support framing is greater than 14' – 0", and no intermediate support framing is shown on the contact documents.
11. Provide isolation type car and counterweight rail brackets at all locations.
 - a. Design the brackets to isolate the rails from the building structure through the use of neoprene sleeves, bushings and pads as manufactured by Mason Industries or approved equal. Provide details for review.

B. Guide Rails / Inserts / Brackets (Reuse From 1st floor to Top – Optionally Complete Replacement)

1. Car guide rails, fish plates, rail brackets, backing support and related attachments shall be inspected to determine if unfavorable conditions exist that diminish the structural integrity of any component.
 - a. In the event substandard conditions are disclosed by means of this inspection, the Contractor shall immediately inform the Consultant as to the exact nature of said problems and then undertake whatever repairs and/or replacements the Consultant may deem appropriate to remedy the situation.
2. Each stack of guide rails shall be individually examined to determine if excessive compression has occurred from building settlement.
 - a. In the event such conditions are found to exist, each affected stack shall be cut off enough to relieve pressure.
3. Each stack of guide rails shall be realigned so that total deviation from plumb in any direction does not exceed 1/8" over the entire length of the hoistway and that DBG measurements never vary more than .030".
4. As required, car guide rails joints shall be individually filled, filed and sanded in order to eliminate minor variations in adjoining machined surfaces.

C. Slide Guides - New

1. Provide swivel sliding type guide shoes with approved replaceable liners with positive feed lubricators.

2. Properly size the shoes according to speed, capacity and dimensions of the elevator.

D. Electrical Conduit / Wiring / Traveling Cable – Complete New

1. Electrical wiring shall be provided.
 - a. All wiring shall be stranded copper conductors, manufactured in compliance with ANSI/ASTM B174-71 and UL 62 requirements, and polyvinyl chloride insulation complying with ETT requirements of UL 62 and Article 400 of the National Electric Code.
 - b. Electrical wiring provided for hoistway interlock shall be of a flame retardant type, capable of withstanding temperatures of at least 392 degrees Fahrenheit. Conductors shall be Type SF or the equivalent thereof.
 - c. Each run of electrical conduit or duct shall contain no less than 10% spare wires and, in any case, no fewer than two (2) spare wires.
 - d. Crimp-on type wire terminals shall be used where possible.
2. Traveling cable shall be provided.
 - a. Each traveling cable shall be provided with a flame and water resistant polyvinyl chloride jacket.
 - b. Electrical wiring shall consist of stranded copper conductors, manufactured in compliance with ANSI/ASTM B174-71 and UL 62 requirements, and polyvinyl chloride insulation complying with ETT requirements of UL 62 and Article 400 of the National Electric Code.
 - c. Each traveling cable shall contain no less than 10% spare wires.
 - d. Traveling cable exceeding 100' in length shall be provided with a steel wire rope support strand from which the cable shall be suspended.
 - e. Traveling cable must be contained within an approved electrical conduit to within 6' of the final suspension point in the hoistway.
 - f. Each traveling cable shall be arranged to provide no fewer than six (6) individually shielded pairs of 20 gauge wire and arranged to contain no less than one (1) coaxial cable for CCTV remote monitoring.
 - g. Traveling cable conductors that terminate at a hoistway center box shall be connected to stud blocks provided for that purpose.
 - 1) Each wiring terminal shall be clearly identified by its nomenclature as shown on the "as built" wiring diagrams and solderless, crimp-on type wire terminals shall be used where possible.
 - h. The attachment of a traveling cable to the underside of the elevator car shall be performed so that a minimum loop diameter of 30x the cable diameter is provided.
 - i. Pre-hang the cables for at least 24 hours with ends suitably weighted to eliminate twisting during operation.
3. Rigidly supported EMT conduit, flexible metal conduit and galvanized steel trough shall be utilized throughout the hoistway.
 - a. Both EMT and flexible conduit shall be connected on either end by use of compression fittings and secured in place with metal clamps sized in accordance with the diameter of conduit utilized.

- 1) Wire or plastic wire ty-raps shall not constitute an acceptable means of fastening.
- b. The use of flexible metal conduit shall be limited to runs not greater than 3' in length.
- c. All abandoned or unused electrical conduit shall be removed from the hoistway.

E. Normal and Final Terminal Stopping Devices - New

1. Provide normal terminal stopping devices to stop the car automatically from any speed obtained under normal operation within the top and bottom overtravel, independent of the operating devices, final terminal stopping device and the buffers.
2. Provide final terminal stopping devices to stop the car and counterweight automatically from the speed specified within the top clearance and bottom overtravel.
3. The terminal stopping devices shall have rollers with rubber or other approved composition tread to provide silent operation when actuated by the cam fixed to the top of the car.
 - a. Terminal stopping devices that are not mechanically operated (i.e.: magnetic proximity) shall be provided by the manufacturer of the control equipment, intended for use as a terminal limit, and designed for reliable operation in the hoistway environment.
4. Final terminal limits shall be pinned so as to prevent movement after final adjustment where required by the AHJ.

2.6 PIT EQUIPMENT

A. Car Spring Buffer - New

1. Provide buffer with necessary blocking and horizontal steel braces under the car.
2. Provide spring type buffers for elevators with operating speeds of up to and including 200 fpm.
 - a. The buffers shall comply in all respects with the requirements of the ASME Code.
3. The buffer shall be tested by a qualified testing laboratory and approved as complying with the ASME Code.
4. Provide a permanent buffer marking plate which indicates the manufacturer's name, identification number, rated impact speed and stroke.
5. Provide a permanent data plate in the vicinity of the counterweight buffer indicating the maximum designed counterweight runby in accordance with ASME A17.1 as may be modified by, and/or in addition to codes and standards accepted by the Authority Having Jurisdiction.

B. Pit Stop Switch - New

1. Where pit depth does not exceed 67", each elevator pit shall be provided with a push/pull or toggle switch that is conspicuously designated "EMERGENCY STOP" and located so

as to be readily accessible from the hoistway entrance on the lowest landing served at a height of approximately 18” above the floor.

- a. This switch shall be arranged to prevent the application of power to the hoist motor and machine brake when placed in the “OFF” position.
2. Where climb-in pit depth exceeds 67”, each pit shall be provided with two (2) push/pull or toggle switches conspicuously designated “EMERGENCY STOP”.
 - a. Both of these stop switches, shall be located immediately adjacent to the pit access ladder.
 - 1) Place one stop switch approximately 47” above the pit floor.
 - 2) Place the second stop switch 18” above the hoistway entrance sill on the lowest landing served.
 - 3) These switches shall be arranged so as to prevent the application of power to the hoist motor or machine brake when either one is placed in the “OFF” position.

C. Jack Assembly, Jack Hole and Casing (New/Replacement)

1. Existing hydraulic cylinder, piston and pit channels shall be removed.
 - a. Contractor shall be responsible for drilling of the jack hole and removal of resultant debris should the existing jack hole collapse.
2. The jack hole shall be fitted with a schedule 40 waterproof PVC casing.
3. The jack assembly shall be of sufficient size to lift the gross load at the rated speed to the height specified and shall be factory tested to ensure adequate strength and freedom from leakage.
 - a. No brittle material, such as grey cast iron, shall be used in the jack construction.
4. The base components of this assembly shall be a cylinder, cylinder head and plunger.
5. Installation shall be plumb and at the exact center of the car guide rail DGB.
6. Channel iron pit structure shall be provided as a means of support and attachment.
7. The hydraulic cylinder shall be constructed from heavy steel pipe meeting ASTM-A53, grade B standards with a forged seamless end cap, threaded inlet fitting and brackets for pit channel attachment.
 - a. Outside walls of the cylinder shall receive no less than three applications of an approved corrosion inhibiting compound.
8. The cylinder head and flange shall be machined from carbon steel and designed to provide a collision point for the plunger stop ring.
 - a. The head shall be equipped with two (2) packing rings separated by a single lantern ring, an oil wiper ring, a bronze guide ring, and an air bleed port.
 - b. The flange shall be arc welded to the upper end of the cylinder to provide a means of attachment and mating surface for the head.

- c. Immediately prior to seeking final acceptance of the completed project as specified herein, the Contractor shall renew both packing rings in the cylinder head.
9. The plunger shall be constructed from precision ground steel pipe meeting ASTM-A53, grade B standards.
 - a. In cases where multiple plunger sections are necessary, threaded coupling with neoprene O-ring seals shall be provided.
 - b. The upper end of the plunger shall be fitted with an inset steel plate that is fillet welded to the inner walls of the plunger and then drilled and tapped for platen plate attachment.
 - c. A heavy steel stop ring shall be arc welded outside the plunger near the bottom end.
 10. Contractor shall be responsible for extra costs necessary to overcome underground rocks, solid debris or water and complete satisfactory drilling of the jack hole.
 11. Should the existing well hole and or casing diameter be inadequate for installation of new cylinder and PVC liner, Contractor shall drill a larger well hole of sufficient diameter to accommodate the new equipment.
- D. Hydraulic Check Valve - New
1. A check valve shall be provided and installed so that it will hold the elevator with rated load at any point when the pump stops and the down valves are closed or the maintained pressure drops below the minimum operating pressure.
- E. Overspeed (Rupture) Valve - New
1. Where required by Code, an overspeed valve shall be provided and installed so that it will cause the flow of oil from the hydraulic jack through the pressure piping to cease when such flow exceeds a preset value relative to car speed in accordance with applicable codes.
- F. Scavenger Pump - New
1. Provide a positive displacement, rotary type pump for the hydraulic elevator.
 - a. The pump shall have a discharge pressure of 200 psi maximum and capacity of 100 gallons per hour.
 - b. The pump shall be self-priming and self-lubricating.
 - c. The pump shall be equipped with a 100 mesh screen strainer.
 - d. The pump housing shall be constructed of brass with stainless steel internal parts.
 2. Mount oil return pump off the pit floor and connect it to the jack unit and the oil tank with copper tubing.

2.7 HOISTWAY ENTRANCES

- A. Hoistway Entrance Structure / Complete New at Lobby Floor (B)

1. Frames - The frames shall be constructed of 14 gauge sheet steel. Provide bronze finish unit frame with welded and mitered corners ground smooth, 2" wide square profile as selected by Architect to match existing 2nd and 3rd floor.
2. Doors - The doors shall be constructed of 16 gauge sheet steel, not less than 1-1/4" thick, reinforced to accept hangers, interlocks or door closers.
3. Equip all hoistway landing doors with one-piece full height non-vision wings of material and finish to match hall side of door panels. The door panel shall be bronze finish to match existing 2nd and 3rd floor.
4. Entrances shall bear 1 ½ hour label of Underwriters Laboratories, Inc.
5. Provide each door panel with two removable laminated plastic composition guides, arranged to run in sill grooves with a minimum clearance, replaceable without removing the door from the hangers and incorporating a steel fire stop.
6. Provide rubber bumpers at the top and bottom of the door to stop them at their limit of travel in opening direction.
7. Sills - Provide narrow-type, extruded sills with the nosing approximately one (1) inch deep and running the full length of door travel.
 - a. The hoistway door sill shall be extruded bronze at least 3/8 inch thick.
 - b. The wearing surface shall be of a non-slip type.
 - c. Rigidly secure the sills to the building construction by means of steel sill support brackets or blocking with necessary metal shimming or adjustments.
 - d. Provide and rigidly secure sill support members to the building structure after blocking and leveling them with necessary metal shimming.
 - 1) Use 4" x 4" x ¼" angle for single speed entrances and 5" x 5" x 3/8" angle for two speed entrances.
 - 2) If formed sheet steel sill support members are used, the structural properties of these members shall match or exceed the structural properties of 4" x 4" x ¼" angle for single speed entrances, and 5" x 5" x 3/8" angle for two speed entrances.
8. Provide a special key so that an authorized person can open door when the car is elsewhere.
 - a. The key hole shall be fitted with metal ferrule that matches the door finish.
 - b. Drilling key holes in the field will not be accepted.
9. Struts - Provide 3" x 3" x 1/4" hot rolled steel angle struts.
 - a. If formed sheet steel struts are used, the structural properties of formed struts shall match or exceed the structural properties of 3" x 3" x 1/4" steel angle.
 - b. Extend the struts from top of sill to either the bottom of floor beam or intermediate framing above.
 - c. Bolt struts in place with not less than two (2) bolts at each end.
 - d. Strut clip angles or brackets shall have a thickness not less than the thickness of the supported strut.
10. Track Support - 3/16 inch thick steel track support plate shall extend between and be bolted to the vertical steel struts with no less than two (2) bolts at each end.
11. Track Covers – 16 gauge steel cover plates shall extend the full travel of the doors.

- a. Covers shall be made in sections for service access to hangers, sheaves, tracks and interlocks.
 - b. The sections above the door opening shall be movable from within the elevator car.
 - c. Cover fastening devices shall be non-removable from the cover.
12. Fascias – 14 gauge steel fascia plates shall extend at least the full width of the door and be secured at hanger support and sill with oval head machine screws.
- a. Provide fascia plates where the clearance between the edge of the loading side of the platform and the inside face of the hoistway enclosure exceeds the code allowed clearance.
13. Toe Guards - Provide 14 gauge steel toe guards to extend 12 inches below any sill not protected by fascia.
- a. The toe guards shall extend the full width of the door and shall return to the hoistway wall at a 15 degree angle and be firmly fastened.
14. Dust Covers - Provide 14 gauge steel dust covers to extend 6 inches above any header not protected by fascia.
- a. The dust covers shall extend to a full width of travel of the doors, return to the hoistway wall at a 15 degree angle and be firmly fastened.
15. The bottom of each horizontally sliding hoistway door panel shall be equipped with guiding members and safety retainers in accordance with A17.1 Safety Code as adopted and/or modified by the AHJ.
- a. The bottom hoistway door panel safety retainers shall be of stainless steel "Z" bar design, or shall be otherwise designed to prevent displacement of the door panel.
 - b. Elevator Contractor must submit proof to the Department, in the form of a statement certified by a licensed architect or engineer, that the engineering and design of the safety retainers comply with the performance standard defined in Appendix "K".

B. Hoistway Entrances (Reuse 2nd and 3rd Floor)

1. Hoistway entrance sills, sill supports, entrance frames, headers and header supports shall be reused and refurbished.
- a. Hoistway entrances that have become distorted or bent shall be straightened, plumbed, reset to the proper width dimension and reinforced as necessary.
 - b. Provide 14 gauge steel fascia plates that extend at least the full width of the door and be secured at hanger support and sill with oval head machine screws.
 - 1) Reinforce fascia to allow not more than ½" of deflection.
 - 2) Provide fascia plates where the clearance between the edge of the loading side of the platform and the inside face of the hoistway enclosure exceeds the code allowed clearance.

- c. Provide 14 gauge steel toe guards that extend 12" below any sill not protected by fascia.
 - 1) The toe guards shall extend the full width of the door and shall return to the hoistway wall at a 15 degree angle and be firmly fastened.
- d. Remove oil, dirt and impurities on new and existing apparatus and give a factory coat of rust inhibitive paint to all exposed surfaces of struts, hanger supports, covers, fascias, toe guards, dust covers and other ferrous metal.

C. Tracks / Hangers / Closers / Related Equipment - New

- 1. Formed or extruded steel landing door hanger tracks shall be provided.
- 2. Each landing door panel shall be suspended from a pair of door hanger assemblies that are compatible with the hanger tracks.
 - a. Hanger assemblies shall be directly mounted to the door panel using 3/8" diameter or better hardware.
 - b. Solid steel blocks shall be used where job-site conditions dictate the use of spacers between hanger assemblies and the landing door panel.
 - c. Hanger assemblies shall be adjusted or shimmed so that door panels are suspended in a plumb manner with no more than 3/8" vertical clearance to the cab entrance threshold.
 - d. Upthrust rollers shall be adjusted for minimal operating clearance against the bottom edge of the hanger track.
 - e. Means shall be provided to prevent hangers from jumping the track.
 - f. Blocks shall be provided to prevent rollers from overrunning the end of the track.
- 3. Each set of center opening landing doors shall be provided with a cable driven relating mechanism which is compatible for use with the door hanger assemblies.
 - a. The relating mechanism shall be properly tensioned and adjusted so as to equalize the relationship between the door panels and the hoistway entrance.
- 4. Each set of single speed side slide landing doors shall be provided with a sill-mounted spring closing mechanism.
 - a. Spirator-type spring closers shall be acceptable should prevailing sill depth or runby clearance conditions require their use.
- 5. Where applicable, each hoistway door interlock assembly shall be provided with an emergency release mechanism utilizing manufacturers' standard type access key at all landings served.
 - a. Drill each hoistway door to accommodate manufacturers standard lock release key and install escutcheon.
 - 1) Escutcheon shall be brushed stainless steel to match door panels where required.
 - 2) Aluminum shall be provided at all other typical floors.

D. Interlocks / Unlocking Devices - New

1. Each set of landing doors shall be provided with a complete electromechanical interlock assembly.
 - a. Each interlock assembly shall consist of:
 - 1) A switch housing with contacts
 - 2) Lock keeper
 - 3) Clutch engagement/release subassembly
 - 4) Associated linkages
 - b. Arrange the lock so that individual leading door panels (side slide or center opening) are locked when in the closed position.
2. Non-typical mounting arrangements for interlocks and/or related mechanisms must receive prior approval from the Consultant.
3. Each hoistway door interlock assembly shall be provided with an emergency release mechanism utilizing a drop-leaf type access key at all landings served.
 - a. Drill each hoistway door to accommodate manufacturers standard lock release key and install escutcheon.
 - 1) Escutcheon shall be brushed stainless steel to match door panels where required.
 - 2) Aluminum shall be provided at all other typical floors.

E. Hoistway Door Bottom Guides / Safety Retainers - New

1. The bottom of each side sliding type hoistway door panel shall be equipped with a minimum of two (2) guiding members.
 - a. Metal mounting angles shall be secured to the integral panel frame structure; and when conditions warrant, additional external metal support plates or angles shall be installed to ensure the integrity of the panel frame is not compromised.
 - b. Guides shall be manufactured of low friction non-metal material with sufficient strength to withstand forces placed on door panels per ASME A17.1 Standards.
 - c. Each guide assembly shall incorporate a steel wear indicator and be so designed to permit sliding member replacements without removal of door panel(s) from top hanger devices.
 - d. Panels shall be hung with a maximum vertical clearance of 3/8 inch between top of sill and bottom of panel and the guide shall engage the sill groove by not less than 1/4 inch.
2. The bottom of each side sliding type hoistway door panel shall be equipped with a guiding member safety retainer to prevent displacement in the event of primary guide means failure.
 - a. A metal reinforcement (12 gauge stainless or galvanized steel) shall be installed between the two (2) primary guiding members (a.k.a. "Z" bracket).

- b. The reinforcement shall be designed with a minimum length of 8 inches or the maximum possible length that will fit between the primary members and a minimum overall height of 2.5 inches secured on the internal face of the door panel. (Hoistway side)
- c. The retainer shall be set with the supplemental safety angle 3/8 inch into the corresponding sill groove; and be capable of preventing displacement of the panel no more than 3/4 inch with an applied force of 1125 lbf at right angles over an area 12 inches x 12 inches at the approximate center of the door panel.

2.8 CAR EQUIPMENT / FRAME

A. Car Frame and Platform - New

- 1. The car frame shall be made of steel members, with a factor of safety as required by the ASME Code to match existing.
- 2. The car platform shall consist of a steel frame with necessary steel stringers, all securely welded together.
- 3. The frame and platform shall be so braced and reinforced that no strain will be transmitted to the elevator car.
 - a. Provide platform with two (2) layers of 3/4" thick marine grade plywood.
 - b. Cover the underside of the car platform with sheet steel.
- 4. The support frame shall carry rubber pads on which the platform shall rest without any connection to the steel frame for sound and vibration isolation.
- 5. Provide extruded **bronze** thresholds having non-slip surface, guide grooves.
- 6. Sound isolate elevator platform with vibration isolation pads. The support frame shall carry rubber pads on which the platform shall rest without any connection to the steel frame.
- 7. Recess the elevator platform to receive finished flooring as selected by the Architect and specified under another section of their specification.
- 8. The car frame shall be made of steel members, with a factor of safety as required by ASME A17.1 standards.
- 9. Construct the car frame to allow for a minimum 8'-6" clear inside cab height.

B. Automatic Leveling / Releveling / Positioning Device - New

- 1. Equip the elevator with a floor leveling device which shall automatically bring the car to a stop within 1/4" of any floor for which a stop has been initiated regardless of load or direction of travel.
- 2. This device shall also provide for releveling which shall be arranged to automatically return the elevator to the floor in the event the elevator should move below or above floor level in excess of 1/4".
- 3. This device shall be operative at all floors served and whether the hoistway or car door is open or closed provided there is no interruption of power to the elevator.

C. Top-of-Car Inspection Operating Station - New

- 1. An inspection operating station shall be provided on top of the elevator car.

2. This station shall be installed so that the controls are plainly visible and readily accessible from the hoistway entrance without stepping on the car.
3. When the station is operational, all operating devices in the car shall be inoperative.
4. Provide the following control devices and features:
 - a. A push/pull or toggle switch designated "EMERGENCY STOP" shall be arranged so as to prevent the application of power to the hoist motor or machine brake when in the "off" position.
 - b. A toggle switch designated "INSPECTION" and "NORMAL" to activate the top of car Inspection Service Operation.
 - c. Push button designated "Up", "Down" and "Enable" to operate the elevator on Inspection Service (the "Enable" button shall be arranged to operate in conjunction with either the "Up" or "Down" button).
 - d. An indicator light and warning buzzer that are subject to activation under Phase I - Fire Emergency Recall Operation.
5. The unit may contain the following additional devices:
 - a. Approved car top lighting fixture with service guard and local control switch.
 - b. Approved 120 Volt grounded GFI convenience receptacle.

D. Emergency Exit Top

1. Ensure it operates as per code and has proper electrical contacts and mechanical locks on the exterior of the cab enclosure.

E. Car Enclosure Work Light / Receptacle - New

1. The top and bottom of each car shall be provided with a permanent lighting fixture and 110 volt GFI receptacle.
2. Light control switches shall be located for easy accessibility from the hoistway entrance.
3. Where sufficient overhead clearance exists, the car top lighting fixture shall be extended no less than 24" above the crosshead member of the car frame.
4. Light bulbs shall be guarded so as to prevent breakage or accidental contact.

F. Master Door Power Operator System – VVVF/AC - New

1. Provide a heavy-duty master door operator on top of the elevator car enclosure for power opening and closing of the cab and hoistway entrance door panels.
2. Operator shall utilize an alternating current motor, controlled by a variable voltage, variable frequency (VVVF) drive and a closed-loop control with programmable operating parameters.
 - a. System may incorporate an encoder feedback to monitor positions with a separate speed sensing device or an encoderless closed-loop VVVF-AC control to monitor motor parameters and vary power applied to compensate for load changes.
3. The type of system shall be designated as a high speed operator, designed for door panel opening at an average speed of 2.0 feet per second and closing at approximately 1.0 foot per second.

- a. Reduce the closing speed as required to limit kinetic energy of closing doors to within values permitted by ASME A17.1 as may be adopted and/or modified by the AHJ.
4. The door shall operate smoothly without a slam or abrupt motion in both the opening and closing cycle directions.
- a. Provide controls to automatically compensate for load changes such as:
 - 1) Wind conditions (stack effect)
 - 2) Use of different weight door panels on multiple landings
 - 3) Other unique prevailing conditions that could cause variations in operational speeds.
 - b. Provide nudging to limit speed and torque in conjunction with door close signaling/closing and timing devices as permitted by ASME A17.1 as may be adopted and/or modified by the AHJ. Nudging shall be initiated by the signal control system and not from the door protective device.
5. In case of interruption or failure of electric power from any cause, the door operating mechanism shall be so designed that it shall permit emergency manual operation of both the car and corridor doors only when the elevator is located in the floor landing unlocking zone.
- a. The hoistway door shall continue to be self-locking and self-closing during emergency operation.
 - b. The door operator and/or car door panel shall be equipped with safety switches and electrical controls to prevent operation of the elevator with the door in the open position as per ASME A17.1 Code Standards.
 - c. Provide zone-lock devices as required by ASME A17.1 as may be adopted and/or otherwise modified by the AHJ.
6. Construct all door operating levers of heavy steel or reinforced extruded aluminum members, designed for stress and forces imposed on the related parts, linkages and fixed components during normal and emergency operation functions.
- a. All pivot points shall have either ball or roller-type bearings, oilite bronze bushings or other non-metallic bushings of ample size.
7. Provide operating data / data tag permanently attached to the operator as required by applicable code and standards.

G. Door Reopening Device - New

- 1. Provide an infrared curtain door protection system.
- 2. The door shall be prevented from closing and reopen when closing if a person interrupts any one of the light rays.
- 3. The door shall start to close when the protection system is free of any obstruction.
- 4. The infrared curtain protective system shall provide:
 - a. Protective field not less than 71" above the sill.

- b. Where a horizontal infrared light beam system is used:
 - 1) A minimum of 47 light beams.
 - 2) Accurately positioned infrared lights to conform to the requirements of the applicable handicapped code .
- c. Modular design to permit on board test operation and replacement of all circuit boards without removing the complete unit.
- d. Controls to shut down the elevator when the unit fails to operate properly.

2.9 FINISH AND MATERIALS

A. Hoistway Entrances Finish and Design

- 1. Hoistway entrances and door panels shall be finished as specified by the Owner.
- 2. Where no finish is specified, finishes shall be baked enamel primer gray.
- 3. Refer to specifications for other design requirements.

B. Car Interior Finishes

- 1. Cab interior finishes shall be as selected by Owner and/or Architect.
- 2. Contractor shall provide samples of finishes as required for approval prior to fabrication.
- 3. Refer to specifications for other design requirements.
- 4. Special attention shall be given to flooring materials and suitability for intended duty.

C. Fixture Schedule

- 1. The design and location of the hall and car operating and signaling fixtures shall comply with the ADAAG.
- 2. All hall and car fixtures shall be selected from the manufacturer's premium line of fixtures as selected and approved by the Architect.
- 3. The layout of the panel and all engraving shall be subject to the approval of the Architect.
- 4. Car Position Indicators
 - a. Provide 2" high liquid crystal or LED indicators with direction arrows, integral with the car operating panel.
 - b. Provide standard car information display system in the operating panel.
 - 1) The system shall include 2" high position indicators with direction arrows and a message downloaded from Elevator Information and Management System.
 - 2) Messages will be selected and/or composed by the Owner and may include time, floor directories, outside temperature, promotional announcements and stock market information.
 - 3) Display system shall have a screen of 12" x 12" with a minimum of 120 degree view angle.

5. Hall Lanterns

- a. Typical floor hall lantern shall be the manufacturer's standard LED or liquid crystal 2 ½" high arrows having illuminating side bars for 180 degree viewing angle.
- b. Arrange lens for ½" projection from faceplate and provide a 1/8" thick metal separator and a light baffle to form up and down indications.
- c. The metal separator shall match the faceplate.

6. Car Lanterns

- a. The car lantern lens shall project a minimum of ¼" and shall be solid Plexiglas.

D. Material Finishes

1. Satin Finish: No. 4 satin, long grain
2. Mirror Finish: No. 8 non-directional mirror polished
3. Sheet Steel:
 - a. Shop Prime: Factory-applied baked on coat of mineral filler and primer
 - b. Finish Paint: Two (2) coats of low sheen baked enamel, color as selected by the Architect.
 - c. Steel Equipment: Two (2) coats of manufacturer's standard rust-inhibiting paint.

2.10 FIXTURES / SIGNAL EQUIPMENT

A. General - Design / Finish

1. The design and location of the hall and car operating and signaling fixtures shall comply with the ADAAG.
2. The operating fixtures shall be custom designed bronze selected from the manufacturer's premium line of fixtures and approved by the Owner / Architect.
3. The layout of the fixtures including all associated signage and engraving shall be as approved by the Owner / Architect.

B. Main Car Operating Panel - New

1. Car operating panel shall be incorporated in the swing-front return of the elevator cab.
 - a. Coordination with car front manufacturer shall be the responsibility of the Elevator Contractor.
2. The push buttons shall become individually illuminated as they are pressed and shall extinguish as the calls are answered.
3. Provide LED call registration lights.
4. The operating panel shall include:
 - a. A call button for each floor served.
 - b. "Door open" / "Door close" buttons.
 - c. "Alarm" button (Interfaced with emergency alarm).
 - d. "Emergency Stop" switch per local law.

- e. Self-dialing, hands-free telephone and/or intercom with call acknowledging feature and A.D.A. design provisions. (See individual unit clarifications)
- 5. Locked Firemen's' Service cabinet, keyed in accordance with local Code, containing required devices and signals in accordance with ASME A17.1 Standards.
 - a. Automatic opening of the locked cabinet door may be provided with signals initiated by the fire detection and alarm system where approved by the Authority Having Jurisdiction.
- 6. Provide a locked service cabinet flush mounted and containing the key switches required to operate and maintain the elevator, including, but not limited to:
 - a. Independent/Attendant service switch with associated operating buttons and signal indicators.
 - b. Light switch.
 - c. Fan switch.
 - d. G. F.C. I. duplex receptacle.
 - e. Emergency light test button and indicator.
 - f. Inspection Service Operation key switch.
 - g. Port for hand-held service tool where applicable.
 - h. Dimmer for cab interior lighting.
- 7. Car operating panel shall incorporate:
 - a. A digital L.E.D. floor position indicator
 - b. Emergency light lens unit and black-filled engraved unit I.D. number or other nomenclature, as approved by Owner/Architect.
 - c. A "No Smoking" advisory and the rated passenger load capacity.

C. Car Position Indicator - New

- 1. The position of the car in the hoistway shall be indicated by the illumination of the position indicator numeral corresponding to the floor at which the car has stopped or is passing.
 - a. Provide 2" high, 10-segment LED type position indicator with direction arrows, integral with the car operating panel.
 - b. Provide standard car information display system in the operating panel as selected by Owner/Architect. The system shall include 2" high position indicators with direction arrows and a message down loaded from Elevator Information and Management System. Messages will be selected and/or composed by the Owner and may include time, floor directories, outside temperature, promotional announcements and stock market information. Display system shall have a screen of 12" by 12" with a minimum of 120 degree view angle.
 - c. Provide Lexan cover lens with hidden support frame behind fixture plate to protect the indicator readout.
 - d. Provide audible floor passing signal per ADA standards where not provided by the elevator signal control.
 - e. Flush mount fixture with cover to match selected car front or car operating panel finish as directed by the Owner.

D. Car Direction Lantern - New

1. Provide a car riding lantern with visual and audible signal in the edge of the strike and/or return post.
2. The lens shall project a minimum of 1/4" and shall be of solid Plexiglas.
3. Use tamperproof screws for flush faceplate with hairline joint.
4. Car lantern shall indicate the direction of travel when doors are 3/4 open.
5. The unit shall sound once for the "up" direction and twice for the "down" direction.
 - a. Provide an electronic chime with adjustable sound volume.

E. Voice Annunciator - New

1. Provide a voice annunciator in each elevator.
2. Coordinate size, shape and design with Designer and other trades.
3. The system shall include, but not limited to:
 - a. Solid state digital speech annunciator
 - b. A recording feature for customized messages
 - c. Playback option
 - d. Built-in voice amplifier
 - e. Master volume control
 - f. Audible indication for selected floor, floor status or position, direction of travel, floor stop and nudging.
4. Locate all associated equipment in a single, clearly labeled enclosure located either in the machine room and/or on car top.

F. Corridor Push Button Stations / Reuse Back Boxes

1. Push button signal fixtures shall be provided on each landing.
2. Each signal fixture shall consist of:
 - a. Up and down illuminating push buttons measuring 3/4" at their smallest dimension as selected by the Owner.
 - b. A recessed mounting box, electrical conduit and wiring.
3. Intermediate landings shall be provided with fixtures containing two (2) push buttons while terminal landings shall be provided with fixtures containing a single push button.
4. Include firefighter key switch in the main lobby level station or other designated recall landing.
5. Where existing fixtures are located greater than 48" above the floor:
 - a. The existing back boxes shall be retained and used to attach the oversized fixture faceplate to locate the new buttons with a centerline between 35" and 48" above the finished floor.
 - 1) The Contractor has the option of providing a single oversized back box in lieu of retaining existing for faceplate attachment.
 - b. Standardize the new centerline distance on all floors.

6. All cutting, patching, grouting and/or plastering of masonry walls resulting from the removal or installation of corridor fixtures shall be performed by the Contractor so as to maintain the fire rating of the hoistway.
 - a. Finished painting or decorating of wall surfaces shall be by Others.
7. All faceplates shall be engraved with fire logo and "In Case of Fire Use Stairs" to help fill the void created by the use of oversized covers.
8. Provide a digital floor position indicator with 1" high numerals at all landings served.

G. Hall Direction Lanterns - New

1. Provide a visual and audible signal at each entrance to indicate the direction of travel and, where applicable, which car shall stop in response to the hall call.
 - a. Design the lantern with up and down indication at intermediate landings and a single indication at terminal landings.
 - b. Lanterns shall sound once for the up direction and twice for the down direction.
 - 1) Provide an electronic chime with adjustable sound volume.
 - c. Provide adjustable signal time (3 to 10 seconds, with 1 second increments) to notify passengers which car shall answer the hall call and preset per ADAAG distance standards.
2. Main Lobby fixture shall incorporate a 2" high LED floor position indicator in the hall lantern fixture with direction arrows located on both sides of the indicator.
3. Locate the lantern adjacent to the corridor entrance.

H. Hoistway Access Switch - New

1. Install a cylindrical type keyed switch at top terminal in order to permit the car to be moved at slow speed with the doors open to allow authorized persons to obtain access to the top of the car.
2. Where there is no separate pit access door, a similar switch shall be installed at the lowest landing in order to permit the car to be moved away from the landing with the doors open in order to gain access to the pit.
3. Locate the switch in the hall call push button station at the top and bottom terminal landings where required if allowed by the Authority Having Jurisdiction.
4. This switch is to be of the continuous pressure spring-return type and shall be operated by a cylinder type lock having not less than a five (5) pin or five (5) disc combination with the key removable only in the "OFF" position.
 - a. The lock shall not be operable by any key which operates locks or devices used for other purposes in the building and shall be available to and used only by inspectors, maintenance men and repairmen in accordance with A17.1 applicable Security Group.
5. Existing provisions that meet the aforementioned criteria may be updated with keyed switches to match new apparatus provided for uniformity of systems within the building.

I. Closed Circuit TV Security System – Wiring Only – CCTV Camera by Others

1. Coordinate to provide necessary wiring connection between machine room and top of cab. Installation of CCTV camera by Others.

2.11 CAB ENCLOSURE

A. New Elevator Cab Allowance (\$20,000 total net allowance) / General Design Requirements

1. The design, materials and finishes of the cab enclosure shall be selected by Owner/Architect.
2. Steel Shell: 14 gauge furniture steel reinforced and designed to accept finished wall panels. Finish shell panels with one coat of rust inhibitive primer and two coats of enamel paint in accordance with Section 09900. Apply 1/8" thick, rubberized sound deadening material to the hoistway side of the shell.
 - a. All panels shall have minimum radii. Apply sealant beads to panel joints before bolting together with lock washers.
 - b. Side emergency exit shall be of inconspicuous flush design, fitted with concealed hinges and an approved locking arrangement. Provide a three point locking system; at top, bottom and side.
3. Wood Shell: 3/4" thick particleboard with backing laminate at both sides designed to accept finished wall panels. Apply 26 gauge sheet steel or fire proofing compound to the hoistway side of the shell.
4. Canopy: Canopy construction methods shall match the shell walls. Use 12 gauge furniture sheet steel and adequately support canopy to comply with the loading requirements of the Code.
 - a. Provide necessary cutouts for the installation of fan and top emergency exit. Arrange exit panel to swing up using a heavy duty piano hinge.
 - b. The exit panel shall have dual locks, necessary stops and a handle.
 - c. When in the locked position, the panel shall be flush with the interior face of the canopy with hairline joints.
5. Base: Where finished base provided under another section of these specifications, recess and prepare the shell to accept the base.
 - a. Provide concealed vent slots above side and rear wall base for proper ventilation. Arrange and size vent slots for quiet operation without any whistling. Use 16 gauge baffles to protect the hoistway side of the vent slots.
 - b. The elevator cab shop drawings shall include elevator vent calculations and number, location and size of top and bottom vent holes.
6. Flooring: Where finished flooring is provided under another section of these specifications, recess and prepare sub-flooring to accept the finished flooring.
7. Front Return Panels, Entrance Posts and Transom: Use 14 gauge furniture sheet steel with proper reinforcing to prevent oil canning.

- a. Swing front return panels shall have required cutouts for the car call buttons, keyed switches, indicators, emergency light fixture, cabinets and the specified special control and signaling devices.
 - 1) Provide concealed full height stainless steel piano hinges of sufficient strength to support the panel, without sagging, in the open position.
 - 2) The concealed locks shall secure the panel at two points with linkage that shall be free of vibration and noise when in the locked position.
 - 3) When locked in the closed position, the front return panel shall be in true alignment with the transom and base.
 - 4) Lock release holes shall be not more than 1/4" diameter and be located at the return side jamb of the panel.
 - 5) Engrave the elevator identification number and capacity, no smoking sign, firefighter instructions, and other code mandated instructions and caution signs directly in the front return panel. Applied panels are unacceptable.
 - b. Transom shall be 14 gauge, and be reinforced and constructed the same as the front return panels.
 - c. Construct entrance posts for the passenger elevators from 12 gauge sheet steel and reinforce to maintain vertical alignment with the adjacent panels.
 - d. Provide channel post entrance jambs for the service elevators. Clad channels with 14 gauge sheet steel and through bolt channels to the floor and to the reinforced header section.
8. Cab Door: Standard 1" thick, 14 gauge hollow metal flush construction, reinforced for power operation and insulated for sound deadening. Paint hatch side of doors black and face cab side with 16 gauge sheet steel in selected material and finish.
- a. The door panels shall have no binder angles. All welds shall be continuous, ground smooth and invisible.
 - b. Drill and reinforce doors for installation of door operator hardware, door protective device, door gibs, etc.
9. Ceiling: Construction techniques for wall panels shall apply to ceiling panel construction. Locate top emergency exit inconspicuously. Construct and mount the exit panel to prevent light leakage around the perimeter of panel.
10. Ventilation: The ventilation system of the exhaust type shall be provided in each elevator.
- a. The system shall include a blower driven by a direct connected motor and mounted on top of car with isolation to effectively prevent transmission of vibration to the car structure. The blower shall have not less than two operating speeds. The ventilation system shall be sized to provide one air change per minute at low speed and 1.5 air changes per minute at high speed. The unit design and installation shall be such that the maximum noise level, when operating at high speed, shall not exceed 55 dBA approximately three feet above the car floor. A three-position switch to control the blower shall be provided in the car station.
 - b. The fan or blower shall start upon the pressing of a car or landing call button and shall stop a predetermined time (approximately 2 minutes) after the car has answered the last registered call.

11. Lighting: Arrange lighting fixtures and ceiling assembly to provide even illumination without hot spots and shadows. Overlap fluorescent lamps where cove lighting is specified.
 - a. Design and configure lighting system to facilitate maintenance of the fixtures.
 - b. The service and freight elevators shall have not less than 40 foot candle illumination at 48" above the finished floor with the doors closed.
12. Handrails: All attachment hardware shall match the selected handrail and shall permit handrail removal from within the cab.
 - a. Provide a minimum of 10 gauge plate at the hatch side of the shell, aligned with the handrail attachment points, to assure secure handrail mounting.
 - b. Design handrail attachment system to support the weight of a person (250 pounds) sitting on it without any deflection and damage to the handrail, cab panel and the shell.
13. Protective Pads and Pad Hooks: Provide pad hooks at locations as directed by the Architect. Protective pads shall cover the front return panels, and the side and rear walls. Provide cutouts in pads for access to the cab operating and signaling devices. Pads shall be fire-resistant canvas with two (2) layers of cotton batting padding.
14. Accessories: Construct elevator cab to accommodate the door operator, hangers, interlocks and all accessory equipment provided under other sections of these specifications, including firefighter phones, card readers and CCTV.
15. All cab materials shall conform to the code prescribed flame spread rating and smoke development requirements.

2.12 EMERGENCY LIGHTING / COMMUNICATIONS / SIGNALING

A. Battery Back Up Emergency Lighting Fixture and Alarm _ New

1. Provide a self-powered emergency light unit in the elevator car operating panel, consisting of a light fixture, alarm bell and a power pack unit.
 - a. Arrange two (2) of the cab light fixtures to operate as the emergency light system.
 - 1) The power pack shall contain a nickel cadmium battery and a charger.
 - 2) Unit shall provide continuous illumination for at least four (4) hours and one (1) hour alarm bell operation.
 - 3) Where required by the application, the unit shall provide cab ventilation for a minimum of one (1) hour.
2. Provide a car-mounted battery unit including solid-state charger and testing means enclosed in common metal container.
 - a. The battery shall be rechargeable nickel cadmium with a 10-year minimum life expectancy. Mount the power pack on the top of the car.

- b. Provide a 6" diameter alarm bell mounted directly to the battery/charger unit and connected to sound when any alarm push button or stop switch in the car enclosure is operated.
- c. The bell shall be configured to operate from power supplied by the building emergency power generator. The bell shall produce a sound output of between 80-90 dBa (measured from a distance of 10') mounted on top of the elevator car.
 - 1) Activation of this bell shall be controlled by the stop switch and alarm button in the car operating station
 - 2) The alarm button shall illuminate when pressed.
- 3. Where required by Code for the specific application, the unit shall provide mechanical ventilation for at least one (1) hour.
- 4. The operation shall be completely automatic upon failure of normal power supply.
- 5. Unit shall be connected to normal power supply for car lights and arranged to be energized at all times so it automatically recharges battery after use.

B. Emergency Voice Communication / Telephone - New

- 1. A hands-free emergency voice communication system shall be furnished in each car mounted as an integral part of the car operating panel.
 - a. Necessary wires shall be included in the car traveling cable and shall consist of a minimum of one shielded pair of 20AWG conductors.
 - b. 120V power shall be provided to power the hands-free device.
- 2. The telephone shall be equipped with an auto-dialer and illuminating indicator which shall illuminate when a call has been placed and begin to flash when the call has been answered.
 - a. Engraving shall be provided next to the indicator which says "When lit help is on the way".
- 3. In addition to the standard "Alarm" button, a separate activation button shall be provided on the car operating panel to initiate the emergency telephone and place a call.
 - a. The telephone must not shut off if the activating button is pushed more than once.
 - b. The telephone shall transmit a pre-recorded location message only when requested by the operator and be provided with an adjustable call time which can be extended on demand by the operator.
 - c. Once two-way communication has been established, voice prompts shall be provided which instruct the operator on how to activate these functions as well as alerting the operator when a call is being attempted from another elevator in the building.
- 4. The system shall be compatible with ring down equipment and PBX switchboards.
- 5. The system shall be capable of serving as the audio output for an external voice annunciation system.
 - a. Conversation levels shall measure 60 dbA or higher and measure 10 dbA above ambient noise levels.

- b. Each device shall be provided with a self-diagnostic capability in order to automatically alert building personnel should an operational problem be detected.
6. The phone shall be able to:
 - a. Receive incoming calls from any On-Site Rescue Station (when provided or required).
 - b. Receive incoming calls from other off-site locations via the public telephone system.
 - c. Acknowledge incoming calls and automatically establishing hands-free two way communications.
 - 1) If no On-Site Rescue Station is provided, each hands-free device shall have built in line consolidation which will allow up to 6 elevators to be called individually from outside the building over a single telephone line and up to 80 elevators if an On-Site Rescue Station is provided.
 7. The emergency elevator communication system shall require a maximum of one telephone line.
 - a. The system must provide line sharing capability to eliminate the need for a dedicated telephone line.
 - b. The line sharing function must ensure that the emergency telephones always receive dialing priority even if the line is in use and that the emergency telephones can be called into from an off-site location.
 8. The system shall provide its own four hour backup power supply in case of a loss of regular AC power.
 9. The system must provide capability for building personnel to call into elevators and determine the charge state of any backup batteries provided for the emergency telephones.
 10. Pushing the activation button in any of the elevator car stations will cause any on-site Rescue Station (where provided or required) or security telephone to ring.
 - a. If the on-site call is not picked up within 30 seconds, the call will be automatically forwarded to a 24 hour off-site monitoring service.
 - b. The arrangements and costs of the off-site monitoring and telephone line shall be by others.
 11. All connections from the junction box to the telephone system shall be done by the Elevator Contractor where existing provisions can be reused.
 12. New telephone lines, where required, shall be provided and interfaced by Others.
 13. All connections from the junction box to the security room's main telephone system shall be done by Others.
 14. All electrical work shall conform to Division 16 requirements.

C. Firefighters' Two-Way Telephone Communications System - New

1. If required, provide a complete two-way telephone communications system for point-to-point communications between authorized personnel.

2. Provide firefighter telephone box or telephone jack in the car operating panel in accordance with the requirements of the local authorities. The box shall be fitted with a flush mounted door having hairline joints.
3. Connection devices (jacks) and all associated wiring shall be provided by the elevator Contractor as part of the base bid.
4. The handsets shall be self-powered and not require an external power source for operation.
 - a. The firefighter phone shall be furnished under Division 16.

D. Life Safety System - New

1. Install Life Safety System speaker in each elevator cab.
2. Provide all necessary wiring and interfacing between the elevator system and the Life Safety System as required.
3. The Life Safety System speaker shall be furnished under Division 16.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspection

1. Study the Contract Documents with regard to the work as specified and required so as to ensure its completeness.
2. Examine surface and conditions to which this work is to be attached or applied and notify the Owner in writing if conditions or surfaces are detrimental to the proper and expeditious installation of the work. Starting the work shall imply acceptance of the surfaces and conditions to perform the work as specified.
3. Verify, by measurements at the job site, dimensions affecting the work. Bring field dimensions which are at variance with those on the accepted shop drawings to the attention of the Owner. Obtain the decision regarding corrective measures before the start of fabrication of items affected.
4. Cooperate in the coordination and scheduling of the work of this section with the work of other sections so as not to delay job progress.

3.2 INSTALLATION / PROJECT PHASING

A. Installation

1. Modernize the elevator, using skilled personnel in strict accordance with the final accepted shop drawings and other submittals.
2. Comply with the code, manufacturer's instructions and recommendations.
3. Coordinate work with the work of other building functions for proper time and sequence to avoid delays and to ensure right-of-way of system. Use lines and levels to ensure dimensional coordination of the work.
4. Accurately and rigidly secure supporting elements within the shaftways to the encountered construction within the tolerance established.

5. Provide and install motor, switch, control, safety and maintenance and operating devices in strict accordance with the submitted wiring diagrams and applicable codes and regulations having jurisdiction.
6. Erect guide rails plumb and parallel with a tolerance of 1/8" (plus or minus 1/16")
7. Install rails so joints do not interfere with brackets.
8. Set entrance plumb in hoistway and in alignment with guide rails prior to erection of the front walls.
9. Arrange door tracks and sheaves so that no metal-to-metal contact exists.
10. Reinforce hoistway fascias to allow not more than 1/2" of deflection.
11. Install elevator cab enclosure on platform plumb and align cab entrance with hoistway entrances.
12. Sound isolate cab enclosure from car structure. Allow no direct rigid connections between enclosure and car structure and between platform and car structure.
13. Isolate cab fan from canopy to minimize vibration and noise.
14. Remove oil, dirt and impurities and give a factory coat of rust inhibitive paint to all exposed surfaces of struts, hanger supports, covers, fascias, toe guards, dust covers and other ferrous metal.
15. Prehang traveling cables for at least 24 hours with ends suitably weighted to eliminate twisting after installation.
16. Pack openings around oil line with fire resistant, sound isolating glass or mineral wool.
17. Provide isolation pad between platen head and car structure.
18. Set jack unit plumb in waterproof hole and bolt it to mounting channels in the pit.
19. Sound isolate pump units and controllers from building structure.
20. After installation, touch up in the field, surfaces of shop primed elements which have become scratched or damaged.
21. Lubricate operating parts of system as recommended by the manufacturer.

B. Project Phasing

1. Phase I - Final design development and contractors' preliminary work procedures to be completed within four (4) weeks from date of contract award.
 - a. Prevailing conditions review and layout.
 - b. Selection meeting for aesthetic design and finishes with Owners' designee.
 - c. Filing for required permits or other governing authorities work procedure requirements.
2. Phase II - Submittal approvals and confirmations shall be completed within eight (8) weeks from date of contract award.
 - a. Selection confirmations.
 - b. Manufacturer's shop drawings applicable, i.e., fixtures, cab, machine room layouts, doors, etc.
 - c. Engineering data acknowledgment applicable, i.e., power, heat, structural loads.
 - d. Delivery dates for major component suppliers, i.e., controls, machinery, fixtures, cabs, etc.
 - e. Posting of permits or other governing agency authorizations to proceed.
 - f. Proposed work implementation schedule based on the aforementioned procedures/confirmations.

3. Phase III - Mobilization of Final Design Approvals

- a. Revision confirmations. (Equipment, etc.)
- b. Preliminary work procedures.
- c. Schedule confirmations.

4. Phase IV – Implementation

3.3 FIELD QUALITY CONTROL

A. Inspection and Testing

1. Upon completion of each work phase or individual elevator specified herein, the Contractor shall, at its own expense, arrange and assist with inspection and testing as may be required by the A.H.J. in order to secure a Certificate of Operation.

B. Substantial Completion

1. The work shall be deemed “Substantially Complete” for an individual unit when, in the opinion of the Consultant, the unit is complete, such that there are no material and substantial variations from the Contract Documents, and the unit is fit for its intended purpose.
2. Governing authority testing shall be completed and approved in conjunction with inspection for operation of the unit; a certificate of operation or other required documentation issued; and remaining items mandated for final acceptance completion are limited to minor punch list work not incorporating any life safety deficiencies.
3. The issuance of a substantial completion notification shall not relieve the Contractor from its obligations hereunder to complete the work.
4. Final completion cannot be achieved until all deliverables, including but not limited to training, spare parts, manuals, and other documentation requirements, have been completed.

C. Contractor’s Superintendent

1. The Contractor shall assign a competent project superintendent during the work progress and any necessary assistant, all satisfactory to the Owner. The superintendent shall represent the Contractor and all instructions given to him shall be as binding as if given to the Contractor.

3.4 PROTECTION / CLEANING

A. Protection and Cleaning

1. Adequately protect surfaces against accumulation of paint, mortar, mastic and disfiguration or discoloration and damage during shipment and installation.
2. Upon completion, remove protection from finished surfaces and thoroughly clean and polish surfaces with due regard to the type of material. Work shall be free from discoloration, scratches, dents and other surface defects.
3. The finished installation shall be free of defects.

4. Before final completion and acceptance, repair and/or replace defective work, to the satisfaction of the Owner, at no additional cost.
5. Remove tools, equipment and surplus materials from the site.

B. Barricades and Hoistway Screening

1. The Contractor shall provide barricades where necessary in order to maintain adequate protection of areas in which work specified by the Contract Documents is being performed, including open hoistway entrances. Fabrication and erection as all barricades shall be in compliance with applicable OSHA regulations.
2. As required, the Contractor shall provide temporary wire mesh screening in the hoistway and of any elevator undergoing work specified in the Contract Documents. This screening shall be installed in such a manner as to completely segregate the hoistway from that of adjacent elevators. Screening shall be constructed from .041" diameter wire in a pattern that rejects passage of a 1" diameter ball.

3.5 DEMONSTRATION

A. Performance and Operating Requirements

1. Passenger elevators shall be adjusted to meet the following performance requirements:
 - a. Speed: within 5% of rated speed under any loading condition.
 - b. Leveling: within 1/4" under any loading condition.
 - c. Typical Floor-to-Floor Time: (Recorded from the doors start to close on one floor until they are 3/4 open at the next floor.) 17.8 seconds.

d. Door Operating Times

Door Type	Opening	Closing
3'-6" side opening	2.6 sec.	5.3 sec.

- e. Door dwell time for hall calls: 4.0 sec with Advance lantern signals
- f. Door dwell time for hall calls: 5.0 sec without Advance lantern signals
- g. Door dwell time for car calls: 3.0 seconds
- h. Reduced non-interference dwell time: 1.0 seconds.

2. Maintain the following ride quality requirements for the passenger elevators:

- a. Noise levels inside the car shall not exceed the following:
 - 1) Car at rest with doors closed and fan off - 40 dba.
 - 2) Car at rest with doors closed, fan running - 55 dba.
 - 3) Car running at high speed, fan off - 50 dba.
 - 4) Door in operation - 60 dba.

B. Acceptance Testing

1. The Contractor shall provide at least five (5) days prior written notice to the Owner and Consultant regarding the exact date on which work specified in the Contract Documents will reach completion on any single unit of vertical transportation equipment.
2. In addition to conducting whatever testing procedures may be required by local inspecting authorities in order to gain approval of the completed work, and before seeking approval of said work by the Owner, the Contractor shall perform certain other tests in the presence of the Consultant.
3. The Contractor shall provide test instruments, test weights, and qualified field labor as required to safely operate the unit under load conditions that vary from empty to full rated load and, in so doing, to successfully demonstrate compliance with applicable performance standards set forth in the project specifications with regard to:
 - a. Operation of safety devices.
 - b. Sustained high-speed velocity of the elevator in either direction of travel.
 - c. Floor leveling accuracy.
 - d. Door opening/closing and dwell times.
 - e. Ride quality inside the elevator car.
 - f. Communication system.
 - g. Simulated and actual emergency power operation
 - h. Firefighter, attendant and independent service operations
4. After hour tests of systems such as emergency generators, fire service, and security systems shall be conducted at no extra cost to the Owner.

END OF SPECIFICATION

SECTION 21 05 13

COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg. C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 21 05 13

SECTION 21 05 17

SLEEVES AND SLEEVE SEALS FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Carbon steel or Stainless steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system

components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves, Galvanized-steel wall sleeves or Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves, Galvanized-steel wall sleeves or Galvanized-steel-pipe sleeves
2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves
5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves
 - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves

END OF SECTION 21 05 17

SECTION 21 05 18

ESCUTCHEONS FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.

- f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
 - D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.
- 3.2 FIELD QUALITY CONTROL
- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 21 05 18

SECTION 21 05 33

HEAT TRACING FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes heat tracing for fire-suppression piping with the following electric heating cables:
 - 1. Plastic insulated, series resistance.
 - 2. Self-regulating, parallel resistance.
- B. Related Requirements:
 - 1. Section 220533 "Heat Tracing for Plumbing Piping."
 - 2. Section 230533 "Heat Tracing for HVAC Piping."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For electric heating cable.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLASTIC-INSULATED, SERIES-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Delta-Therm Corporation.
 - 2. Easy Heat; a division of EGS Electrical Group LLC.
 - 3. Orbit Manufacturing.
 - 4. Pyrotenax; a brand of Tyco Thermal Controls LLC.

5. Raychem; a brand of Tyco Thermal Controls LLC.
 6. WarmlyYours Inc.
 7. Watts Radiant, Inc.; a subsidiary of Watts Water Technologies, Inc.
- B. Comply with IEEE 515.1.
- C. Heating Element: Single- or dual-stranded resistor wire. Terminate with waterproof, factory-assembled, nonheating leads with connectors at both ends.
- D. Electrical Insulating Jacket: Minimum 4.0-mil Kapton with silicone, Tefzel, or polyolefin.
- E. Cable Cover: Aluminum braid and silicone or Hylar outer jacket.
- F. Maximum Operating Temperature (Power On): 300 deg. F.
- G. Maximum Exposure Temperature (Power Off): 185 deg. F.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics:
1. Maximum Heat Output: 7.5 W/ft..
 2. Piping Diameter: As shown on drawings or determined by calculations.
 3. Number of Parallel Cables: As shown on drawings or determined by calculations.
 4. Spiral Wrap Pitch: As determined by manufacturer.
 5. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: 120 or 208 or as specified on drawings.
 - b. Phase: As specified.
 - c. Hertz: As specified
 - d. Full-Load Amperes: As specified
 - e. Minimum Circuit Ampacity: As specified.
 - f. Maximum Overcurrent Protection: As specified.

2.2 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. BriskHeat.
 2. Chromalox.
 3. Delta-Therm Corporation.
 4. Easy Heat; a division of EGS Electrical Group LLC.
 5. Nelson Heat Trace; a division of EGS Electrical Group LLC.
 6. Pyrotenax; a brand of Tyco Thermal Controls LLC.
 7. Raychem; a brand of Tyco Thermal Controls LLC.
 8. Thermon Americas Inc.

9. Trasor Corp.

- B. Comply with IEEE 515.1.
- C. Heating Element: Pair of parallel No. 16 or No. 18 AWG, tinned or nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin.
- E. Cable Cover: Tinned-copper or Stainless-steel braid and polyolefin outer jacket with ultraviolet inhibitor.
- F. Maximum Operating Temperature (Power On): 150 deg. F.
- G. Maximum Exposure Temperature (Power Off): 185 deg. F.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics:
 - 1. Maximum Heat Output: 12 W/ft.
 - 2. Piping Diameter: As shown on drawings or determined by calculations.
 - 3. Number of Parallel Cables: As shown on drawings or determined by calculations.
 - 4. Spiral Wrap Pitch: As determined by manufacturer.
 - 5. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: 120 or 208 or as specified on drawings.
 - b. Phase: As specified.
 - c. Hertz: As specified
 - d. Full-Load Amperes: As specified
 - e. Minimum Circuit Ampacity: As specified.
 - f. Maximum Overcurrent Protection: As specified.

2.3 CONTROLS

- A. Remote bulb unit with adjustable temperature range from 30 to 50 deg. F.
- B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
- C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
- D. Corrosion-resistant, waterproof control enclosure.

2.4 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer or as recommended in writing by manufacturer.
- B. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install electric heating cable where indicated and according to NFPA 70 and NFPA 13.
- B. Install electric heating cables after piping has been tested and before insulation is installed.
- C. Install electric heating cables according to IEEE 515.1.
- D. Install insulation over piping with electric cables according to Section 210700 "Fire-Suppression Systems Insulation."
- E. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- F. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- I. Connect heat-tracing controls to fire-alarm system according to NFPA 13. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 2. Test cables for electrical continuity and insulation integrity before energizing.
 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- C. Cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Remove and replace damaged heat-tracing cables.

END OF SECTION 21 05 33

SECTION 21 05 48

VIBRATIONS AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Restraining braces.

1.2 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: As per Authority having jurisdiction for project.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: As per Authority having jurisdiction for project

1.4 ACTION SUBMITTALS

- A. Product Data: For each product indicated.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene, rubber or hermetically sealed compressed fiberglass.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Restrained Mounts: All-directional mountings with seismic restraint.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.
- H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 4. Hilti, Inc.
 5. Kinetics Noise Control.
 6. Loos & Co.; Cableware Division.
 7. Mason Industries.
 8. TOLCO Incorporated; a brand of NIBCO INC.
 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 2. Install seismic-restraint devices using methods approved by [an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction] providing required submittals for component.
- B. Piping Restraints:
 1. Comply with requirements in MSS SP-127 and NFPA 13.
 2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
 3. Brace a change of direction longer than 12 feet (3.7 m).
- C. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction providing required submittals for component.
- D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.2 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for piping flexible connections.

END OF SECTION 21 05 48

SECTION 21 05 53

IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. **Material and Thickness:** Brass, 0.032 inch stainless steel, 0.025 inch aluminum, or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
2. **Minimum Label Size:** Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. **Minimum Letter Size:** 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. **Fasteners:** Stainless-steel rivets or self-tapping screws.
5. **Adhesive:** Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. **Material and Thickness:** Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
2. **Minimum Label Size:** Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. **Minimum Letter Size:** 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. **Fasteners:** Stainless-steel rivets or self-tapping screws.
5. **Adhesive:** Contact-type permanent adhesive, compatible with label and with substrate.

- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS (AS PER AUTHORITY HAVING JURISDICTION)

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- B. Letter Color: White
- C. Background Color: Red
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless-steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 LABEL INSTALLATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install or permanently fasten labels on each major item of mechanical equipment.
- D. Locate equipment labels where accessible and visible.
- E. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting." and Section 099600 "High-Performance Coatings."
- F. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

END OF SECTION 21 05 53

SECTION 21 05 85

FIRE PROTECTION FIRESTOPPING

PART 1- GENERAL

1.1 DESCRIPTION

- A. Provide a U.L. approved firestopping system in accordance with the Contract Documents.

1.2 WORK INCLUDED

- A. Firestop Compounds.
- B. Damming Material.

1.3 SUBMITTALS

- A. Submit shop drawings, product data, and manufacturer's installation instructions for all materials and prefabricated devices, providing descriptions sufficient for identification at the job site. Literature shall indicate product characteristics, typical use, performance and limitation criteria and test data.
- B. Submit shop drawings showing proposed material, reinforcement, anchorage, fastenings, and method of installation. Construction details shall accurately reflect actual job conditions.
- C. Submit Material Safety Data Sheets with product delivered to job site.
- D. U.L. Tested Systems: Submit drawings showing typical installation details for the methods of installation. Indicate which firestop materials will be used and thickness for different hourly ratings, and approved UL system number.
- E. Engineering Judgements: Submit manufacturer's drawings for all non-standard applications where no U.L. tested system exists. All drawings must indicate the "Tested" U.L. system upon which the judgement is based so as to assess the relevance of the judgement to some known performance.
- F. Submit manufacturer's installation procedures for each type of product.
- G. Approved Applicator: Submit document from manufacturer wherein manufacturer recognizes the installer as qualified or submit a list of past projects to demonstrate capability to perform intended work.
- H. Upon completion, installer shall provide written certification that materials were installed in accordance with the manufacturer's installation instruction and details.

1.4 QUALITY ASSURANCE

- A. Firestop system installation shall conform to requirements of qualified designs or

manufacturer approved modifications, as supported by engineering reports. Field inspections shall be carried out by the firestop manufacturer to verify that the installation is in accordance with the manufacturer requirements.

- B. Install firestop materials and systems as required by these Contract Documents and meet and be accepted for use by applicable design building and construction codes.
- C. Submit manufacturer's product data, letter of certification, or certified laboratory test report that the material or combination of materials (firestop system) meets the requirements specified in accordance with the applicable referenced standards.
- D. The firestop compound shall not contain any solvents or inorganic fibers. The penetration seal material must be unaffected by moisture and must maintain the integrity of the floor or wall assembly for its rated time period when tested in accordance with ASTM E814 (UL1479). The system shall be U.L. Classified for up to and including 3 hours.
- E. Firestopping materials shall be asbestos and lead free and shall not incorporate or not require the use of hazardous solvents.
- F. Firestopping sealants must be flexible, allowing for normal pipe movement.
- G. All fire stopping materials shall be manufactured by one manufacturer.
- H. Installation of firestopping systems shall be performed by a Contractor (or Contractors) trained or approved by the firestop manufacturer.
- I. Material used shall be in accordance with the manufacturer's written installation instructions.
- J. Submit a line-by-line statement of compliance or non-compliance with this specification section.

PART 2 - PRODUCTS

2.1 FIRESTOPPING

- A. Provide firestop compounds for caulk, pour, trowel or pump application. Material must be capable of sealing openings around single or multiple pipes against fire, smoke and toxic gases, and maintaining rating with a thickness no greater than the structure.
- B. Provide a damming material, where required, per manufacturer's recommendations and as shown on the Drawings.
- C. Provide a firestop system consisting of a material, or combination of materials, to retain the integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke or gases through penetrations in fire-rated barriers. It shall be used in specific locations as follows:

1. Penetrations for the passage of piping through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor slabs and floor/ceiling assemblies), and vertical service shafts.
2. Locations shown specifically on the drawings or where specified in other sections of these specifications.

2.2 MATERIALS

- A. Firestopping materials/systems shall be flexible to allow for normal movement of building structure and penetrating item(s) without affecting the adhesion or integrity of the system.
- B. Firestopping materials shall not require hazardous waste disposal of used containers/packages.
- C. Provide firestopping materials free of solvents which will not experience shrinkage while curing.
- D. Firestopping materials shall be unaffected by moisture.

2.3 ACCEPTABLE MANUFACTURERS

- A. Specified Technologies, Inc.
- B. Dow Corning
- C. Flamesafe
- D. International Protective Coatings

PART 3 - EXECUTION

- 3.1 Deliver materials to site in original unopened containers or packages bearing the manufacturer's name, brand designation, product description and U.L. Classification Mark.
- 3.2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job site.
- 3.3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- 3.4 Comply with recommended procedures, precautions or remedies described in Material Safety Data Sheets as applicable.

3.5 EXAMINATION

- A. Examine areas and conditions under which work is to be performed and notify the Contractor in writing of conditions detrimental to proper and timely completion of

the work.

- B. Verify that openings are properly sized and in suitable condition to receive the work of this section.
- C. Verify manufacturer's printed instructions for installation and when applicable, curing in accordance with temperature and humidity. Conform to ventilation and safety requirements.
- D. Verify the condition of the substrates before starting work.
- E. Verify Weather Conditions. Do not proceed with installation of firestop materials when temperatures fall outside the manufacturer's suggested limits.
- F. Verify that firestopping materials are installed so as not to contaminate adjacent surfaces.
- G. Schedule firestopping after installation of penetrants but prior to concealing the openings.
- H. Where firestopping is installed at locations which will remain exposed in the completed work, provide protection as necessary to prevent damage to adjacent surfaces and finishes, and protect as necessary against damage from other construction activities.
- I. Verify that all pipe, conduit, ducting which penetrate fire-rated construction have been permanently installed prior to installation of firestop.

3.6 PREPARATION

- A. Clean substrate of dirt, dust, grease, oil, loose materials, rust or other matter that may affect the proper fitting or adhesion of the firestopping materials.
- B. Clean metal and glass surfaces with a non-alcohol solvent.

3.7 INSTALLATION

- A. Installation of firestops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's details installation procedures.
- B. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
- C. Unless specified and approved, all insulation used in conjunction with through-penetrations shall remain intact and undamaged and may not be removed.
- D. Seal holes and penetrations to ensure an effective smoke seal.
- E. In areas of high traffic, protect firestopping materials from damage. If the opening is large, install firestopping materials capable of supporting the weight of a human.

- F. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.
 - G. All combustible penetrants (e.g. non-metallic pipes or insulated metallic pipes) shall be firestopped using products and systems tested in a configuration representative of the field condition.
 - H. Dam Construction
 - 1. When required to properly contain firestopping materials within openings, damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Noncombustible damming materials may be left as a permanent component of the firestop system.
- 3.8 Firestopping may be required by other Subcontractors under related sections of the project specifications. Identify all locations requiring firestopping and coordinate the work of this section with work performed under other sections of the project to provide a uniform system of firestopping.
- 3.9 Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.
- 3.10 Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation.
- 3.11 Firestop systems do not re-establish the structural integrity of load bearing partitions. Contractor shall consult the structural engineer prior to penetrating any load bearing assembly.
- A. FIRESTOPPING Un-Insulated Cold Pipes
 - 1. Install a pipe sleeve through the wall or slab to be penetrated with an inside diameter large enough to include the pipe and firestopping.
 - 2. Install firestop material at each end of sleeve to form a U.L. approved system.
 - 3. Mark penetration in an approved manner to verify manufacturer's inspection.
 - 4. Cover firestopping with escutcheon cover.
 - B. Insulated Pipes
 - 1. Install a pipe sleeve through the wall or slab to be penetrated with an inside diameter large enough to include the specified thickness of insulation.
 - 2. Pipe insulation should be continuous through sleeve. Insulation should be covered with a vapor barrier. For depth of wall plus 1" on either side of wall or slab, vapor barrier shall be wrapped with a 26 gauge sheetmetal

inner sleeve. Firestop shall be applied between wall sleeve and pipe protection sleeve.

3. Install firestop material at each end of sleeve to form a U.L. approved system.
4. Mark penetration in an approved manner to verify manufacturer's inspection.
5. Cover firestopping with escutcheon cover.

3.12 FIELD QUALITY CONTROL

- A. Prepare and install firestopping systems in accordance with manufacturer's printed instruction and recommendations.
- B. Follow safety procedures recommended in the Material Safety Data Sheets.
- C. Finish surfaces of firestopping which are to remain exposed in the completed work to a uniform and level condition.
- D. All areas of work must be accessible until inspection by the applicable Code Authorities.
- E. Correct unacceptable firestops and provide additional inspection to verify compliance with this specification.

3.13 CLEANING

- A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surface.
- B. Leave finished work in neat, clean condition with no evidence of spill overs or damage to adjacent surfaces.

END OF SECTION

SECTION 21 12 00

FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Hose connections.
4. Fire-department connections.
5. Alarm devices.
6. Pressure gages.

B. Related Sections:

1. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
2. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
3. Section 213113 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
4. [Section 283111 "Digital, Addressable Fire-Alarm System"] [Section 283112 "Zoned (DC Loop) Fire-Alarm System"] for alarm devices not specified in this Section.

1.2 SYSTEM DESCRIPTIONS

- A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- B. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- C. Automatic Wet-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- D. Automatic Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has dry pipe valve system connected to fire pump system. Piping is dry. Water must be pumped into standpipes to satisfy demand.

1.3 PERFORMANCE REQUIREMENTS

- A. Fire-Suppression Standpipe System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- B. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Available fire-hydrant flow test records indicate the following conditions as per accepted by authorities having jurisdiction:
 - a. Date:
 - b. Time: p.m.
 - c. Performed by:
 - d. Location of Residual Fire Hydrant R:
 - e. Location of Flow Fire Hydrant F:
 - f. Static Pressure at Residual Fire Hydrant R:
 - g. Measured Flow at Flow Fire Hydrant F:
 - h. Residual Pressure at Residual Fire Hydrant R:
- C. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.
 1. Minimum residual pressure at each hose-connection outlet is as follows:
 - a. NPS 1-1/2 (DN 40) Hose Connections: 65 psig
 - b. NPS 2-1/2 (DN 65) Hose Connections: 100 psig
 2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:
 - a. NPS 1-1/2 (DN 40) Hose Connections: 100 psig
 - b. NPS 2-1/2 (DN 65) Hose Connections: 175 psig
- D. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- C. Welding certificates.
- D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

- 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized and Black Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

- B. Schedule 30, Galvanized and Black Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

- C. Thinwall Galvanized and Black Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

- D. Standard-Weight, Galvanized and Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.

- E. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.

- F. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

- G. Malleable- or Ductile-Iron Unions: UL 860.

- H. Cast-Iron Flanges: ASME B16.1, Class 125.

- I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

- J. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

- K. Grooved-Joint, Steel-Pipe Appurtenances:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
2. Pressure Rating: 175 psig (1200 kPa) or 250 psig (1725 kPa) minimum (as per system requirements).
 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 1. Valves shall be UL listed or FM approved.
 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- B. Check Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.

- k. Globe Fire Sprinkler Corporation.
- l. Groeniger & Company.
- m. Kennedy Valve; a division of McWane, Inc.
- n. Matco-Norca.
- o. Metraflex, Inc.
- p. Milwaukee Valve Company.
- q. Mueller Co.; Water Products Division.
- r. NIBCO INC.
- s. Potter Roemer.
- t. Reliable Automatic Sprinkler Co., Inc.
- u. Shurjoint Piping Products.
- v. Tyco Fire & Building Products LP.
- w. United Brass Works, Inc.
- x. Venus Fire Protection Ltd.
- y. Victaulic Company.
- z. Viking Corporation.
- aa. Watts Water Technologies, Inc.

- 2. Standard: UL 312.
- 3. Pressure Rating: 250 psig (1725 kPa) minimum.
- 4. Type: Swing check.
- 5. Body Material: Cast iron.
- 6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
- 2. Standard: UL 262.
- 3. Pressure Rating: 175 psig (1200 kPa).
- 4. Body Material: Bronze.
- 5. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
- b. American Valve, Inc.
- c. Clow Valve Company; a division of McWane, Inc.
- d. Crane Co.; Crane Valve Group; Crane Valves.
- e. Crane Co.; Crane Valve Group; Jenkins Valves.
- f. Crane Co.; Crane Valve Group; Stockham Division.
- g. Hammond Valve.
- h. Milwaukee Valve Company.
- i. Mueller Co.; Water Products Division.
- j. NIBCO INC.
- k. Shurjoint Piping Products.
- l. Tyco Fire & Building Products LP.
- m. United Brass Works, Inc.
- n. Watts Water Technologies, Inc.

2. Standard: UL 262.
3. Pressure Rating: 250 psig (1725 kPa) minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Valves NPS 2 (DN 50) and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.

5. Valves NPS 2-1/2 (DN 65) and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch or electrical, 115-V ac, prewired, two-circuit, supervisory switch with visual indicating device.

2.5 HOSE CONNECTIONS

A. Adjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. GMR International Equipment Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. Potter Roemer.
 - h. Tyco Fire & Building Products LP.
 - i. Wilson & Cousins Inc.
 - j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
2. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure-control device, for connecting fire hose.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Material: Brass or bronze.
5. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle or gate.
9. Pressure-Control Device Type: Pressure reducing or restricting. (see drawing)
10. Design Outlet Pressure Setting: See drawing
11. Finish: Polished chrome plated, Rough brass or bronze or Rough chrome plated.

B. Nonadjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.

- c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. GMR International Equipment Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. Kennedy Valve; a division of McWane, Inc.
 - h. Mueller Co.; Water Products Division.
 - i. NIBCO INC.
 - j. Potter Roemer.
 - k. Tyco Fire & Building Products LP.
 - l. Wilson & Cousins Inc.
2. Standard: UL 668 hose valve for connecting fire hose.
 3. Pressure Rating: 300 psig (2070 kPa) minimum.
 4. Material: Brass or bronze.
 5. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as indicated.
 6. Inlet: Female pipe threads.
 7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
 8. Pattern: Angle or gate.
 9. Finish: Polished chrome plated, Rough brass or bronze or Rough chrome plated.

2.6 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. GMR International Equipment Corporation.
 - d. Guardian Fire Equipment, Inc.
 - e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.

8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal, Square, and Vertical. (Coordinate per wall construction)
11. Number of Inlets: Two.
12. Outlet Location: Back, Bottom or Top. (See drawing).
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE or STANDPIPE." (as per authority having jurisdiction)
14. Finish: Polished chrome plated, Rough brass or bronze or Rough chrome plated.
15. Outlet Size: NPS 4 (DN 100) or NPS 6 (DN 150).

2.7 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig (1725 kPa).
7. Design Installation: Horizontal or vertical.

C. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.

4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.8 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AMETEK; U.S. Gauge Division.
 2. Ashcroft Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 300 psig.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - E EXECUTION

3.1 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression standpipe piping to water-service piping at service entrance into building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories at connection to fire-suppression water-service piping
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.2 WATER-SUPPLY CONNECTIONS

- A. Connect fire-suppression standpipe piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories at connection to water-distribution piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

- C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
- D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install drain valves on standpipes. Extend drain piping to outside of building.
- F. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.
- G. Install alarm devices in piping systems.
- H. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.
- I. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- J. Drain dry-type standpipe system piping.
- K. Pressurize and check dry-type standpipe system piping.
- L. Fill wet-type standpipe system piping with water.
- M. Install electric heating cables and pipe insulation on wet-type, fire-suppression standpipe piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."
- N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

3.6 HOSE-CONNECTION INSTALLATION

- A. Install hose connections adjacent to standpipes.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install NPS 1-1/2 (DN 40) hose-connection valves with flow-restricting device.
- D. Install NPS 2-1/2 (DN 65) hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter and flow-restricting device.
- E. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 104413 "Fire Extinguisher Cabinets."

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.8 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.

- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire-department equipment.
- C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.10 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Wet-type, fire-suppression standpipe piping, NPS 6 and smaller, shall be one of the following:
 - 1. Standard-weight black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Standard-weight, black-steel pipe with cut or roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 4. Standard-weight galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 5. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- C. Wet-type, fire-suppression standpipe piping, NPS 8 and larger, shall be one of the following:
 - 1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, Schedule 30 or thinwall, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Standard-weight or Schedule 30, black-steel pipe with cut or roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 4. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

5. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- D. Dry-type, fire-suppression standpipe piping, shall be one of the following:
1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

END OF SECTION 21 12 00

SECTION 21 13 13 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.

B. Related Sections:

1. Section 211200 "Fire-Suppression Standpipes" for standpipe piping.
2. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
3. Section 213113 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.

1.2 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.3 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
1. Contractor to obtain the latest available fire-hydrant flow test records conducted by the A/E.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers or 5 psi whichever is greater.
 2. Sprinkler Occupancy Hazard Classifications (to be cross referenced with authority having jurisdiction):
 - a. Building Service Areas: Ordinary Hazard, Group 1
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1
 - c. General Storage Areas: Ordinary Hazard, Group 1
 - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1

- e. Office and Public Areas: Light Hazard
- f. Restaurant Service Areas: Ordinary Hazard, Group 1
- 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
 - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
 - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- 4. Maximum Protection Area per Sprinkler: Per UL listing.
- 5. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft. (20.9 sq. m)
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes
 - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Qualification Data: For qualified Installer and professional engineer.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- F. Sprinklers shall be referred to on drawings and other documentation by the manufacturer's model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations are not permitted.

- G. Welding certificates.
- H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- I. Field quality-control reports.
- J. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - 2. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Date Stamped Castings: All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
 - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 SOURCE LIMITATIONS

- A. Source Limitations: Obtain all grooved joint couplings, fittings, valves, and specialties from single source. Obtain grooving tools from same source as grooved components.

2.3 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized and Black Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 30, Galvanized and Black Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Thinwall Galvanized and Black Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- D. Galvanized and Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- E. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- F. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME 16.1, Class 125.
- I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- J. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- K. Grooved-Joint, Steel-Pipe Appurtenances:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company
 - b. Anvil International, Inc.
 - c. Corcoran Piping System Co.
 - d. National Fittings, Inc.
 - e. Shurjoint Piping Products.
 - f. Tyco Fire & Building Products LP.
 2. Pressure Rating: 175 psig (1200 kPa) or 250 psig (1725 kPa) or 300 psig (2070 kPa) minimum as per system requirement.
 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; short pattern, with flow equal to standard pattern, and with dimensions matching steel pipe.
 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and ASTM A 449 electroplated steel bolts and nuts.
- L. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig (1200-kPa) pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Victaulic Company – “Vic-Press”

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- D. Grooved Joint Lubricant: Compatible with gasket elastomer and fluid media. Supplied by coupling manufacturer.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company; Vic-Lube or comparable engineer approved product.

2.5 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 1. Valves shall be UL listed or FM approved.
 2. Minimum Pressure Rating: 175 psig.
 3. Minimum Pressure Rating for High-Pressure Piping 300 psig.
- B. Check Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.
 - k. Globe Fire Sprinkler Corporation.
 - l. Groeniger & Company.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.

- o. Metraflex, Inc.
- p. Milwaukee Valve Company.
- q. Mueller Co.; Water Products Division.
- r. NIBCO INC.
- s. Potter Roemer.
- t. Reliable Automatic Sprinkler Co., Inc.
- u. Shurjoint Piping Products.
- v. Tyco Fire & Building Products LP.
- w. United Brass Works, Inc.
- x. Venus Fire Protection Ltd.
- y. Victaulic Company.
- z. Viking Corporation.
- aa. Watts Water Technologies, Inc.

- 2. Standard: UL 312.
- 3. Pressure Rating: 250 psig (1725 kPa) minimum or 300 psig (2070 kPa) as per system requirement.
- 4. Type: Swing check.
- 5. Body Material: Cast iron.
- 6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
- 2. Standard: UL 262.
- 3. Pressure Rating: 175 psig (1200 kPa).
- 4. Body Material: Bronze.
- 5. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide Victaulic Company; Series 771H or comparable product by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.

- d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Shurjoint Piping Products.
 - l. Tyco Fire & Building Products LP.
 - m. United Brass Works, Inc.
 - n. Watts Water Technologies, Inc.
2. Standard: UL 262.
 3. Pressure Rating: 250 psig (1725 kPa) minimum or 300 psig (2070 kPa) as per system requirements.
 4. Body Material: Cast or ductile iron.
 5. End Connections: Flanged or grooved.
- E. Indicating-Type Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide Victaulic Company; Series Series 705 butterfly valve or comparable product by one of the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
 2. Standard: UL 1091.
 3. Pressure Rating: 175 psig (1200 kPa) minimum.
 4. Valves NPS 2 (DN 50) and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
 5. Valves NPS 2-1/2 (DN 65) and Larger:
 - a. Valve Type: Butterfly.

- b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch or electrical, 115-V ac, prewired, two-circuit, supervisory switch with visual indicating device.

2.6 TRIM AND DRAIN VALVES

A. General Requirements:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Minimum Pressure Rating: 175 psig (1200 kPa).

B. Ball Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Affiliated Distributors.
 - b. Anvil International, Inc.
 - c. Barnett.
 - d. Conbraco Industries, Inc.; Apollo Valves.
 - e. Fire-End & Croker Corporation.
 - f. Fire Protection Products, Inc.
 - g. Flowserve.
 - h. FNW.
 - i. Jomar International, Ltd.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. Kitz Corporation.
 - l. Legend Valve.
 - m. Metso Automation USA Inc.
 - n. Milwaukee Valve Company.
 - o. NIBCO INC.
 - p. Potter Roemer.
 - q. Red-White Valve Corporation.
 - r. Southern Manufacturing Group.
 - s. Stewart, M. A. and Sons Ltd.
 - t. Tyco Fire & Building Products LP.
 - u. Victaulic Company.
 - v. Watts Water Technologies, Inc.

2.7 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, Victaulic Company; Series 751 or comparable product by one of the following:
 - a. AFAC Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Venus Fire Protection Ltd.
 - f. Victaulic Company.
 - g. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4 (DN 20).
6. End Connections: Threaded.

2.8 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. GMR International Equipment Corporation.
 - d. Guardian Fire Equipment, Inc.
 - e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal Square Vertical coordinate per wall construction.
11. Number of Inlets: Two.
12. Outlet Location: Back Bottom or Top. (see drawings)
13. Retain first option in first subparagraph below if standpipes will supply a sprinkler system.
14. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE AUTO SPKR." As per authority having jurisdiction.
15. Finish: Polished chrome plated, Rough brass or bronze or rough chrome plated.
16. Outlet Size: NPS 4 (DN 100) or NPS 6 (DN 150).

B. Elbow with Drain Connection: Install 90-degree elbow with drain connection at low point near each fire department connection to allow for system drainage to prevent freezing.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company; #10-DR or comparable engineer approved product.

2.9 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company - Style 920/920N.
 - b. Anvil International, IncNational Fittings, Inc.
 - c. Shurjoint Piping Products.

d. Tyco Fire & Building Products LP.

2. Standard: UL 213.
3. Pressure Rating: 175 psig (1200 kPa) minimum or 300 psig (2070 kPa) as per system requirements.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company; Zone Control Riser Module, Series 747M
 - b. AGF Manufacturing Inc.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum or 300 psig (2070 kPa) as per system requirements.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
2. Standard: UL 199.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company - TestMaster II, Style 720

- b. AGF Manufacturing Inc.
- c. Triple R Specialty.
- d. Tyco Fire & Building Products LP.
- e. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum or 300 psig (2070 kPa) as per system requirements.
4. Body Material: Cast-bronze or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved end.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig (1725 kPa) minimum or 300 psig (2070 kPa) as per system requirements.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

2.10 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig (1200 kPa) maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.

4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum or 300 psig (2070 kPa).
- C. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767
 2. Nonresidential Applications: UL 199
 3. Residential Applications: UL 1626
 4. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes:
1. White
 2. Chrome Plated
 3. Bronze.
 4. Painted.
- E. Special Coatings:
1. Wax.
 2. Lead.
 3. Corrosion-resistant paint.
 4. Nickel-Teflon
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: White, one piece, flat or White, two piece, with 1-inch (25-mm) vertical adjustment.
 2. Sidewall Mounting: White, one piece, flat.
 3. Escutcheons: Listed, supplied, and approved for use with sprinkler by the sprinkler manufacturer.
- G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 2. Standard: UL 199.
 3. Type: Wire cage with fastening device for attaching to sprinkler.
 4. Guards: Listed, supplied, and approved for use with the sprinkler by sprinkler manufacturer.

2.11 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company – Style 760
 - b. Globe Fire Sprinkler Corporation.
 - c. Tyco Fire & Building Products LP.
 - d. Viking Corporation.
 2. Standard: UL 753.
 3. Type: Mechanically operated, with Pelton wheel.
 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
 5. Size: 10-inch (250-mm) diameter.
 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
 7. Inlet: NPS 3/4 (DN 20).
 8. Outlet: NPS 1 (DN 25) drain connection.
- C. Electrically Operated Alarm Bell:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Notifier; a Honeywell company.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 2. Standard: UL 464.
 3. Type: Vibrating, metal alarm bell.
 4. Size: 6-inch minimum diameter.
 5. Finish: Red-enamel factory finish, suitable for outdoor use.
- D. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
 2. Standard: UL 346.
 3. Water-Flow Detector: Electrically supervised.
 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 5. Type: Paddle operated.

6. Pressure Rating: 250 psig (1725 kPa).
7. Design Installation: Horizontal or vertical.

E. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.12 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AMETEK; U.S. Gauge Division.
 2. Ashcroft, Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 300 psig (0 to 2070 kPa).
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.2 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."

- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings. (The couplings shall serve as disconnect points.)
- I. Install sprinkler piping with drains for complete system drainage.
- J. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- K. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- L. Install alarm devices in piping systems.
- M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- O. Fill sprinkler system piping with water.
- P. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
 - 1. Assure grooved ends are clean and free from indentations, projections, or roll marks.
 - 2. Use gaskets molded and produced by coupling manufacturer of an elastomer suitable for intended service.
 - 3. On-Site Training: For contractor's field personnel in use of grooving tools and installation of product shall be provided by coupling manufacturer's factory-trained representative. (Distributor's representative is not considered qualified to conduct the training.)
 - 4. Job Site Visitation: Manufacturer's representative shall periodically visit jobsite to ensure best practices in grooved product installation are being followed.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
 - 1. Assure grooved ends are clean and free from indentations, projections, or roll marks.

2. Use gaskets molded and produced by coupling manufacturer of an elastomer suitable for intended service.
 3. On-Site Training: For contractor's field personnel in use of grooving tools and installation of product shall be provided by coupling manufacturer's factory-trained representative. (Distributor's representative is not considered qualified to conduct the training.)
 4. Job Site Visitation: Manufacturer's representative shall periodically visit jobsite to ensure best practices in grooved product installation are being followed.
- M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.
- D. Do not install sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs.
- E. Sprinkler bulb protector shall be removed by hand. Do not use any tools or devices that could damage the bulb.

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.8 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.10 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.11 DEMONSTRATION AND TRAINING

- A. On-Site Training: For contractor's field personnel in use of grooving tools and installation of product shall be provided by coupling manufacturer's factory-trained representative. (Distributor's representative is not considered qualified to conduct the training.)
- B. Job Site Visitation: Manufacturer's representative shall periodically visit jobsite to ensure best practices in grooved product installation are being followed.
- C. Train The State's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.12 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
 - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

3. Standard-weight, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
 4. Standard-weight, galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
 5. Standard-weight, black-steel pipe with cut or roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 6. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 7. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:
1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Standard-weight, black-steel pipe with cut or roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 5. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.13 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers. Basis of Design Victaulic V2704
 2. Rooms with Suspended Ceilings: Pendent (Basis of Design Victaulic V2708), recessed (Basis of Design Victaulic V2708), flush, and concealed sprinklers (Basis of Design Victaulic V38) as indicated.
 3. Wall Mounting: Sidewall sprinklers. (Basis of Design Victaulic V2710)
 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers (Basis of Design Victaulic V36) as indicated.
 5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: White, with painted white escutcheon.
 3. Recessed Sprinklers: White, with white escutcheon.
 4. Residential Sprinklers: White.
 5. Upright Pendent and Sidewall Sprinklers: White in finished spaces exposed to view; white in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 13

SECTION 21 13 16

DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinkler specialty pipe fittings.
5. Sprinklers.
6. Alarm devices.
7. Pressure gages.

B. Related Sections:

1. Section 211200 "Fire-Suppression Standpipes" for standpipe piping.
2. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
3. Section 213113 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
4. Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System" for alarm devices not specified in this Section.

1.2 SYSTEM DESCRIPTIONS

- ###### **A. Dry-Pipe Sprinkler System:** Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

1.3 PERFORMANCE REQUIREMENTS

- ###### **A. Standard-Pressure Piping System Component:** Listed for 175-psig (1200-kPa) minimum working pressure.
- ###### **B. Delegated Design:** Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
1. Available fire-hydrant flow test records indicate the following conditions as per accepted by authorities having jurisdiction:
 - a. Date:
 - b. Time: p.m.
 - c. Performed by:
 - d. Location of Residual Fire Hydrant R:
 - e. Location of Flow Fire Hydrant F:

- f. Static Pressure at Residual Fire Hydrant R:
 - g. Measured Flow at Flow Fire Hydrant F:
 - h. Residual Pressure at Residual Fire Hydrant R:
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
- 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers or 5 psi whichever is greater.
 - 2. Sprinkler Occupancy Hazard Classifications (to be cross referenced with authority having jurisdiction):
 - a. Building Service Areas: Ordinary Hazard, Group 1
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1
 - c. General Storage Areas: Ordinary Hazard, Group 1
 - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1 Office and Public Areas: Light Hazard
 - e. Restaurant Service Areas: Ordinary Hazard, Group 1
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
 - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
 - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
 - 4. Maximum Protection Area per Sprinkler: Per UL listing.
 - 5. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft. (20.9 sq. m)
 - b. Storage Areas: 130 sq. ft. (12.1 sq. m)
 - c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m)
 - d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m)
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
 - 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes
 - b. Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes
 - c. Extra-Hazard Occupancies: 500 gpm (31.5 L/s) for 90 to 120 minutes
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer[and professional engineer].
- B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- C. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
 - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 30, Galvanized-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Thin wall Galvanized-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- D. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- E. Galvanized, Steel Couplings: ASTM A 865, threaded.
- F. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME B16.1, Class 125.
- I. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Shurjoint Piping Products.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.

2. Pressure Rating: 175 psig or 250 psig (1725 kPa) or 300 psig minimum (as required by system).
3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 1. Valves shall be UL listed or FM approved.
 2. Minimum Pressure Rating: 175 psig (1200 kPa).
- B. Check Valves:
 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.
 - k. Globe Fire Sprinkler Corporation.
 - l. Groeniger & Company.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.
 - o. Metraflex, Inc.
 - p. Milwaukee Valve Company.
 - q. Mueller Co.; Water Products Division.
 - r. NIBCO INC.

- s. Potter Roemer.
- t. Reliable Automatic Sprinkler Co., Inc.
- u. Shurjoint Piping Products.
- v. Tyco Fire & Building Products LP.
- w. United Brass Works, Inc.
- x. Venus Fire Protection Ltd.
- y. Victaulic Company.
- z. Viking Corporation.
- aa. Watts Water Technologies, Inc.

- 2. Standard: UL 312
- 3. Pressure Rating: 250 psig (1725 kPa) minimum.
- 4. Type: Swing check.
- 5. Body Material: Cast iron.
- 6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
- 2. Standard: UL 262.
- 3. Pressure Rating: 175 psig (1200 kPa).
- 4. Body Material: Bronze.
- 5. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.

- i. Mueller Co.; Water Products Division.
- j. NIBCO INC.
- k. Shurjoint Piping Products.
- l. Tyco Fire & Building Products LP.
- m. United Brass Works, Inc.
- n. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig (1725 kPa) minimum or 300 psig (2070 kPa).
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.
- E. Indicating-Type Butterfly Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
 2. Standard: UL 1091.
 3. Pressure Rating: 175 psig (1200 kPa) minimum.
 4. Valves NPS 2 (DN 50) and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
 5. Valves NPS 2-1/2 (DN 65) and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
 6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch electrical, 115-V ac, prewired, two-circuit, supervisory switch with visual indicating device.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig (1200 kPa).

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Affiliated Distributors.
 - b. Anvil International, Inc.
 - c. Barnett.
 - d. Conbraco Industries, Inc.; Apollo Valves.
 - e. Fire-End & Croker Corporation.
 - f. Fire Protection Products, Inc.
 - g. Flowserve.
 - h. FNW.
 - i. Jomar International, Ltd.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. Kitz Corporation.
 - l. Legend Valve.
 - m. Metso Automation USA Inc.
 - n. Milwaukee Valve Company.
 - o. NIBCO INC.
 - p. Potter Roemer.
 - q. Red-White Valve Corporation.
 - r. Southern Manufacturing Group.
 - s. Stewart, M. A. and Sons Ltd.
 - t. Tyco Fire & Building Products LP.
 - u. Victaulic Company.
 - v. Watts Water Technologies, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body Material: Cast or ductile iron.

4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Venus Fire Protection Ltd.
 - f. Victaulic Company.
 - g. Viking Corporation.
2. Standard: UL 260
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air Compressor:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Gast Manufacturing Inc.
 - 2) General Air Products, Inc.
 - 3) Viking Corporation.
 - b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - c. Motor Horsepower: Fractional.
 - d. Power: 120-V ac, 60 Hz, single phase.

2.7 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. GMR International Equipment Corporation.
 - d. Guardian Fire Equipment, Inc.
 - e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.

4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal Square Vertical coordinate per wall construction.
11. Number of Inlets: Two.
12. Outlet Location: Back Bottom or Top. (see drawings)
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE AUTO SPKR." As per authority having jurisdiction.
14. Finish: Polished chrome plated, Rough brass or bronze or rough chrome plated.
15. Outlet Size: NPS 4 (DN 100) or NPS 6 (DN 150).

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.

- c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Pressure Rating: 175 psig (1200 kPa) minimum.
 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded.
- D. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
 2. Standard: UL 199.
 3. Pressure Rating: 175 psig (1200 kPa) minimum.
 4. Body Material: Brass.
 5. Size: Same as connected piping.
 6. Inlet: Threaded.
 7. Drain Outlet: Threaded and capped.
 8. Branch Outlet: Threaded, for sprinkler.
- E. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Pressure Rating: 175 psig (1200 kPa) minimum.
 4. Body Material: Cast- or ductile-iron housing with sight glass.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded.
- F. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CECA, LLC.

- b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
 3. Pressure Rating: 250 psig (1725 kPa) minimum.
 4. Body Material: Steel pipe with EPDM O-ring seals.
 5. Size: Same as connected piping.
 6. Length: Adjustable.
 7. Inlet and Outlet: Threaded.

2.9 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig (1200 kPa) maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig (1725 kPa) minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199
2. Residential Applications: UL 1626
3. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

E. Special Coatings:

1. Wax.
2. Lead.

3. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat or Chrome-plated steel, two piece, with 1-inch (25-mm) vertical adjustment.

2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Reliable Automatic Sprinkler Co., Inc.

b. Tyco Fire & Building Products LP.

c. Victaulic Company.

d. Viking Corporation.

2. Standard: UL 199.

3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Globe Fire Sprinkler Corporation.

b. Tyco Fire & Building Products LP.

c. Victaulic Company.

d. Viking Corporation.

2. Standard: UL 753.

3. Type: Mechanically operated, with Pelton wheel.

4. Alarm Gong: Cast aluminum with red-enamel factory finish.

5. Size: 10-inch (250-mm) diameter.

6. Components: Shaft length, bearings, and sleeve to suit wall construction.

7. Inlet: NPS 3/4 (DN 20).

8. Outlet: NPS 1 (DN 25) drain connection.

C. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fire-Lite Alarms; a Honeywell company.

b. Kennedy Valve; a division of McWane, Inc.

c. Potter Electric Signal Company.

d. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.11 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AMETEK, Inc.; U.S. Gauge Division.
 2. Ashcroft, Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 300 psig (0 to 2070 kPa).
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.2 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements in Section 221116 "Domestic Water Piping" for interior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.

- C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- N. Drain dry-pipe sprinkler piping.
- O. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices/air compressors.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air supply piping.

3.6 SPRINKLER INSTALLATION

Coordinate this article with Drawings.

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.8 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Coordinate with fire-pump tests. Operate as required.
 - 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.10 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.11 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded, grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Dry-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
 - 1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.
 - 3. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- D. Dry-pipe sprinkler system, NPS 2-1/2 to NPS 6 shall be one of the following:
 - 1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Dry pendent, recessed, flush, and concealed sprinklers, as indicated.
 - 3. Wall Mounting: Dry sidewall sprinklers.
 - 4. Spaces Subject to Freezing: Upright, dry pendent sprinklers; and dry sidewall sprinklers as indicated.
 - 5. Special Applications: Extended-coverage and quick-response sprinklers where indicated
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 - 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 - 4. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

SECTION 21 13 16

SECTION 21 32 13 - ELECTRICAL DRIVEN VERTICAL TURBINE FIRE PUMPS WITH PRE-FABRICATED PUMP HOUSE

This section is included for this contract to execute the installation and commissioning of the pre-fabricated fire pump house purchased separately. Parts 1 and 2 are for reference only. Part 3 shall be included in this contract.

PART 1- GENERAL (for reference)

1.01 DESCRIPTION

- A. Provide packaged fire protection pumps and house in accordance with the Contract Documents.

1.02 WORK INCLUDED

- A. Fire Protection Pumps built in a Pre-Fabricated Pump House designed in accordance with the requirements of NFPA 20.
- B. Provide instruction manuals to GC for installation, testing and all other required work (including connections) to complete the system commissioning. Coordinate the lifting and installation of pump house and all required connections (including electrical, plumbing and fire alarm connections). Provide personnel for field startup and testing of equipment.

1.03 SUBMITTALS

- A. Catalog Data: Manufacturer's literature and illustrations.
- B. Shop Drawings
 - 1. Dimensions.
 - 2. Detail of valving and piping arrangements.
 - 3. Wiring diagram of prewired controllers, required control wiring and power wiring diagrams.
 - 4. Written description of sequence of operation.
 - 5. Pump curves indicating service conditions.
- C. Installation: Manufacturer's installation instructions to GC.
- D. Operating Instructions: Written operating instructions including start-up and shutdown to GC.
- E. Maintenance Data to GC
 - 1. Written instructions on items requiring periodic maintenance.
 - 2. Parts List.

- F. Factory Tests and Certificates (to consultant/the State)
 - 1. Pumps hydraulically tested for pressure/flow performances.
 - 2. Provide certified test data.
- G. Responsibility of Manufacturer
 - 1. The manufacturer shall be responsible for the complete pumping system and shall guarantee pumps, motors, control and all components of the pumping system.

1.04 QUALITY ASSURANCE

- A. Factory Mutual (FM)
- B. Underwriters Laboratories
- C. National Fire Protection Association (NFPA)
- D. Local authorities.
- E. Manufacturer of the specified equipment shall be a business regularly engaged in the manufacture, assembly, construction, start up, and maintenance of fire pumping distribution equipment of the type required for this project. The manufacturer shall have at least ten (10) years of successful experience in providing stations of the type, design, function, and quality as required for this project.
- F. Provide earthquake restraint systems as required by State Building Code and any required calculations.

1.05 ABBREVIATIONS

- A. Factory Mutual (FM)
- B. Underwriters Laboratories (UL)
- C. National Fire Protection Association (NFPA)
- D. Outside Screw and Yoke (OS&Y)
- E. National Electrical Manufacturers Association (NEMA)
- F. American Society for Testing and Materials (ASTM)

PART 2- PRODUCTS (for reference)

2.01 GENERAL

- A. All pumps shall be as scheduled in the specifications.
- B. Pumping systems shall be complete with all necessary controls, starters and alarms.

- C. All pumps shall be U.L. listed and FM approved.

2.02 FIRE PUMPS ACCESSORIES

- A. The system manufacturer shall furnish accessories as follows:
 - A. 1 ½” automatic air release valve
 - B. 3 ½” Discharge pressure gauge
 - C. ¾” relief valve
 - D. Flush dome type hose valve header, 125# flanges with chains and caps, including UL/FM butterfly isolation valve with tamper switch complete with wiring to alarm panel – by others
 - E. 3 brass 2.5" hose gate valve, NST angle (To be stored near pump)
 - F. Piping for the jockey pump, which includes two (2) OS&Y gate valves and a check valve, with necessary tees, elbows, and pipe tappings.
 - G. Mounting of all named equipment on an open I-Beam structural steel base.
 - H. All pressure-sensing lines are to be piped in hard type “L” copper or brass piping in Accordance with NFPA 20 guidelines.
 - I. Wiring between drivers and their controllers is to be in rigid conduit which is countersunk and run through the centers of the inner support members of the skid in accordance with OSHA safety recommendations and to provide the State with a professionally “finished” appearance to pump house.
 - J. UL/FM system wafer check valve, UL/FM system butterfly valve complete with tamper switch and wiring to alarm panel by contractor.

2.03 AUTOMATIC FIRE PUMP MOTOR CONTROLLER

- A. The fire pump controller shall be a UL/FM labeled combination manual and automatic type. Provide soft start controller with floor mounted start/stop push buttons, 0-300# pressure transducer, minimum run timer.
- B. The enclosure NEMA 2 floor mounted and meeting the requirements of the most recently mandated edition of NFPA 20 and shall be listed by Underwriters Laboratories and approved by Factory Mutual.
- C. The withstand rating of the controller shall not be less than 100,000 RMS Symmetrical at 460 volts.
- D. The controller shall include a motor rated combination isolating disconnect switch/circuit breaker, mechanically interlocked and operated with a single, externally mounted handle. When moving the handle from OFF to ON, the interlocking mechanism shall sequence the isolating disconnect switch ON first

and then the circuit breaker. When the handle is moved from ON to OFF, the mechanism shall sequence the circuit breaker open first, and then the isolating disconnect switch. The isolating disconnect switch and circuit breaker shall be mechanically interlocked so that the enclosure door cannot be opened with the handle in the ON position except by a hidden tool operated defeater mechanism.

- E. The controller shall have a minimum running period timer set for ten minutes. Terminals shall be provided to field convert the controller from automatic to manual shutdown.
- F. The controller shall have externally mounted, individual visual indicators for POWER AVAILABLE, LOW PRESSURE, LOCAL START, REMOTE START, DELUGE VALVE OPEN, PHASE FAILURE, PHASE REVERSAL, INTERLOCK ON, PUMP RUNNING, LOW ROOM TEMPERTURE, and RUN TIMER ON. The controller shall be supplied with duplicate individual PHASE FAILURE, PHASE REVERSAL, PUMP RUNNING, and LOW ROOM TEMPERTURE alarm contacts.
- G. The controller shall have a USB port for recording pressure.
- H. The power transfer switch shall be designed for use with Generator set emergency power source. Firetrol Model FTA950 Automatic power transfer switch for Generator back-up.
- I. The power transfer switch shall include a motor rated disconnect/isolating switch capable of interrupting the motor locked rotor current. The disconnect/isolating switch shall be mechanically interlocked so that the enclosure door cannot be opened with the handle in the ON position except by a hidden tool operated defeater mechanism.
- J. The transfer switch circuitry shall be capable of sensing both the normal power source and the emergency source. The normal power source pick up shall be set at 90% nominal voltage and 95% nominal frequency. All voltage sensing, frequency sensing, and time delays shall be field adjustable. The transfer signal shall be delayed for one second, delaying the transfer and engine start signals so as to override momentary normal power outages.
- K. The transfer switch shall have TRANSFER SWITCH NORMAL, TRANSFER SWITCH EMERGENCY, and EMERGENCY ISOLATING SWITCH OFF pilot lights, TEST, and SILENCE ALARM pushbuttons mounted on the flange of the enclosure. The transfer switch shall be electrically operated and mechanically held, and shall be capable of being operated by a manual transfer mechanism located on the switch.
- L. The transfer switch must be manufactured by the fire pump controller manufacturer and be in the same enclosure and rated for fire service.

2.04 JOCKEY PUMP MOTOR CONTROLLER

- A. The jockey pump controller is to be UL Listed, complete with pressure transducer, run period timer, fusible disconnect, Hand-Off-Automatic selector switch and a pressure switch in a wall mounted NEMA 2 enclosure. Provide jockey pump

controller to match available power supply same as the main fire pump or equivalent.

- B. Provide the following items:
1. Running period timer
 2. Control circuit transformer
 3. Pump operating pilot light
 4. Power available pilot light
 5. Digital display of pressure

2.05 VERTICAL TURBINE FIRE PUMP

- A. The fire-pumping system shall be designed to deliver 750 GPM when operating at 110 PSI using a 60HP Motor The pump shall also deliver not less than 150% of rated capacity at a pressure not less than 65% of rated pressure. Motor and pump speed shall not exceed 1750 RPM. Unit pressure shut-off head shall not exceed 140% of rated pressure. Supply power to the system shall be 460 Volts, 3 phase, 60 Hertz. Pump is to be a vertical turbine type for Fire Pump service constructed in accordance with NFPA-20, UL 448 and approved by U.L. and F.M..
- B. The water supply for the fire pump shall be from an aboveground concrete tank of 22,500 gallons.
- C. The total installed length of the pump from bottom of baseplate to bottom of suction inlet manifold shall be 13 feet. The pump discharge head assembly shall be cast iron and fitted with a discharge connection machined to ANSI 125/250 rating dimensions. The pump discharge head shall provide rigid mounting support for the complete pump assembly and for the vertical hollow shaft motor. The pump line shaft bearings shall be water lubricated by the water being pumped.
- D. Pump column pipe shall be in sections not longer than 10 feet each. Pump bowl assemblies shall include cast iron enameled bowls, cast bronze impellers and bowl lateral seal rings. Pump bowl assemblies shall be submerged as recommended in NFPA Pamphlet 20. Each pump shall be installed with a cast or fabricated nonferrous metal strainer having a free area of not less than four times the suction inlet area. Strainer openings shall be sized to restrict the passage of objects one-half inch sphere size.
- E. The pump driver shall be a vertical hollow shaft induction motor of horsepower shown on drawings. The motor locked rotor current shall not exceed the values stated in NFPA Pamphlet 20. The motor shall be constructed so that the total hydraulic and static thrust of the pump's rotating assembly can be carried by the motor thrust bearings. The motor shall mount directly on the pump discharge head assembly with a registered fit for correct shaft alignment. The motor shall be equipped with a top drive coupling and nut for axial adjustment of the pump impellers and shall have a non-reverse ratchet to prevent pump back-spin.

- F. The pump manufacturer shall furnish piping accessory items for the pump installation which will adapt the pump connections to the fire protection system and test connections as follows: Fire pump fittings which are subjected to pump discharge pressure shall be ANSI 125 250 pound rating.
- G. BOWLS:
1. ASTM A48 Class 30 cast iron, designed for maximum efficiency and long life. Pump shall consist of suction nozzle, bow assembly and discharge case for connecting to the discharge column pipe.
- H. IMPELLERS:
1. ASTM B584-636 bronze, enclosed type with non-overloading characteristics. All water passages shall be smooth surfaces. Impellers shall be fastened to pump shaft by means of ASTM AS62A I 655 collets or ASTM A582-303SS keys.
- I. BOWL WEAR RING:
1. ASTM B144 bronze secured to the bowl with a pressed fit and shall be renewable.
- J. PUMP SHAFT
1. Shall be ASTM AS82, Grade 416 stainless steel. Line shaft shall be the same.
2. Coordinate required length of shaft with drawings.
- K. BOTTOM BEARING:
1. ASTM 8505, alloy 836 bronze sleeve type fully enclosed in bearing shell provided with large grease reservoir. Bearing shall be packed with non-soluble grease or approved equal. A sand collar of ASTM B505-836 bronze shall be provided.
- L. INTERMEDIATE BEARING:
1. Furnish at each bowl assembly and shall be ASTM B505, alloy 836 bronze.
- M. LINE SHAFT BEARING:
1. Synthetic rubber, water lubricated bearings shall be used. The bearing shall be held in an ASTM A48, Class 30 cast iron spider cast integral with pipe coupling and fitted with a bronze bearing retaining ring. Bearings shall have a maximum spacing of 10'0".
- N. STUFFING BOX:
1. An ASTM A48, Class 30 cast iron stuffing box shall be provided containing an ASTM B505-836, bronze bearing, graphite impregnated backing with a bleed-off connection and grease lubricating connection to a lantern ring. A bronze, split type packing gland shall be employed. Separator rings shall be furnished between each ring of packing to prolong packing life.
- O. COLUMN PIPE:

1. Shall be ASTM A53 steel pipe having screwed coupled connections. Coordinate required length with drawings and provide required supports.

P. DISCHARGE HEAD AND MOTOR STAND:

1. Shall be ASTM A48 Class 30 cast iron, one-piece construction with a circular-mounting base. The top of the discharge head shall be machined with a rabbet fit to facilitate alignment of the motor and pump shaft. The height of the discharge head shall permit coupling the line shaft to the motor drive shaft above the stuffing box. The outlet flange shall be 125 pound ANSI standard flat face.

Q. STRAINER:

1. Bronze basket or cone type strainer is to be provided. The bowls and head shall be hydrostatically tested to twice the shut-off head, but not less than 250 PSI. The pump shall be given a complete laboratory performance test, recording not less than 5 points including shut-off head, dully point and 150% of rated capacity point at a head not less than 65% of rated head. Shut-off head shall not exceed 140% of rated head.

R. MOTOR:

1. Motor shall be vertical hollow shaft squirrel cage induction type with non-reverse ratchet and thrust bearings with minimum 2 year bearing life (10-year average) and momentary up-thrust protection. Motor shall be 75 HP 1750 RPM 460 volts 3 phase, 60 cycle ODP and not exceeding 600 volts. Enclosure shall be weather-protected type 1. The motor shall have a 1.15 service factor, Class B insulation with NEMA design B at design point. The motor locked rotor current shall not exceed the values as stated in NFPA 20.

2.06 JOCKEY PUMP

- A. The jockey pump is to be a Vertical Submersible Turbine jockey pump with mechanical seal. Designed for 15 GPM at 125 PSI, complete with a 3450 RPM, 2 HP motor vertical, and submersible motor. Motor voltage and phase are to be same available power supply same the main fire pump.

2.07 PREFABRICATED ENVIRONMENTAL ENCLOSURE

- A. Building Size shall be 12'-3" wide X 14' long X 9'-9" high. A clear height of 7'-8" shall be maintained within the room. Additional 2 feet wall space, wall openings and power feed is to be provided for suction tank electric heater (freeze prevention) control/status panel. Building is to be supplied complete with all necessary component parts, to form a complete building system and all parts shall be new and free from all defects or imperfections. The building width and length shall be measured from the outside of the building wall panels and the height of the building shall be the distance measured from the bottom surface of the base channel to the exterior juncture of the roof and sidewall panels and will require a building state certification.
- B. Factory exteriors color of building and roof to be Tan or White as selected by architect.

C. GENERAL

1. Environmental enclosures shall be constructed with prefabricated wall and ceiling panels formed to exact size as described below and manufactured by Kysor Panel Systems, Fort Worth, TX or Trachte, Oregon, WI or equivalent.

D. INSULATION

1. House shall be provided with 2 hour fire wall as required by NFPA 20. Insulation shall be 100% rigid urethane with an at temperature conductivity factor (K factor) not to exceed 0.128 Btu/hr. Urethane is to be poured in place with a density of 2.2 pounds per cubic foot. Overall coefficient of heat transfer (U factor) and R value to be as follows:
24 (Walls) and 34 (ceiling)
2. This insulation shall be a listed urethane with a rating of no more than 25 for flame spread and 450 for smoke developed per ASTM E84. This urethane shall also meet the ignition properties requirements of ASTM D-1929.

E. MODULAR PANEL CONSTRUCTION

1. All panels to be constructed with die-formed interior and exterior metal pans securely fastened to a perimeter frame of kiln dried spruce-pine-fir (SPF) specie, #2 grade lumber. Perimeter frame to feature tongue and groove profile for positive alignment and sealing. Panel shall be filled with poured-in-place urethane, securely bonded to metal pans and perimeter frame to create a rigid structural panel with a tough, resilient, shock-resisting surface. Provide standard panels, interchangeable, for ease of assembly. Provide special panels, if required, manufactured to the size required to obtain a specified building size. Provide pressure treated (Chemicals) perimeter bracing.

F. PANEL FASTENERS

1. Provide cam-lock fasteners to ensure a tight and positive seal, and reduce on-the-job installation time. Fastener material shall be steel housing, hook and pin with high-pressure die-cast zinc cam. Hardened steel hexagonal wrench is provided to tighten panel fasteners. The hook of the fastener shall engage over the pin when rotating the wrench and with cam-action, draw the panels tightly together. Polyethylene snap-in caps cover the wrench holes. Lock spacing shall not exceed 48" on center.

G. PANEL GASKETS

1. Each joint shall exhibit a polyvinyl chloride (PVC) bulb type; compression gasket to eliminate water vapor permeability. All gaskets are factory installed and require no additional handling. Gaskets shall be resistant to chemical corrosion and ultraviolet radiation. Gasket operating temperature shall be -34 degrees C to +71 degrees C (-30 degrees F to +160 degrees F).

H. FINISHES

1. Provide interior and exterior metal pans as follows:
Galvanized Steel: Tan Embossed 22 gauge or White as selected by Architect

I. METAL COMMERCIAL DOORS

1. Door shall be seamless, constructed of two face sheets of 18 gauge cold rolled steel, stretcher-leveled quality of flatness. Vertical edges of doors shall have neat hemmed edge seam mechanically interlocked for maximum structural integrity. All hinge reinforcements shall be of 8 gauge steel projection welded to door. Doors for exterior shall be 1-3/4" thick, 4'-0" x 7'-0".

Widths	: Sizes
X 7'-0" Double	: exhaust fan

2. The number of doors, their location and direction of swing is shown on the plans.
3. Standard frames shall be double rabbeted 16 gauge cold rolled steel. Frames shall be mitered, face welded and ground smooth. All hinge reinforcements shall be of 8 gauge steel projection welded to frame. Reinforcements for strike and surface mounted hardware shall be a minimum of 14 gauge. Frames shall be furnished with a factory installed rubber mutes, 3 per strike jamb.
4. Doors and frames shall be factory painted with one coat of baked on primer. All doors shall be preassembled in their frames and hardware installed and tested prior to shipment. Field installation of the door unit shall not require any frame assembly, door handling or hardware installation.
5. Provide door hardware, including non-removable pin butt hinges with individual lockset and accessories, for exterior doors as follows:
 - a) Hinges: 1-1/2" pair (per door), 4-1/2" x 4-1/2", stainless steel. (U.S. 32D), non-removable pins
 - b) Keyed lockset with storeroom function (US 32D).
 - c) Hasp & Staple: 7" extra heavy type, cadmium plated.
 - d) Head Bolt: 6" long with 24" chain, cadmium finish.
 - e) Foot Bolt: 6" long, cadmium finish.
 - f) Weatherstripping
 - g) Threshold: aluminum
 - h) Door stop and latch

J. ROOF HATCH

1. Roof hatch will be designed per the pump selection size.

K. COMPOSITE TESTING

1. Provide panel systems that meet the requirements of the following:

- (a) Flame spread and smoke developed per UL-723, ASTM E-84 and Chapter 26 of the International Building Code
- (b) Ignition properties per ASTM D-1929
- (c) Factory Mutual Standard 4894

L. REGULATIONS AND CODES

- 1. All work and materials shall be in full accordance with local and State Building Code. Provide all items required by the regulations and codes, but not necessarily specified herein or shown on the drawings.

M. CAULKING AND SEALANTS

- 1. Insulated panels shall be set on galvanized "Z" base trim, secured to concrete slab, with non-drying butyl caulking. All openings and penetrations through insulated panels shall be sealed with silicone sealant. Clean and degrease applicable surfaces.

N. INSTALLATION

- 1. Install in complete accordance with the manufacturer's printed instructions.

O. LOUVERS

- 1. Louvers shall be the "fixed" type with insect screen. Louver frame shall be made from 22 gauge galvanized steel. Louvers shall be horizontally centered and set into 47" insulated panels.

P. EXHAUST FANS

- 1. Provide manufacturer standard exhaust fan.

Q. ROOF SYSTEM

- 1. Provide a prefabricated roof system for the enclosure, complete with roof hatch, to provide a waterproof covering for insulated ceiling panels.
- 2. Roof system shall be galvanized standing seam, 22 gauge, 16 inches wide, sheet metal over ceiling panels with a slope of 1/4" per foot. Fasteners shall be corrosion resistant rubber washered Tek screws with length and strength required for metal to be fastened.
- 3. Provide an additional 2 feet extension of the roof for future installation of external electrical panels.

R. GUTTERS AND DOWNSPOUTS

- 1. Provide enclosure complete with gutters and downspouts, standard metal finishes to match the finish on the insulated panels.

S. EQUIPMENT SUPPORT BLOCKING

- 1. Provide all blocking as required to support pump equipment indicated. Coordinate with pump supplier.

T. SKID MOUNT

- 1. Provide steel skid mount, to receive pump system, ready for casting in concrete floor.

U. ELECTRICAL CONTINUITY

1. Grounding plate with threaded lugs and mechanically fastened continuity trim are available upon request.

V. WALL OPENINGS

1. The building manufacturing is to supply all necessary framing and connectors to structurally replace the panel removed by any wall or roof openings. The supplier of the unit being installed shall provide all trim and flashing required to make weather-tight the unit placed in any opening.

W. INSTALLED ACCESSORIES

1. (2) 3 1/2 KVA CFM space heaters with wall mounted thermostat (Each sized per local weather requirements for proper CFM) to handle full heating requirements in case of one unit failure.
2. (1) Motorized Damper
3. (1) Duplex battery powered interior emergency lighting
4. (1) Duplex wall mounted GFCI convenience outlet
5. (1) Overhead automatic sprinkler system with flow sensor per NFPA 13
6. (1) 100-amp service entrance rated disconnects provided and installed per NEC and NFPA 20.
7. (1) Exhaust Fan & Thermostat
8. (2) 100W Fluorescent Vapor Tight Lights
9. (6) 15 AMP Single Pole Circuit Breakers
10. Exterior 70 W High Pressure Sodium Wall Pack with Photocell
11. (1) Low Temperature Alarm wired to remote panel to be located in the office or as directed. Provide connection point in panel for connection to fire alarm system to send an alarm to the fire department central system, to notify fire department no heat. Coordinate all work with electrical contractor.
12. 6" solenoid and float operated diaphragm type fill valve to suction tank to be supplied. Control panel to be installed in enclosure.

X. FACTORY PREFABRICATION

1. All of the above equipment is to be mounted on an open I-Beam structural steel skid having recessed inner support members. All piping, pressure-sensing lines, shut off valves, stuffing box, and casing relief drain lines shall be firmly anchored to the steel base by means of structural steel supports. All electrical wiring between drivers and controller is to be ran in rigid conduit, countersunk and ran through the center of the inner support members of the skid.
 - (a) Coordinate with drawings for additional information.
2. All equipment shall be factory tested by the system manufacturer in accordance with NFPA 20, UL and FM prior to shipment. Additionally, the system manufacturer prior to shipment shall hydrostatically test the entire package. The unit shall be built and tested in an enclosed weatherproof shop and the manufacturer shall provide a certified X-Y plot test report prior to shipping of the system for engineering approval.

Y. THIRD PARTY CERTIFICATION

1. All packaged equipment shall be independently Third Party labeled as a system suitable for the intended use by a Nationally Recognized Testing Laboratory (NRTL) in accordance with OSHA Federal Regulations

29CFR1910.399 and NFPA 70, National Electric Code (NEC), Article 90-7.

2.08 ACCEPTABLE MANUFACTURERS

- A. Fire Pump
 - 1. Peerless Pump Company
 - 2. Patterson Pump
 - 3. Aurora Pump Company
 - 4. Or Approved Equal
- B. Jockey Pump
 - 1. Grundfos
 - 2. MTH Pumps
 - 3. Or Approved Equal
- C. Fire Pump Controllers, Jockey Pump Controllers, Automatic Transfer Switch
 - 1. Firetrol
 - 2. Cutler Hammer
 - 3. Hubbell
 - 4. Joslyn Clark
 - 5. Or Approved Equal

2.09 INSTALLATION

- A. Completely align and level pumps, motors and bases. Where pumps and motor are shipped as a unit, realign them in the field.
- B. Grout base plates completely to provide a non-deflecting support.
- C. Secure pumps to bases with proper size anchor bolts.
- D. Install and align mechanical seals in accordance with the manufacturer's recommendation.
- E. Pump manufacturer to set packing, adjust impellers and check alignment prior to start-up.
- F. Each concrete base (rectangular or 'T' shaped) for horizontally split pumps to include supports and base elbows for the suction and discharge connections. Base elbows to be bolted and grouted to the concrete foundation.

- G. Construct all apparatus of materials and pressure ratings suitable for the conditions encountered during continuous operation.
- H. Provide casing connections for vent, drain, suction and discharge pressure gauges.
- I. Balance impellers and all other moving components statically and dynamically.
- J. Match centrifugal pump impellers and casings so that at specified operating conditions the impeller diameter is not more than 90% of the maximum diameter impeller which can satisfactorily operate in the casing.
- K. Pumps must operate stably without pulsation, vibration or internal recirculation. Pump operating characteristics at the design point must be such that a variation of 10% in head results in not more than a 15% variations in gpm and does not affect the stability of operation of the pump.
- L. Select pumps so that when operating at rated RPM, the pump motor cannot be overloaded despite variations in pumping head.
- M. Coordinate all openings required for pump installations, access, etc. through pre-cast concrete top slab and walls as necessary with pre-cast supplier.

2.10 FACTORY TEST, FIELD ACCEPTANCE AND PERFORMANCE TEST

- A. All equipment will be factory tested in accordance with the requirements of N.F.P.A., U.L., and F.M. Additionally, the entire package system will be hydrostatically tested by the system manufacturer prior to shipment.
- B. The system manufacturer representative, shall be present and conduct the start up and field acceptance test. The pump, motor, and controller shall meet the intent of the specifications and outlines set forth in NFPA 20. Provide 5 man days minimum.
- C. Training shall be onsite instruction to State's representatives for system review and operation. A minimum of 5 (five) days' notice is to be given to the State to establish a time for this review. Provide 2 man days minimum.
- D. Fire pump manufacturer will be required to submit a notarized Certificate of Compliance certifying that all components of the fire pump unit were in fact supplied by the fire pump manufacturer and acknowledging its responsibility for the proper function of the unit.
- E. Submit operating instruction and maintenance manuals, complete with schematic wiring and diagram for the fire pump system, operating controls and maintenance data.

2.11 WARRANTY

- A. The standard manufacturer warranty shall be for full-value replacement for a minimum of two (2) years from the date the State approves/accepts the Contractor's Letter of Final Completion. The standard warranty shall include all

necessary routine maintenance on all equipment included in this prepurchase package.

- B. The pre-packaged fire pumping system and house shall have a guarantee in writing by the manufacturer for a period of 2 years from the date of substantial completion of the project against defect in design, material or construction. The Manufacturer shall provide a written Agreement which will include the desired warranty period and all preventive maintenance required during the warranty period of the equipment in order to comply with the Contract requirements.
- C. All equipment shall be new, of first-class material, and of a proven design. Workmanship shall be of the best quality, free from any defects that might render the equipment unsuitable or inefficient for the purpose for which it is to be used. The manufacturer shall guarantee that, during the construction phase, a qualified service representative will respond to the site within a maximum of four (4) hours of notification. The service person shall be capable of affecting all necessary repairs and restoring the system.
- D. Although the guarantee shall be enforceable as provided, no requirement of this Contract with respect to guarantees by the manufacturer shall be deemed to be a limitation upon any rights which the State would have, either expressed or implied, in the absence of such guarantees, the said guarantee being given only for the greater assurance of the State.

PART 3- EXECUTION (to be included in contract)

This part lists the work that will be the responsibility of the Contractor in order to complete the fire pump house installation.

3.01 GENERAL

- A. Contractor shall coordinate schedule of delivery with the fire pump house supplier
- B. Contractor shall unload the fire pump house from flat bed truck, lift and install fire pump house delivered to site by fire pump house supplier.
- C. Contractor shall set the house in place and secure it to the floor slab
- D. Contractor shall provide all required plumbing, electrical connections to the fire pump house
- E. Contractor to install supplied solenoid and float operated diaphragm type fill valve and provide all wiring to tank fill control panel.
- F. Contractor shall supply and install suction tank electric heater and coordinate space for panels and required openings for control panel and wiring.
- G. Contractor shall pour concrete for foundation pad
- H. Contractor shall provide steel diamond plated access hatch cover and frame for 3'x3' tank access. Cover shall be 2 pieces, hinged and airtight.

- I. Contractor to coordinate field test of the fire pump house done by fire pump supplier representative. The pump, motor, and controller shall meet the intent of the specifications and outlines set forth in NFPA 20.

END OF SECTION

SECTION 22 05 13

COMMON MOTOR REQUIRMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg. C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- C. Motors 1/20 HP and Smaller: Shaded-pole type.
- D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 22 05 13

SECTION 22 05 17

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes:** Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes:** ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves:** ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves:** ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves:** 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Carbon steel or Stainless steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system

components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves, Galvanized-steel wall sleeves or Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves, Galvanized-steel wall sleeves or Galvanized-steel-pipe sleeves.
2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6 : Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 22 05 17

SECTION 22 05 18

ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Final finish shall be approved by Architect/State.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.

- f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.
- 3.2 FIELD QUALITY CONTROL
- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 22 05 18

SECTION 22 05 19

METER AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.

1.2 ACTION SUBMITTALS

- ###### **A. Product Data:** For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- ###### **A. Product certificates.**

1.4 CLOSEOUT SUBMITTALS

- ###### **A. Operation and maintenance data.**

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- ###### **A. Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Inc.
2. Ernst Flow Industries.
3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Noshok.
7. Palmer Wahl Instrumentation Group.
8. REOTEMP Instrument Corporation.
9. Tel-Tru Manufacturing Company.
10. Trerice, H. O. Co.
11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

12. Weiss Instruments, Inc.
13. WIKA Instrument Corporation - USA.
14. Winters Instruments - U.S.
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F and deg C.
- E. Connector Type(s): Union joint, adjustable angle, rigid, back and rigid, bottom, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
 2. Standard: ASME B40.200.
 3. Case: Cast aluminum, 9 inch nominal size unless otherwise indicated.
 4. Case Form: Adjustable angle, Back angle or Straight unless otherwise indicated.
 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg. F and deg. C.
 7. Window: Glass.
 8. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.

10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ernst Flow Industries.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - g. Weiss Instruments, Inc.
 - h. WIKA Instrument Corporation - USA.
2. Standard: ASME B40.200.
3. Case: Plastic 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle, Back angle or Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg. F and deg. C.
7. Window: Glass.
8. Stem: Aluminum, brass, or stainless steel and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.

10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Terice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Liquid-filled or Sealed or Open-front, pressure relief or Solid-front, pressure relief types; cast aluminum or drawn steel 6-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal, Brass or Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Flo Fab Inc.
 - d. Marsh Bellofram.
 - e. Miljoco Corporation.
 - f. Noshok.
 - g. Palmer Wahl Instrumentation Group.
 - h. REOTEMP Instrument Corporation.
 - i. Tel-Tru Manufacturing Company.
 - j. Terice, H. O. Co.
 - k. Weiss Instruments, Inc.
 - l. WIKA Instrument Corporation - USA.
 - m. Winters Instruments - U.S.
 2. Standard: ASME B40.100.
 3. Case: Sealed type; plastic; 6-inch nominal diameter.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
 8. Pointer: Dark-colored metal.
 9. Window: Glass.
 10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
- C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.

- j. Tel-Tru Manufacturing Company.
 - k. Trerice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
- 2. Standard: ASME B40.100.
 - 3. Case: Liquid-filled or Sealed type; cast aluminum or drawn steel; 6-inch nominal diameter with back or front flange and holes for panel mounting.
 - 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
 - 8. Pointer: Dark-colored metal.
 - 9. Window: Glass.
 - 10. Ring: Metal or Stainless steel.
 - 11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
- D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Miljoco Corporation.
 - d. Noshok.
 - e. Palmer Wahl Instrumentation Group.
 - f. REOTEMP Instrument Corporation.
 - g. Tel-Tru Manufacturing Company.
 - h. Trerice, H. O. Co.
 - i. Weiss Instruments, Inc.
 - j. WIKA Instrument Corporation - USA.
 - k. Winters Instruments - U.S.
 - 2. Standard: ASME B40.100.
 - 3. Case: Sealed] type; plastic 6-inch nominal diameter with back or front flange and holes for panel mounting.
 - 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball or Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid or one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install thermometers in the following locations:
 1. Inlet and outlet of each water heater.
 2. Inlets and outlets of each domestic water heat exchanger.
 3. Inlet and outlet of each domestic hot-water storage tank.
 4. Inlet and outlet of each remote domestic water chiller.
- K. Install pressure gages in the following locations:
 1. Building water service entrance into building.
 2. Inlet and outlet of each pressure-reducing valve.

3. Suction and discharge of each domestic water pump.

- L. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- M. Adjust faces of meters and gages to proper angle for best visibility.

3.2 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Liquid-filled or Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
 - 1. Liquid-filled or Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
 - 1. Liquid-filled or Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- D. Thermometers at inlet and outlet of each remote domestic water chiller shall be one of the following:
 - 1. Liquid-filled or Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- E. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg. F
- B. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg. F

3.4 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be one of the following:
 - 1. Liquid-filled, Sealed, Open-front, pressure-relief or Solid-front, pressure-relief, direct or remote-mounted, metal case.
 - 2. Sealed, direct or remote-mounted, plastic case.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
 - 1. Liquid-filled, Sealed, Open-front, pressure-relief or Solid-front, pressure-relief, direct or remote-mounted, metal case.
 - 2. Sealed, direct or remote-mounted, plastic case.
- C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
 - 1. Liquid-filled, Sealed, Open-front, pressure-relief or Solid-front, pressure-relief, direct or remote-mounted, metal case.
 - 2. Sealed, direct or remote-mounted, plastic case.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 200 psi and 0 to 1400 kPa.
- B. Scale Range for Domestic Water Piping: 0 to 200 psi and 0 to 1400 kPa.

END OF SECTION 22 05 19

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron swing check valves with closure control.
7. Bronze gate valves.
8. Iron gate valves.
9. Bronze globe valves.
10. Iron globe valves.
11. Chainwheels.

B. Related Sections (where applicable):

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
3. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
4. Section 221423 "Storm Drainage Piping Specialties" for valves applicable only to this piping.

1.2 ACTION SUBMITTALS

- ###### **A. Product Data:** For each type of valve indicated.

1.3 QUALITY ASSURANCE

- ###### **A. ASME Compliance:** ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- ###### **B. NSF Compliance:** NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- ###### **A.** Refer to valve schedule articles for applications of valves.
- ###### **B. Valve Pressure and Temperature Ratings:** Not less than indicated and as required for system pressures and temperatures.

- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.

2.2 BRASS BALL VALVES

- A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kitz Corporation.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.
- B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.

- d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
- e. Hammond Valve.
- f. Jamesbury; a subsidiary of Metso Automation.
- g. Jomar International, LTD.
- h. Kitz Corporation.
- i. Legend Valve.
- j. Marwin Valve; a division of Richards Industries.
- k. Milwaukee Valve Company.
- l. NIBCO INC.
- m. Red-White Valve Corporation.
- n. RuB Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

C. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Hammond Valve.
- b. Jamesbury; a subsidiary of Metso Automation.
- c. Legend Valve.
- d. Marwin Valve; a division of Richards Industries.
- e. Milwaukee Valve Company.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Forged brass.

- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

2.3 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.

B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

C. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. DynaQuip Controls.
 - f. Hammond Valve.
 - g. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Regular.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Flo Fab Inc.
 - h. Hammond Valve.
 - i. Kitz Corporation.
 - j. Legend Valve.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Norriseal; a Dover Corporation company.
 - n. Red-White Valve Corporation.
 - o. Spence Strainers International; a division of CIRCOR International, Inc.
 - p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Flo Fab Inc.

- h. Hammond Valve.
 - i. Kitz Corporation.
 - j. Legend Valve.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Norriseal; a Dover Corporation company.
 - n. Red-White Valve Corporation.
 - o. Spence Strainers International; a division of CIRCOR International, Inc.
 - p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
- C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. American Valve, Inc.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - e. Crane Co.; Crane Valve Group; Center Line.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. DeZurik Water Controls.
 - h. Flo Fab Inc.
 - i. Hammond Valve.
 - j. Kitz Corporation.
 - k. Legend Valve.
 - l. Milwaukee Valve Company.
 - m. Mueller Steam Specialty; a division of SPX Corporation.
 - n. NIBCO INC.
 - o. Norriseal; a Dover Corporation company.

- p. Spence Strainers International; a division of CIRCOR International, Inc.
- q. Sure Flow Equipment Inc.
- r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- s.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated or -coated ductile iron.

D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. American Valve, Inc.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- e. Crane Co.; Crane Valve Group; Center Line.
- f. Crane Co.; Crane Valve Group; Stockham Division.
- g. DeZurik Water Controls.
- h. Flo Fab Inc.
- i. Hammond Valve.
- j. Kitz Corporation.
- k. Legend Valve.
- l. Milwaukee Valve Company.
- m. Mueller Steam Specialty; a division of SPX Corporation.
- n. NIBCO INC.
- o. Norriseal; a Dover Corporation company.
- p. Spence Strainers International; a division of CIRCOR International, Inc.
- q. Sure Flow Equipment Inc.
- r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.

- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated or -coated ductile iron.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.

- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

2.6 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Kitz Corporation.
- f. Legend Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.
- k. Sure Flow Equipment Inc.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.

- f. Trim: Bronze.
- g. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Composition.
 - g. Seat Ring: Bronze.
 - h. Disc Holder: Bronze.
 - i. Disc: PTFE or TFE.
 - j. Gasket: Asbestos free.

2.7 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and spring.

B. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.

- c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and weight.

2.8 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.

- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.9 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.

- f. Kitz Corporation.
- g. Legend Valve.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Powell Valves.
- k. Red-White Valve Corporation.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Legend Valve.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Powell Valves.
- k. Red-White Valve Corporation.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.

- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

2.10 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - j. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
 - d. Red-White Valve Corporation.
2. Description:
 - a. Standard: MSS SP-80, Type 2.

- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

2.11 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.12 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to butterfly valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.

4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for butterfly, gate and globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
 1. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 1. Shutoff Service: Ball, butterfly, or gate valves.
 2. Throttling Service: Globe or ball or butterfly, ball, or butterfly valves.
 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One or Two piece, full, regular or reduced port, brass or bronze with brass or bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze or ductile-iron disc.
3. Iron Swing Check Valves: Class 125, metal or nonmetallic-to-metal seats.
4. Iron Gate Valves: Class 125, NRS or OS&Y.

3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG)

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One or Two piece, full regular or reduced port, brass or bronze with brass or bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze or nonmetallic disc.
4. Bronze Gate Valves: Class 125, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze or ductile-iron disc.
3. Iron Swing Check Valves: Class 125, metal or nonmetallic-to-metal seats.
4. Iron Gate Valves: Class 125, NRS or OS&Y.

3.6 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: One or Two piece, full, regular or reduced port, brass or bronze with brass or bronze trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125, NRS.
6. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM or NBR seat, aluminum-bronze or ductile-iron disc.
3. Iron Swing Check Valves: Class 125, metal or nonmetallic-to-metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring weight.
5. Iron Gate Valves: Class 125, NRS or OS&Y.
6. Iron Globe Valves: Class 125.

3.7 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One or Two piece, full, regular or reduced port, brass or bronze with brass or bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, NRS.
5. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Swing Check Valves: Class 125, metal or nonmetallic-to-metal seats.
3. Iron Swing Check Valves with Closure Control: Class 125, lever and spring weight.
4. Iron Gate Valves: Class 125, NRS or OS&Y.
5. Iron Globe Valves: Class 125.

END OF SECTION 22 05 23

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- ###### **A. Delegated Design:** Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- ###### **B. Structural Performance:** Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.3 ACTION SUBMITTALS

- ###### **A. Product Data:** For each type of product indicated.
- ###### **B. Shop Drawings:** Signed and sealed by a qualified professional engineer (where required by authorities having jurisdiction). Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
 2. Equipment supports.
- ###### **C. Delegated-Design Submittal:** For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- ###### **A. Welding certificates.**

1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting.", Section 099123 "Interior Painting." And Section 099600 "High-Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg. F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.

7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 22 05 33

HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes plumbing piping heat tracing for freeze prevention, domestic hot-water-temperature maintenance, and snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables:
 - 1. Plastic insulated, series resistance.
 - 2. Self-regulating, parallel resistance.
- B. Related Requirements:
 - 1. Section 210533 "Heat Tracing for Fire-Suppression Piping."
 - 2. Section 230533 "Heat Tracing for HVAC Piping."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For electric heating cable.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLASTIC-INSULATED, SERIES-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Delta-Therm Corporation.
 - 2. Easy Heat; a division of EGS Electrical Group LLC.

3. Orbit Manufacturing.
 4. Pyrotenax; a brand of Tyco Thermal Controls LLC.
 5. Raychem; a brand of Tyco Thermal Controls LLC.
 6. WarmlyYours Inc.
 7. Watts Radiant, Inc.; a subsidiary of Watts Water Technologies, Inc.
- B. Comply with IEEE 515.1.
- C. Heating Element: Single- or dual-stranded resistor wire. Terminate with waterproof, factory-assembled, nonheating leads with connectors at both ends.
- D. Electrical Insulating Jacket: Minimum 4.0-mil Kapton with silicone, Tefzel, or polyolefin.
- E. Cable Cover: Aluminum braid and silicone or Hylar outer jacket.
- F. Maximum Operating Temperature (Power On): 300 deg. F.
- G. Maximum Exposure Temperature (Power Off): 185 deg. F.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics:
1. Maximum Heat Output: 7.5 W/ft..
 2. Piping Diameter: As shown on drawings or determined by calculations.
 3. Number of Parallel Cables: As shown on drawings or determined by calculations.
 4. Spiral Wrap Pitch: As determined by manufacturer.
 5. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: 120 or 208 or as specified on drawings.
 - b. Phase: As specified.
 - c. Hertz: As specified
 - d. Full-Load Amperes: As specified
 - e. Minimum Circuit Ampacity: As specified.
 - f. Maximum Overcurrent Protection: As specified.

2.2 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. BriskHeat.
 2. Chromalox.
 3. Delta-Therm Corporation.
 4. Easy Heat; a division of EGS Electrical Group LLC.
 5. Nelson Heat Trace; a division of EGS Electrical Group LLC.
 6. Pyrotenax; a brand of Tyco Thermal Controls LLC.

7. Raychem; a brand of Tyco Thermal Controls LLC.
 8. Thermon Americas Inc.
 9. Trasor Corp.
- B. Comply with IEEE 515.1.
- C. Heating Element: Pair of parallel No. 16 or No. 18 AWG, tinned or nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin.
- E. Cable Cover: Tinned-copper or Stainless-steel braid and polyolefin outer jacket with ultraviolet inhibitor.
- F. Maximum Operating Temperature (Power On): 150 deg. F.
- G. Maximum Exposure Temperature (Power Off): 185 deg. F.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics:
1. Maximum Heat Output: 12 W/ft.
 2. Piping Diameter: As shown on drawings or determined by calculations.
 3. Number of Parallel Cables: As shown on drawings or determined by calculations.
 4. Spiral Wrap Pitch: As determined by manufacturer.
 5. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: 120 or 208 or as specified on drawings.
 - b. Phase: As specified.
 - c. Hertz: As specified
 - d. Full-Load Amperes: As specified
 - e. Minimum Circuit Ampacity: As specified.
 - f. Maximum Overcurrent Protection: As specified.

2.3 CONTROLS

- A. Pipe-Mounted Thermostats for Freeze Protection:
1. Remote bulb unit with adjustable temperature range from 30 to 50 deg. F.
 2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
 3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
 4. Corrosion-resistant, waterproof control enclosure.
- B. Precipitation and Temperature Sensor for Snow Melting on Roofs and in Gutters:
1. Microprocessor-based or Automatic control with manual on, automatic, and standby/reset switch.

2. Precipitation and temperature sensors shall sense the surface conditions of roof and gutters and shall be programmed to energize the cable as follows:
 - a. Temperature Span: 34 to 44 deg. F.
 - b. Adjustable Delay-Off Span: 30 to 90 minutes.
 - c. Energize Cables: Following two-minute delay if ambient temperature is below set point and precipitation is detected.
 - d. De-Energize Cables: On detection of a dry surface plus time delay.
3. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.
4. Minimum 30-A contactor to energize cable or close other contactors.
5. Precipitation sensor shall be freestanding.
6. Provide relay with contacts to indicate operational status, on or off, for interface with central HVAC control-system workstation.

C. Programmable Timer for Domestic Hot-Water-Temperature Maintenance:

1. Microprocessor based.
2. Minimum of four separate schedules.
3. Minimum 24-hour battery carryover.
4. On-off-auto switch.
5. 365-day calendar with 20 programmable holidays.
6. Relays with contacts to indicate operational status, on or off, and for interface with central HVAC control-system workstation.

2.4 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Section 220553 "Identification for Plumbing Piping and Equipment."
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Install the following types of electric heating cable for the applications described:
 1. Snow and Ice Melting on Roofs and in Gutters and Downspouts: Plastic-insulated, series-resistance or Self-regulating, parallel-resistance heating cable.

2. Temperature Maintenance for Domestic Hot Water: Self-regulating, parallel-resistance heating cable.

3.2 INSTALLATION

- A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
- B. Electric Heating-Cable Installation for Snow and Ice Melting on Roofs and in Gutters and Downspouts: Install on roof and in gutters and downspouts with clips furnished by manufacturer that are compatible with roof, gutters, and downspouts.
- C. Electric Heating-Cable Installation for Freeze Protection for Piping:
 1. Install electric heating cables after piping has been tested and before insulation is installed.
 2. Install electric heating cables according to IEEE 515.1.
 3. Install insulation over piping with electric cables according to Section 220719 "Plumbing Piping Insulation."
 4. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- D. Electric Heating-Cable Installation for Temperature Maintenance for Domestic Hot Water:
 1. Install electric heating cables after piping has been tested and before insulation is installed.
 2. Install insulation over piping with electric heating cables according to Section 220719 "Plumbing Piping Insulation."
 3. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- E. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 2. Test cables for electrical continuity and insulation integrity before energizing.
 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- C. Cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Remove and replace damaged heat-tracing cables.

END OF SECTION 22 05 33

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.2 ACTION SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg. F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red or as specified by architect/required by Authority having jurisdiction.
- C. Background Color: White or as specified by architect/required by Authority having jurisdiction.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg. F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting." And Section 099600 "High-Performance Coatings."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule (authority have jurisdiction shall take precedence if applicable):
 - 1. Low-Pressure, Compressed-Air Piping:
 - a. Background Color: Red.
 - b. Letter Color: White.
 - 2. Medium-Pressure, Compressed-Air Piping:
 - a. Background Color: White.
 - b. Letter Color: Red.
 - 3. Domestic Water Piping:
 - a. Background Color: Blue.
 - b. Letter Color: White.
 - 4. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: White.
 - b. Letter Color: Black.

END OF SECTION 22 05 53

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic hot-water piping.
2. Domestic recirculating hot-water piping.
3. Sanitary waste piping exposed to freezing conditions.
4. Storm-water piping exposed to freezing conditions.
5. Roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals (NONE)

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Pittsburgh Corning Corporation; Foamglas.

2. Special-Shaped Insulation: ASTM C 552, Type III.
 3. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 4. Preformed Pipe Insulation with Factory-Applied [ASJ] [ASJ-SSL]: Comply with ASTM C 552, Type II, Class 2.
 5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Aeroflex USA, Inc.; Aerocel.

Armacell LLC; AP Armaflex.

K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Fibrex Insulations Inc.; Coreplus 1200.

Johns Manville; Micro-Lok.

Knauf Insulation; 1000-Degree Pipe Insulation.

Manson Insulation Inc.; Alley-K.

Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg. F (454 Deg. C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Armacell LLC; Tubolit.

Nomaco Insulation; IMCOLOCK and NOMALOCK.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg. F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Aeroflex USA, Inc.; Aero seal.

Armacell LLC; Armaflex 520 Adhesive.

Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.

K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.

Eagle Bridges - Marathon Industries; 225.

Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.

Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

Eagle Bridges - Marathon Industries; 225.

Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.

Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Dow Corning Corporation; 739, Dow Silicone.

Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

P.I.C. Plastics, Inc.; Welding Adhesive.

Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.

Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.

Eagle Bridges - Marathon Industries; 550.

Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.

Mon-Eco Industries, Inc.; 55-50.

Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg. F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

Eagle Bridges - Marathon Industries; 405.

Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.

Mon-Eco Industries, Inc.; 44-05.

Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg. F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:

Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

Eagle Bridges - Marathon Industries; 405.

Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.

Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg. F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg. F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
Johns Manville; Zeston.
P.I.C. Plastics, Inc.; FG Series.
Proto Corporation; LoSmoke.
Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: Color-code jackets based on system. Color as selected by Architect.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.

ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.

RPR Products, Inc.; Insul-Mate.

2. Sheet and roll stock ready for shop or field sizing.
3. Finish and thickness are indicated in field-applied jacket schedules.
4. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick polysurlyn.
5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- (0.063-mm-) thick polysurlyn.
6. Factory-Fabricated Fitting Covers:

Same material, finish, and thickness as jacket.

Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.

Tee covers.

Flange and union covers.

End caps.

Beveled collars.

Valve covers.

Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

Pittsburgh Corning Corporation; Pittwrap.

Polyguard Products, Inc.; Insulrap No Torch 125.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

ABI, Ideal Tape Division; 428 AWF ASJ.

Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.

Compac Corporation; 104 and 105.

Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

ABI, Ideal Tape Division; 491 AWF FSK.

Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.

Compac Corporation; 110 and 111.

Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

ABI, Ideal Tape Division; 370 White PVC tape.

Compac Corporation; 130.

Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

ABI, Ideal Tape Division; 488 AWF.

Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.

Compac Corporation; 120.

Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

ITW Insulation Systems; Gerrard Strapping and Seals.

RPR Products, Inc.; Insul-Mate Strapping and Seals.

- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

- C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

C & F Wire.

2.11 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Engineered Brass Company.

Insul-Tect Products Co.; a subsidiary of MVG Molded Products.

McGuire Manufacturing.

Plumberex.

Truebro; a brand of IPS Corporation.

Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Truebro; a brand of IPS Corporation.

Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating

cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- #### A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water: Insulation shall be the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 3. Polyolefin: 1 inch thick.
- B. Stormwater and Overflow: Insulation shall be the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 3. Polyolefin: 1 inch thick.
- C. Roof Drain and Overflow Drain Bodies: Insulation shall be the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 3. Polyolefin: 1 inch thick.
- D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be[one of] the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 3. Polyolefin: 1 inch thick.
- E. Sanitary Waste Piping Where Heat Tracing Is Installed: Mineral-fiber, preformed pipe insulation, Type I, 1-1/2 inches thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping: Insulation shall be the following:
 - 1. Cellular Glass: 2 inches thick.
 - 2. Flexible Elastomeric: 2 inches thick.
 - 3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - 4. Polyolefin: 2 inches thick.
- B. Domestic Hot and Recirculated Hot Water: Insulation shall be[one of] the following:

1. Cellular Glass: 2 inches thick.
 2. Flexible Elastomeric: 2 inches thick.
 3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 4. Polyolefin: 2 inches thick.
- C. Sanitary Waste Piping Where Heat Tracing Is Installed: Insulation shall be [one of] the following:
1. Cellular Glass: 2 inches thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. PVC, Color-Coded by System: 30 mils thick.
 2. Aluminum, Smooth, Corrugated or Stucco Embossed: 0.040 inch thick.
- D. Piping, Exposed:
 1. PVC, Color-Coded by System: 30 mils thick.
 2. Aluminum, Smooth, Corrugated or Stucco Embossed: 0.040 inch thick.

3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. PVC, Color-Coded by System: 30 mils thick.
 2. Aluminum, Smooth, Corrugated or Stucco Embossed: 0.040 inch thick.
- D. Piping, Exposed:
 1. PVC: 40 mils thick.
 2. Painted Aluminum, Smooth, Corrugated or Stucco Embossed with Z-Shaped Locking Seam: 0.032 inch thick.

3.17 CRAWLSPACE, UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. Provide with PITTWRAP® Jacketing - a 3 mm (125 mil) thick heat sealed high polymer asphalt membrane with an integral glass scrim and an integral 0.02 mm (1 mil) aluminum foil and a thin Mylar film on the surface. Where the pipe and insulation diameter permits, the insulation should be provided with a factory-applied jacket. Where freezing conditions are anticipated during installation, refer to product data sheet for application procedure.

- B. On any service in marine environment, very wet soils, and repeated soaking environments, the system is to have a second layer of the appropriate PITTWRAP®Jacketing field applied over the first, with staggered laps and Joints.
- C. Apply sections of factory or pre-jacketed insulation to the pipe with insulation butt joints tight and the jacket lap positioned as recommended. For self-sealing jackets, the jacket lap will face down see Product Data sheet FI-283.
- D. Remove the release paper from the lap and firmly and securely press the lap into place making certain to avoid wrinkles and fish mouths. The lap shall then be further sealed using a rolling device such as a wallpaper roller. Rotate the insulation section so that the lap end is facing down in the 10 or 2 o'clock position.
- E. Apply successive sections of pre-jacketed insulation in the same manner with the insulation sections tightly butted to the previous section and the jacket laps in line.
- F. Apply butt strips as per section I. Instructions are also included on the self-seal jacketing product data sheets.
- G. If the insulation jacket is to be field applied, the FOAMGLAS® insulation shall be installed with the longitudinal insulation joints straight up and down (at the 12 and 6 o'clock position). Insulation shall be applied with no joint sealant. All insulation joints shall be tightly butted.
- H. Seal the jacket lap as described in section D.
- I. Install 102 mm (4 in.) wide butt strips of the same jacketing material being used on the insulation sections, to all butt joints. When applying the butt strips, line up the longitudinal joints of the jacketing sections. Remove the release paper from the butt strip and start the butt strip application by embedding it onto the joint. Finish by wrapping the butt strip all the way around the butt joint and overlap it over the bead. Use the same roller procedure as mentioned in section D above to secure the butt strip in place.
- J. All fittings shall be finished using the same five-layer procedure (see manufacturer requirement) above with one exception. Instead of using a torch to flash off the Mylar film on the surface of the jacket, a "reverse butt strip procedure" shall be used. The reverse butt strip procedure is as follows:
 - 1. Terminate the jacket a distance of 102 mm (4 in.) preceding any fitting such that 102 mm (4 in.) of insulation is exposed.
 - 2. Remove the release paper from a full butt strip and apply it to the insulation such that the adhesive (butyl) side of the strip is facing up. Line up the longitudinal laps of the installed reversed butt strip and the abutting section of jacketing as though it were two sections of jacket in a normal run.
 - 3. Install a butt strip by the same procedure as in Section 5.9 above. This will allow 51mm (2 in.) of exposed butyl to facilitate bonding of the mastic to the jacket.
 - 4. Follow the procedure by manufacture for mastic and fabric finish application.
- K. Inspect the insulation system to be certain there are no openings, folds, wrinkles, or pinholes in the jacketing or the mastic finish.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

1.2 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.
- B. LEED Submittals (NONE)

1.3 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.
- G. Copper Pressure-Seal-Joint Fittings:
 - 1. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
 - 2. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

H. Copper Push-on-Joint Fittings:

1. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
2. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe:

1. ASTM A 53/A 53M, Type E, Grade B, Standard Weight.
2. Include ends matching joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.

C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Malleable-Iron Unions:

1. ASME B16.39, Class 150.
2. Hexagonal-stock body.
3. Ball-and-socket, metal-to-metal, bronze seating surface.
4. Threaded ends.

E. Flanges: ASME B16.1, Class 125, cast iron.

2.5 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.

2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.6 TRANSITION FITTINGS

- A. General Requirements:
 1. Same size as pipes to be joined.
 2. Pressure rating at least equal to pipes to be joined.
 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International.
 - e. Matco-Norca.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
 2. Standard: ASSE 1079.
 3. Pressure Rating: 125 psig minimum at 180 deg F or 150 psig (1035 kPa) or as required by system.
 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a division of Watts Water Technologies, Inc.

- e. Wilkins; a Zurn company.
 2. Standard: ASSE 1079.
 3. Factory-fabricated, bolted, companion-flange assembly.
 4. Pressure Rating: 125 psig minimum at 180 deg F or 150 psig (1035 kPa) or as required by system.
 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Nonconducting materials for field assembly of companion flanges.
 3. Pressure Rating: 150 psig or as required by system.
 4. Gasket: Neoprene or phenolic.
 5. Bolt Sleeves: Phenolic or polyethylene.
 6. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
 2. Standard: IAPMO PS 66.
 3. Electroplated steel nipple complying with ASTM F 1545.
 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 5. End Connections: Male threaded or grooved.
 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples, nipples and unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 : Use dielectric flanges, flange kits or nipples.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
- 1. Soft copper tube, ASTM B 88, Type K : wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
- 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be the following:
- 1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- G. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
- 1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M ; cast-or wrought-copper, solder-joint fittings; and brazed or soldered joints.
 - 3. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M ; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 4. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper push-on-joint fittings; and push-on joints.
- H. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
- 1. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M ; cast- or wrought-copper, solder-joint fittings; and brazed joints.
 - 2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M ; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 3. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; grooved-joint, copper-tube appurtenances; and grooved joints.
 - 4. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
- I. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; cast-or wrought-copper, solder-joint fittings; and brazed or soldered joints.
 2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; grooved-joint, copper-tube appurtenances; and grooved joints.
 3. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
- J. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12 , shall be one of the following:
1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
 2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

END OF SECTION 22 11 16

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer valves.

B. Related Requirements (where applicable):

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 224713 "Drinking Fountains" for water filters for water coolers.

1.2 ACTION SUBMITTALS

- ###### **A. Product Data:** For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- ###### **A. Field quality-control reports.**

1.4 CLOSEOUT SUBMITTALS

- ###### **A. Operation and maintenance data.**

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze or Chrome plated.

- B. Hose-Connection Vacuum Breakers:

1. Standard: ASSE 1011.
2. Body: Bronze, nonremovable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Chrome or nickel plated, or Rough bronze.

2.4 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/2 or NPS 3/4.
4. Body: Bronze.
5. End Connections: Union, solder joint.
6. Finish: Chrome plated or Rough bronze.

- B. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Size: as per drawings.
5. Design Flow Rate: as per system requirement.

6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight-through, vertical-inlet, horizontal-center-section, and vertical-outlet or vertical flow.
9. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies:

1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications unless otherwise indicated.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Size: as per drawings.
5. Design Flow Rate: as per system requirements.
6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. Honeywell International Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: as per drawings.

5. Design Flow Rate: as per system requirements.
6. Design Inlet Pressure: as per system requirements.
7. Design Outlet Pressure Setting: as per system requirements.
8. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO Inc.
 - h. Red-White Valve Corp.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. Honeywell International Inc.

- e. Legend Valve.
- f. Leonard Valve Company.
- g. Powers; a division of Watts Water Technologies, Inc.
- h. Symmons Industries, Inc.
- i. TACO Incorporated.
- j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: as per drawing.
9. Tempered-Water Design Flow Rate: as per system requirement.
10. Valve Finish: Chrome plated or Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a division of Watts Water Technologies, Inc.
 - e. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted or Cabinet-type, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: as per drawing.
9. Tempered-Water Design Flow Rate: as per system requirement.
10. Valve Finish: Chrome plated, Polished, chrome plated or Rough bronze.
11. Piping Finish: Chrome plated or Copper.

12. Cabinet: Factory fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch to 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch to 0.062 inch.
 - c. Strainers NPS 5 and Larger: 0.10 inch to 0.125 inch.
6. Drain: Factory-installed, hose-end drain valve.

2.9 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle or Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Standard: ASME A112.21.3M for concealed or exposed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
5. Inlet: NPS 3/4 or NPS 1.
6. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Polished nickel bronze or Chrome plated.
9. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
10. Nozzle and Wall-Plate Finish: Polished nickel bronze or Rough bronze.
11. Operating Keys(s): Two with each wall hydrant.

B. Nonfreeze, Hot- and Cold-Water Wall Hydrants:

1. Standard: ASME A112.21.3M for concealed or exposed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamps.
5. Inlet: NPS 3/4 or NPS 1.
6. Outlet: Concealed.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Polished nickel bronze or Chrome plated.
9. Vacuum Breaker:
 - a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7 on outlet.
10. Operating Keys(s): Two with each wall hydrant.

C. Vacuum Breaker Wall Hydrants:

1. Standard: ASSE 1019, Type A or Type B.
2. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
3. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
4. Pressure Rating: 125 psig (860 kPa).
5. Operation: Loose key or wheel handle.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 1/2 or NPS 3/4.

8. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products, Inc.

- c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
- B. Drainage-Type, Trap-Seal Primer Device:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
 3. Size: NPS 1-1/4 minimum.
 4. Material: Chrome-plated, cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install balancing valves in locations where they can easily be adjusted.
- D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve and pump.
- F. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.

- G. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.
- H. Install water-hammer arresters in water piping according to PDI-WH 201.
- I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- J. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

3.4 DOMESTIC WATER PIPING SPECIALTIES WILL BE CONSIDERED DEFECTIVE IF THEY DO NOT PASS TESTS AND INSPECTIONS.

- A. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 21 11 19

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Section:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance:** Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.3 ACTION SUBMITTALS

- A. Product Data:** For each type of product indicated.
- B. LEED Submittals (NONE)**

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates:** For waste and vent piping, accessories, and components, from manufacturer.
1. **Basis for Certification:** Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.**

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.**

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.**

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company; a division of MCP Industries, Inc.
 - g. Stant.
 - h. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Stant.
 - g. Tyler Pipe.
- 2. Standards: ASTM C 1277 and ASTM C 1540.
- 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- K. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger or as determined by local authority having jurisdiction or indicated in drawings.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- N. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.5 VALVE INSTALLATION

- A. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.

2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
 5. NPS 6: 10 feet with 5/8-inch rod.
 6. NPS 8: 10 feet with 3/4-inch rod.
- I. Install supports for vertical copper tubing every 10 feet.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
 - 6. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and larger shall be the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty cast-iron hubless-piping couplings; and coupled joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 and larger shall be the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty cast-iron hubless-piping couplings; coupled joints.
 3. PVC piping in first subparagraph below is limited in size to NPS 12 (DN 300).
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 13 16

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Floor drains.
 - 4. Roof flashing assemblies.
 - 5. Miscellaneous sanitary drainage piping specialties.
 - 6. Flashing materials.
 - 7. Grease interceptors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.14.1.
 - 3. Size: Same as connected piping.
 - 4. Body: Cast iron.
 - 5. Cover: Cast iron with bolted or threaded access check valve.

6. End Connections: Hub and spigot or hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition].
8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Size: Same as floor drain outlet.
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

2.2 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass or cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.

- c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing, threaded, adjustable housing cleanout.
 3. Size: Same as connected branch.
 4. Type: Heavy-duty, adjustable housing or Threaded, adjustable housing.
 5. Body or Ferrule: Cast iron.
 6. Clamping Device: Required.
 7. Outlet Connection: Spigot or Threaded.
 8. Closure: Brass plug with straight threads and gasket, Brass plug with tapered threads or Cast-iron plug.
 9. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, Painted cast iron, Polished bronze or Rough bronze.
 11. Frame and Cover Shape: Round.
 12. Top Loading Classification: Heavy Duty or as specified.
 13. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.36.2M. Include wall access.
 3. Size: Same as connected drainage piping.
 4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 5. Closure: Countersunk or raised-head or drilled-and-threaded, brass or cast-iron plug.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 7. Wall Access: Round, deep, chrome-plated bronze or flat, chrome-plated brass or stainless-steel cover plate with screw.

8. Wall Access: Round or Square, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Seepage Flange: where required for floor type/construction.
4. Anchor Flange: where required for floor type/construction
5. Clamping Device: where required for floor type/construction
6. Outlet: Bottom or Side.
7. Backwater Valve: Drain-outlet type
8. Coating in first subparagraph below is usually used only on sanitary floor drains.
9. Coating on Interior and Exposed Exterior Surfaces: [Acid-resistant enamel]
10. Sediment Bucket: Required.
11. Top or Strainer Material: Bronze, Gray iron or Nickel bronze.
12. Top of Body and Strainer Finish: Nickel bronze, Polished bronze or Rough bronze.
13. Top Shape: Round or Square.
14. Top Loading Classification: Heavy Duty unless specified otherwise.
15. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection where required.
16. Trap Material: Bronze, Cast iron.
17. Trap Pattern: Standard P-trap.
18. Trap Features: Cleanout and trap-seal primer valve drain connection where required.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 1. Open-Top Vent Cap: Without cap.
 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains :

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS ½ side inlet.

D. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.

2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.6 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.7 GREASE INTERCEPTORS

A. Grease Interceptors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Applied Chemical Technology, Incorporated.
 - b. Highland Tank
 - c. Josam Company; Josam Div.
 - d. MIFAB, Inc.
 - e. Rockford Sanitary Systems, Inc.
 - f. Schier Products Company.
 - g. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - h. Tyler Pipe; Wade Div.
 - i. Watts Drainage Products Inc.
 - j. Zurn Plumbing Products Group; Light Commercial Operation.
 - k. Zurn Plumbing Products Group; Specification Drainage Operation.
 - l. Ashland Trap Distribution Co.

- m. Bio-Microbics, Inc.
 - n. Canplas LLC.
 - o. Schier Products Company.
 - p. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASME A112.14.3 and PDI-G101, for intercepting and retaining fats, oils, and greases from food-preparation or processing wastewater.
 3. Plumbing and Drainage Institute Seal: Required.
 4. Body Material: Cast iron or steel
 5. Interior Lining: Corrosion-resistant enamel.
 6. Exterior Coating: Corrosion-resistant enamel.
 7. Mounting: Above floor, Recessed in acid-resistant, coated steel frame and cradle or Recessed, flush with floor.
 8. Flow-Control Fitting: Required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.

- c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Assemble open drain fittings and install with top of hub 2 inches above floor.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
- 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- M. Install vent caps on each vent pipe passing through roof.
- N. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
- 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 - 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 - 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- O. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

SECTION 22 13 29

SANITARY SEWERAGE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submersible sewage pumps.
2. Wet-pit-volute sewage pumps.
3. Sewage-pump basins and basin covers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SEWAGE PUMPS

A. Submersible, Fixed-Position, Single-Seal Sewage Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Barnes; Crane Pumps & Systems.
 - b. Bell & Gossett Domestic Pump; ITT Corporation.
 - c. EBARA Fluid Handling.
 - d. Federal Pump Corp.
 - e. Flo Fab inc.
 - f. Goulds Pumps; ITT Corporation.
 - g. Grundfos Pumps Corp.
 - h. ITT Flygt Corporation.
 - i. Liberty Pumps.

- j. Little Giant Pump Co.
 - k. McDonald, A. Y. Mfg. Co.
 - l. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
 - m. Peerless Pump, Inc.
 - n. Pentair Pump Group; Hydromatic Pumps.
 - o. Pentair Pump Group; Myers.
 - p. Swaby Manufacturing Company.
 - q. Weil Pump Company, Inc.
 - r. Weinman Division; Crane Pumps & Systems.
 - s. WILO-EMU USA LLC.
 - t. Zoeller Company.
2. Description: Factory-assembled and -tested sewage-pump unit.
 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
 4. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 5. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron, ASTM A 532/A 532M, abrasion-resistant cast iron or ASTM B 584, cast bronze and stainless steel, nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
 6. Pump and Motor Shaft: Stainless steel or steel, with factory-sealed, grease-lubricated ball bearings.
 7. Seal: Mechanical.
 8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: Air or Oil.
 9. Controls:
 - a. Enclosure: NEMA 250, Type (as required by project).
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 10. Controls:
 - a. Enclosure: NEMA 250, Type as required by project; pedestal or wall-mounted.
 - b. Switch Type: Mechanical-float, Mercury-float or Pressure type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.

- c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
- d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

11. Control-Interface Features:

- a. Remote Alarm Contacts: For remote alarm interface.
- b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

B. Submersible, Quick-Disconnect, Double-Seal Sewage Pumps:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABS Pumps Inc.
 - b. Barnes; Crane Pumps & Systems.
 - c. Bell & Gossett Domestic Pump; ITT Corporation.
 - d. BJM Pumps, LLC.
 - e. Chicago Pump Company; a division of Yeomans Chicago Corporation.
 - f. EBARA Fluid Handling.
 - g. E.I.M. Electric Co., Ltd.
 - h. Federal Pump Corp.
 - i. Gorman-Rupp Company (The).
 - j. Goulds Pumps; ITT Corporation.
 - k. HOMA Pump Technology Inc.
 - l. ITT Flygt Corporation.
 - m. KSB Inc.
 - n. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
 - o. Pentair Pump Group; Fairbanks Morse.
 - p. Pentair Pump Group; Hydromatic Pumps.
 - q. Pentair Pump Group; Myers.
 - r. PX Pumps USA.
 - s. Stancor, Inc.
 - t. Sta-Rite Industries, Inc.
 - u. Swaby Manufacturing Company.
 - v. Tsurumi America, Inc.
 - w. Weil Pump Company, Inc.

- x. Weinman Division; Crane Pumps & Systems.
 - y. WILO-EMU USA LLC.
 - z. Zoeller Company.
2. Description: Factory-assembled and -tested sewage-pump unit with guide-rail supports.
 3. Pump type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
 4. Pump Casing: Cast iron, with open inlet, and discharge fittings for connection to guide-rail support.
 5. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron or ASTM A 532/A 532M, abrasion-resistant cast iron or ASTM B 584, cast bronze and stainless steel, nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
 6. Pump and Motor Shaft: Stainless steel or steel, with factory-sealed, grease-lubricated ball bearings.
 7. Seals: Mechanical.
 8. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
 9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: Air or Oil.
 10. Controls:
 - a. Enclosure: NEMA 250, Type as required by project.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 11. Controls:
 - a. Enclosure: NEMA 250, Type as required by project; pedestal or wall-mounted.
 - b. Switch Type: Mechanical-float, Mercury-float or Pressure type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 12. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.

2) Alarm status.

13. Guide-Rail Supports:

- a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
- b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
- c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
- d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
- e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
- f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
- g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

C. Capacities and Characteristics (as specified on drawings):

1. Each Pump:
 - a. Solids Handling Capability: 2-1/2 inches minimum where applicable.

2.2 WET-PIT-VOLUTE SEWAGE PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alyan Pump Company.
2. Armstrong Pumps Inc.
3. Chicago Pump Company; a division of Yeomans Chicago Corporation.
4. Federal Pump Corp.
5. Flo Fab inc.
6. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
7. Peerless Pump, Inc..
8. Pentair Pump Group; Aurora Pump.
9. Swaby Manufacturing Company.
10. Tramco Pump Company.
11. Vertiflo Pump Company.
12. Weil Pump Company, Inc.
13. Weinman Division; Crane Pumps & Systems.
14. Yeomans Chicago Corporation.

B. Description: Factory-assembled and -tested sewage-pump unit.

C. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.

D. Pump Casing: Cast iron, with open inlet and threaded or flanged connection for discharge piping.

- E. Pump Shaft: Stainless-steel and steel.
- F. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron, ASTM A 532/A 532M, abrasion-resistant cast iron and ASTM B 584, cast bronze, nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
- G. Sleeve Bearings: Bronze. Include oil-lubricated, intermediate sleeve bearings at 48-inch maximum intervals if basin depth is more than 48 inches, and grease-lubricated, ball-type thrust bearings.
- H. Pump and Motor Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- I. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class 125, cast-iron flanges and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings.
- J. Support Plate: Cast iron or coated steel and strong enough to support pumps, motors, and controls. Refer to Part 2 "Sewage-Pump Basins and Basin Covers" Article for requirements.
- K. Shaft Seal: Stuffing box, with graphite-impregnated braided-yarn rings and bronze packing gland.
- L. Motor: Single-speed; grease-lubricated ball bearings and mounted on vertical, cast-iron pedestal.
- M. Controls:
 - 1. Enclosure: NEMA 250, Type as required by project.
 - 2. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.
 - 5. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- N. Controls:
 - 1. Enclosure: NEMA 250, Type as required by project. Pedestal or wall-mounted.
 - 2. Switch Type: Mechanical-float, Mercury-float or Pressure type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- O. Control-Interface Features:
 - 1. Remote Alarm Contacts: For remote alarm interface.
 - 2. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a. On-off status of pump.
 - b. Alarm status.
- P. Capacities and Characteristics (as specified on drawings):
 - a. Solids Handling Capability: 2-1/2 inches minimum.

2.3 SEWAGE-PUMP BASINS AND BASIN COVERS

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
 - 1. Material: Cast iron or Fiberglass.
 - 2. Reinforcement: Mounting plates for pumps, fittings, guide-rail supports if used, and accessories.
 - 3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 - 1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.
- C. Capacities and Characteristics (as specified on drawings):
 - 1. Cover Material: Cast iron or steel with bituminous coating.

2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation and filling are specified in Section 312000"Earth Moving."

3.2 INSTALLATION

- A. Pump Installation Standard: Comply with HI 1.4 for installation of centrifugal pumps.

END OF SECTION 22 13 29

SECTION 22 14 13

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

- ###### **A. Seismic Performance:** Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.3 ACTION SUBMITTALS

- ###### **A. Product Data:** For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 INFORMATIONAL SUBMITTALS

- ###### **A. Seismic Qualification Certificates:** For storm drainage piping, accessories, and components, from manufacturer.

- ###### **B. Field quality-control reports.**

1.5 QUALITY ASSURANCE

- ###### **A. Piping materials shall bear label, stamp, or other markings of specified testing agency.**

- ###### **B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.**

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- ###### **A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.**

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements
 - a. ANACO-Husky.
 - b. Fernco Inc.
 - c. MIFAB, Inc.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements.
 - a. ANACO-Husky.
 - b. Fernco Inc.
 - c. MIFAB, Inc.
 - 2. Standards: ASTM C 1277 and ASTM C 1540.
 - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast-copper fittings or ASME B16.29, wrought-copper, solder-joint fittings.
- C. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.

3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements.
 - 1) Fernco Inc.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - 3) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
 - J. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
 - K. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Storm Drain: 1/8 inch per foot downward in direction of flow for piping NPS3 and smaller; 1/8 inch per foot downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Storm-Drainage Piping: 1/8 inch per foot downward in direction of flow.
 - L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
 - M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
 - N. Install aboveground ABS piping according to ASTM D 2661.
 - O. Install underground ABS piping according to ASTM D 2321.
 - P. Plumbing Specialties:
 - 1. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
 - 3. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."
 - Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- 3.3 JOINT CONSTRUCTION
- A. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

- C. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: shielded, nonpressure transition couplings.

3.5 VALVE INSTALLATION

- A. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
 - 2. Install backwater valves in accessible locations.
 - 3. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42 clamps.
 - 6. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 - 6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 5. NPS 6: 10 feet with 5/8-inch rod.
 - 6. NPS 8: 10 feet with 3/4-inch rod.
- I. Install supports for vertical copper tubing every 10 feet.
- J. Install hangers for piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
- K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
 - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
 - 2. Install horizontal backwater valves with cleanout cover flush with floor, in pit with pit cover flush with floor.

3. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.8 IDENTIFICATION

- A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.10 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, storm drainage piping shall be the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Underground storm drainage piping NPS 6 and smaller shall be the following:
1. Service class, cast-iron soil pipe and fittings and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Underground, storm drainage piping NPS 8 and larger shall be the following:
1. Service class, cast-iron soil pipe and fittings and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.
 3. Dissimilar Pipe-Material Couplings: shielded, nonpressure transition couplings.

END OF SECTION 22 14 13

SECTION 22 14 23

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Backwater valves.
5. Trench drains.
6. Flashing materials.

1.2 ACTION SUBMITTALS

- ###### **A. Product Data:** For each type of product indicated.

1.3 QUALITY ASSURANCE

- ###### **A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.**

PART 2 - PRODUCTS

2.1 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adaptors:

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and NPS 4 outlet.

C. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.2 CLEANOUTS

A. Floor Cleanouts:

1. Standard: ASME A112.36.2M, for heavy-duty, adjustable housing or threaded, adjustable housing cleanouts.
2. Size: Same as connected branch.
3. Type: Heavy-duty, adjustable housing or Threaded, adjustable housing.
4. Body or Ferrule Material: Cast iron or stainless steel.
5. Closure: Brass plug with straight threads and gasket, Brass plug with tapered threads or Cast-iron plug.
6. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
7. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, polished bronze or Stainless steel.
8. Frame and Cover Shape: Round or Square.
9. Top-Loading Classification: Heavy Duty.
10. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Test Tees:

1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk or raised head or brass.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or Hubless, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, drilled-and-threaded, brass or cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, deep, chrome-plated bronze or flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round or Square, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.3 BACKWATER VALVES

A. Cast-Iron, Horizontal Backwater Valves:

1. Standard: ASME A112.14.1, for backwater valves.
2. Size: Same as connected piping.
3. Body Material: Cast iron.
4. Cover: Cast iron with bolted or threaded access check valve.

5. End Connections: Hub and spigot or hubless.
6. Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
7. Extension: ASTM A 74, Service class; full-size, cast-iron soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

2.4 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft..
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- B. Install downspout boots at grade with top 6 inches above grade. Secure to building wall.
- C. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- D. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4.
 4. Locate cleanouts at base of each vertical soil and waste stack.
- E. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- F. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- G. Install horizontal backwater valves in floor with cover flush with floor.
- H. Install test tees in vertical conductors and near floor.
- I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- J. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

- K. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23

SECTION 22 33 00

ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
- B. Commercial, electric, domestic-water booster heaters.
- C. Commercial, electric, storage, domestic-water heaters.
- D. Commercial, light-duty, storage, electric, domestic-water heaters.
- E. Residential, electric, storage, domestic-water heaters.
- F. Thermostat-control, electric, tankless, domestic-water heaters.
- G. Domestic-water heater accessories.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated.
- B. LEED Submittals (if applicable):
- C. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."
- D. Shop Drawings:
- E. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Electric, Domestic-Water Booster Heaters:
 - 1) Controls and Other Components: Five years.
 - b. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Five years.
 - c. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Three years.
 - d. Residential, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: 10 years.
 - 2) Controls and Other Components: Three years.
 - e. Electric, Tankless, Domestic-Water Heaters: Five year(s).
 - f. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Electric, Domestic-Water Booster Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradford White Corporation.

- b. Coates Heater Company, Inc.
 - c. Electric Heater Company (The).
 - d. Hatco Corporation.
 - e. HESco Industries, Inc.
 - f. Lochinvar Corporation.
 - g. Rheem Manufacturing Company.
 - h. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
2. Standard: UL 1453.
 3. Tank Construction: Corrosion-resistant metal or steel.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 4. Factory-Installed Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1.
 - d. Jacket: Rectangular shaped, with stainless-steel front panel, unless otherwise indicated.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - 1) Option: Booster heaters with total of 9 kW or less may have two or three elements.
 - f. Temperature Control: Adjustable thermostat, to setting of at least 180 deg F (82 deg C).
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valve. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 - i. Gages: Combination temperature-and-pressure type or separate thermometer and pressure gage.
 5. Special Requirements: NSF 5 construction with [brackets for undercounter] [legs for floor] installation.
- B. Commercial, Electric, Storage, Domestic-Water Heaters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Water Heaters.
 - b. Bradford White Corporation.
 - c. Cemline Corporation.
 - d. Electric Heater Company (The).
 - e. GSW Water Heating.
 - f. HESco Industries, Inc.

- g. Lochinvar Corporation.
 - h. Precision Boilers, Inc.
 - i. PVI Industries, LLC.
 - j. RECO USA.
 - k. Rheem Manufacturing Company.
 - l. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - m. State Industries.
 - n. Vaughn Manufacturing Corporation.
2. Standard: UL 1453.
3. Storage-Tank Construction: ASME-code, steel horizontal or vertical arrangement.
- a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed Storage-Tank Appurtenances:
- a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1.
 - d. Jacket: Steel with enameled finish.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
5. Special Requirements: NSF 5 construction.
- C. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Water Heaters.
 - b. Bradford White Corporation.
 - c. Electric Heater Company (The).
 - d. GSW Water Heating.

- e. Heat Transfer Products, Inc.
- f. Lochinvar Corporation.
- g. Rheem Manufacturing Company.
- h. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
- i. State Industries.
2. Standard: UL 174.
3. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
 - e. Jacket: Steel with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
5. Special Requirements: NSF 5 construction with legs for off-floor installation.
- D. Capacity and Characteristics (as specified in drawings):

2.2 RESIDENTIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Residential, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Water Heaters.
 - b. Bradford White Corporation.
 - c. Electric Heater Company (The).
 - d. GSW Water Heating.
 - e. Heat Transfer Products, Inc.

- f. HESco Industries, Inc.
 - g. Lochinvar Corporation.
 - h. Rheem Manufacturing Company.
 - i. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - j. State Industries.
 - k. Vaughn Manufacturing Corporation.
2. Standard: UL 174.
3. Storage-Tank Construction: Steel.
- a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed Storage-Tank Appurtenances:
- a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE 90.2.
 - e. Jacket: Steel, cylindrical, with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for nonsimultaneous operation unless otherwise indicated. Limited to 12 kW total.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics (as specified in drawings):

2.3 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

A. Thermostat-Control, Electric, Tankless, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Bosch Water Heating.
 - b. Chronomite Laboratories, Inc.
 - c. E-Tankless Water Heaters Corp.
 - d. Keltech, Inc.
 - e. Niagara Industries, Inc.

- f. Rinnai, Inc.
2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
3. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
 - a. Connections: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. Heating Element: Resistance heating system.
 - d. Temperature Control: Thermostat.
 - e. Safety Control: High-temperature-limit cutoff device or system.
 - f. Jacket: Aluminum or steel with enameled finish or plastic.
4. Support: Bracket for wall mounting.
5. Capacity and Characteristics (as specified in drawings).

2.4 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL Inc.
 - b. Flexcon Industries.
 - c. Honeywell International Inc.
 - d. Pentair Pump Group (The); Myers.
 - e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - f. State Industries.
 - g. Taco, Inc.
 2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 3. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 4. Capacity and Characteristics (as specified on drawings).
- B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- D. Heat-Trap Fittings: ASHRAE 90.2.

- E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- (172.5-kPa-) maximum outlet pressure unless otherwise indicated.
- F. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- I. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches (457 mm) above the floor.
- K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.5 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete." And Section 033053 "Miscellaneous Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.

8. Anchor domestic-water heaters to substrate.
- B. Residential, Electric, Domestic-Water Heater Mounting: Install residential, electric, domestic-water heaters on water-heater stand on floor or on domestic-water heater mounting bracket.
 1. Maintain manufacturer's recommended clearances.
 2. Arrange units so controls and devices that require servicing are accessible.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 5. Anchor domestic-water heaters to substrate.
- C. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket.
 1. Maintain manufacturer's recommended clearances.
 2. Arrange units so controls and devices that require servicing are accessible.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 5. Anchor domestic-water heaters to substrate.
- D. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- E. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- F. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- G. Install combination temperature and pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- H. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- I. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- J. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for

outlet pressure of 25 psig (172 kPa). Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."

- K. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- L. Fill electric, domestic-water heaters with water.
- M. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

END OF SECTION 22 33 00

SECTION 22 42 13.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flushometer valves.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals (NONE)
- C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 FLUSHOMETER VALVES

A. Battery-Powered, Solenoid-Actuator, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Coyne & Delany Co.
 - b. TOTO USA, INC.
 - c. Sloan Valve Company.
 - d. Zurn Industries, LLC; Commercial Brass and Fixtures.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig (860 kPa).
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

11. Consumption: 1.28 gal. (4.8 L) or 1.6 gal. (6 L) per flush.
12. Minimum Inlet: NPS 1 (DN 25).
13. Minimum Outlet: NPS 1-1/4 (DN 32).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install flushometer valves for accessible water closets with activation mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.

3.2 CONNECTIONS

- A. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- B. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- C. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.3 ADJUSTING

- A. Adjust water pressure at flushometer valves to produce proper flow.

3.4 CLEANING AND PROTECTION

- A. Clean and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed fittings.

END OF SECTION 22 42 13.13

SECTION 22 42 13.16 - COMMERCIAL URINALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flushometer valves.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals (NONE)
- C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 URINAL FLUSHOMETER VALVES

A. Battery-Powered, Solenoid-Actuator, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Coyne & Delany Co.
 - b. Gerber Plumbing Fixtures LLC.
 - c. Hydrotek International, Inc.
 - d. Kohler Co.
 - e. Moen Incorporated.
 - f. Sloan Valve Company.
 - g. TOTO USA, INC.
 - h. Zurn Industries, LLC; Commercial Brass and Fixtures.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig (860 kPa).
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.

8. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
9. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
10. Consumption: 0.5 gal. or 1.0 gal. per flush.
11. Minimum Inlet: NPS 3/4 or NPS 1
12. Minimum Outlet: NPS 3/4 or NPS 1-1/4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Flushometer-Valve Installation:
 1. Install flushometer-valve water-supply fitting on each supply to each urinal.
 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
 3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
 4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.3 CONNECTIONS

- A. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- B. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- C. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

- A. Adjust water pressure at flushometer valves to produce proper flow.
- B. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. Clean fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed fittings.

END OF SECTION 22 42 13.16

SECTION 22 42 16.13

COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lavatories.
2. Faucets.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals (NONE)
- C. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of automatic faucets.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

- A. Lavatory: self rimming, vitreous china, counter mounted.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Standard America.
 - b. Briggs Plumbing Products, Inc.
 - c. Capizzi.
 - d. Crane Plumbing, L.L.C.
 - e. Ferguson Enterprises, Inc.; ProFlo Brand.
 - f. Gerber Plumbing Fixtures LLC.
 - g. Kohler Co.
 - h. Mansfield Plumbing Products LLC.
 - i. Peerless Pottery Sales, Inc.

- j. TOTO USA, INC.
- k. Zurn Industries, LLC; Commercial Brass and Fixtures.
- 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: Self-rimming for above-counter mounting.
 - c. Faucet-Hole Location: Top.
 - d. Color: White.
 - e. Mounting Material: Sealant.

B. Lavatory : Oval, vitreous china, undercounter mounted.

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Standard America.
 - b. Capizzi.
 - c. Crane Plumbing, L.L.C.
 - d. Ferguson Enterprises, Inc.; ProFlo Brand.
 - e. Gerber Plumbing Fixtures LLC.
 - f. Kohler Co.
 - g. Mansfield Plumbing Products LLC.
 - h. Peerless Pottery Sales, Inc.
 - i. TOTO USA, INC.
 - j. Zurn Industries, LLC; Commercial Brass and Fixtures.
- 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: For undercounter mounting.
 - c. Faucet-Hole Location: On countertop.
 - d. Color: White.
 - e. Mounting Material: Sealant and undercounter mounting kit.

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted, with back.

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Standard America.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C.
 - d. Ferguson Enterprises, Inc.; ProFlo Brand.
 - e. Gerber Plumbing Fixtures LLC.
 - f. Kohler Co.
 - g. Mansfield Plumbing Products LLC.
 - h. Peerless Pottery Sales, Inc.

- i. Zurn Industries, LLC; Commercial Brass and Fixtures.
 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: For wall hanging.
 - c. Faucet-Hole Location: Top.
 - d. Color: White.
 - e. Mounting Material: Chair carrier.
 3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier or Type II, concealed-arm lavatory carrier with escutcheons. Include rectangular, steel uprights.
- B. Lavatory: Ledge back, vitreous china, wall mounted.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Standard America.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C.
 - d. Ferguson Enterprises, Inc.; ProFlo Brand.
 - e. Gerber Plumbing Fixtures LLC.
 - f. Kohler Co.
 - g. Mansfield Plumbing Products LLC.
 - h. Peerless Pottery Sales, Inc.
 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: For wall hanging.
 - c. Faucet-Hole Location: Top.
 - d. Color: White.
 - e. Mounting Material: Chair carrier.
 3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier or Type II, concealed-arm lavatory carrier with escutcheons. Include rectangular, steel uprights.
- C. Lavatory: Wheelchair, vitreous china, wall mounted.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Standard America.
 - b. Crane Plumbing, L.L.C.
 - c. Ferguson Enterprises, Inc.; ProFlo Brand.
 - d. Gerber Plumbing Fixtures LLC.
 - e. Kohler Co.
 - f. Mansfield Plumbing Products LLC.
 - g. Peerless Pottery Sales, Inc.
 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.

- b. Type: Slab or wheelchair.
 - c. Nominal Size: Rectangular, 27 by 20 inches (686 by 508 mm).
 - d. Faucet-Hole Punching: Three holes, 2-inch (51-mm) centers.
 - e. Faucet-Hole Location: Top.
 - f. Color: White.
 - g. Mounting: For concealed-arm carrier.
3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier with rectangular, steel uprights.

2.3 SOLID-BRASS, AUTOMATICALLY OPERATED FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: Automatic-type, battery-powered, electronic-sensor-operated, mixing, solid-brass valve.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Standard America.
 - b. Bradley Corporation.
 - c. Chicago Faucets.
 - d. Delta Faucet Company.
 - e. Elkay Manufacturing Co.
 - f. Grohe America, Inc.
 - g. Kohler Co.
 - h. Moen Incorporated.
 - i. Sloan Valve Company
 - j. Speakman Company.
 - k. T & S Brass and Bronze Works, Inc.
 - l. Zurn Industries, LLC; Commercial Brass and Fixtures.
 - 2. Standard: ASME A112.18.1/CSA B125.1 and UL 1951.
 - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
 - 5. Body Type: Centerset, Widespread or Single hole.
 - 6. Body Material: Commercial, solid brass.
 - 7. Finish: Polished chrome plate.
 - 8. Maximum Flow Rate: 0.5 gpm
 - 9. Maximum Flow: 0.25 gal. per metering cycle.
 - 10. Mounting Type: Deck, exposed.
 - 11. Spout Outlet: Aerator.

2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.
- F. Risers:
 - 1. NPS 1/2 (DN 15).
 - 2. Chrome plated, soft-copper flexible tube or ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 (DN 32) offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/2 by NPS 1-1/4 (DN 40 by DN 32).
 - 2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall or two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall or one-piece, cast-brass trap with swivel 0.029-inch thick tubular brass wall bend; and chrome-plated, brass or steel wall flange.
 - 3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

- E. Seal joints between lavatories and counters and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by the State.

END OF SECTION 22 42 16.13

SECTION 22 42 16.16
COMMERCIAL SINKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service basins.
2. Service sinks.
3. Utility sinks.
4. Handwash sinks.
5. Sink faucets.
6. Laminar-flow, faucet-spout outlets.
7. Supply fittings.
8. Waste fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals (if applicable):

1. Product Data for Prerequisite WE 1 and Credit WE 3, Credit WE 2, and Credit WE 3: Documentation indicating flow and water consumption requirements.
2. Product Data for Prerequisite WE 1: Documentation indicating flow and water consumption requirements.
3. Product Data for Prerequisite WE 1 and Credit WE 2: Documentation indicating flow and water consumption requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 SERVICE BASINS

A. Service Basins: Plastic, floor mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Crane Plumbing, L.L.C.

- b. Ferguson Enterprises, Inc.; ProFlo Brand.
 - c. Florestone Products Co., Inc.
 - d. Mustee, E. L., & Sons, Inc.
 - e. Swan Corporation (The).
 - f. Zurn Industries, LLC; Light Commercial Specialty Plumbing Products.
2. Fixture:
 - a. Standard: IAPMO/ANSI Z124.6.
 - b. Material: Cast polymer
 - c. Rim Guard: On all top surfaces.
 - d. Drain: Grid with NPS 2 (DN 50) or NPS 3 (DN 80) outlet.
 3. Mounting: On floor and flush to wall.

2.2 SERVICE SINKS

A. Service Sinks: Enameled, cast iron, trap standard mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Standard America.
 - b. Commercial Enameling Company.
 - c. Gerber Plumbing Fixtures LLC.
 - d. Kohler Co.
 - e. Zurn Industries, LLC; Commercial Brass and Fixtures.
2. Fixture:
 - a. Standard: ASME A112.19.1/CSA B45.2.
 - b. Type: Service sink with back.
 - c. Color: White.
 - d. Mounting: NPS 2 (DN 50) or NPS 3 (DN 80) P-trap standard with grid strainer inlet, cleanout, and floor flange.
 - e. Rim Guard: On front and sides.
3. Support: ASME A112.6.1M, Type II, sink carrier.

2.3 UTILITY SINKS

A. Utility Sinks: Stainless steel, counter mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Advance Tabco.
 - b. Eagle Group; Foodservice Equipment Division.
 - c. Elkay Manufacturing Co.
 - d. Griffin Products, Inc.

- e. Just Manufacturing.
- 2. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Type: Ledge back.
 - c. Metal Thickness: 0.050 inch.
 - d. Compartment:
 - 1) Drain: Grid with NPS 2 tailpiece and twist drain
 - e. Each Compartment:
 - 1) Drains: Grid with NPS 2 (DN 50) tailpiece and twist drain
 - f. Mounting: On ledge.
- 3. Supply Fittings:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
 - 1) Operation: Wheel handle.
 - 2) Risers: NPS 1/2 (DN 15), chrome-plated, rigid-copper pipe, chrome-plated, soft-copper flexible tube or ASME A112.18.6, braided or corrugated stainless-steel flexible hose].
- 4. Waste Fittings:
 - a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Trap(s):
 - 1) Size: NPS 2 (DN 50).
 - 2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch thick brass tube to wall or two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated brass or steel wall flange.
 - 3) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.
 - c. Continuous Waste:
 - 1) Size: NPS 2 (DN 50).
 - 2) Material: Chrome-plated, 0.032-inch- (0.83-mm-) thick brass tube.
- 5. Mounting: On counter with sealant.

2.4 HANDWASH SINKS

- A. Handwash Sinks: Stainless steel, wall mounted.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Advance Tabco.
 - b. AERO Manufacturing Company.
 - c. Amtekco Industries, Inc.

- d. Eagle Group; Foodservice Equipment Division.
 - e. Elkay Manufacturing Co.
 - f. Griffin Products, Inc.
 - g. Just Manufacturing.
2. Fixture:
- a. Standards: ASME A112.19.3/CSA B45.4 and NSF/ANSI 2.
 - b. Type: Basin with radius corners, back for faucet, and support brackets.
 - c. Nominal Size: 17 by 16 by 5 inches (432 by 406 by 127 mm).
3. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
4. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
5. Support: ASME A112.6.1M, Type II, sink carrier.

2.5 SINK FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets: Manual type, single-control or two-lever-handle mixing valve.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Standard America.
 - b. Bradley Corporation.
 - c. Chicago Faucets.
 - d. Delta Faucet Company.
 - e. Elkay Manufacturing Co.
 - f. GROHE America, Inc.
 - g. Just Manufacturing.
 - h. Kohler Co.
 - i. Moen Incorporated.
 - j. Speakman Company.
 - k. T & S Brass and Bronze Works, Inc.
 - l. Zurn Industries, LLC; Commercial Brass and Fixtures.
 - m. American Standard America.
 - n. Bradley Corporation.
 - o. BrassTech Inc.
 - p. Central Brass Company.
 - q. Chicago Faucets.
 - r. Danze, Inc.
 - s. Delta Faucet Company.

- t. Eljer, Inc.
 - u. Elkay Manufacturing Co.
 - v. Franke Consumer Products, Inc.
 - w. Gerber Plumbing Fixtures LLC.
 - x. Griffin Products, Inc.
 - y. GROHE America, Inc.
 - z. Hansgrohe USA.
 - aa. Hydrotek International, Inc.
 - bb. Intersan Manufacturing Company.
 - cc. Just Manufacturing.
 - dd. Kohler Co.
 - ee. Matco-Norca.
 - ff. Moen Incorporated.
 - gg. Price Pfister, Inc.
 - hh. Speakman Company.
 - ii. T & S Brass and Bronze Works, Inc.
 - jj. WhiteRock Corp.
 - kk. Wolverine Brass, Inc.
 - ll. Zurn Industries, LLC; Commercial Brass and Fixtures.
 - mm. American Standard America.
 - nn. Briggs Plumbing Products, Inc.
 - oo. Danze, Inc.
 - pp. Delta Faucet Company.
 - qq. Eljer, Inc.
 - rr. Ferguson Enterprises, Inc.; ProFlo Brand.
 - ss. Gerber Plumbing Fixtures LLC.
 - tt. Matco-Norca.
 - uu. Moen Incorporated.
 - vv. Sterling; a Kohler company.
 - ww. WhiteRock Corp.
 - xx. Wolverine Brass, Inc.
2. Standard: ASME A112.18.1/CSA B125.1.
 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
 4. Body Type: Centerset, Widespread or Single hole.

5. Body Material: Commercial, solid brass, General-duty, solid brass with Copper or brass underbody].
6. Finish: Chrome plated or Polished chrome plate
7. Maximum Flow Rate: 2.2 gpm (8.3 L/min.)
8. Vacuum Breaker: Required for hose outlet.
9. Spout Outlet: Aerator or Hose thread according to ASME B1.20.7 or Plain end

2.6 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following] [provide products by one of the following:
 1. AM Conservation Group, Inc.
 2. Chronomite Laboratories, Inc.
 3. NEOPERL, Inc.
- C. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.7 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key or Wheel handle
- F. Risers:
 1. NPS 1/2 (DN 15)
 2. Chrome-plated, rigid-copper pipe, Chrome-plated, soft-copper flexible tube or ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

2.8 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 (DN 40) offset and straight tailpiece.
- C. Trap:
 1. Size: NPS 1-1/2 (DN 40).
 2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass

tube to wall or one-piece, cast-brass trap with swivel 0.029-inch- thick tubular brass wall bend; and chrome-plated brass or steel wall flange.

3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by the State.

END OF SECTION 22 42 16.16

SECTION 22 47 13

DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes drinking fountains and related components.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountains.
- B. LEED Submittals (NONE)

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

A. Drinking Fountains:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Belson Outdoors, Inc.
 - b. Haws Corporation.
 - c. Petersen Manufacturing Co., Inc.
 - d. Sanderson Concrete Inc.
 - e. Stern-Williams Co., Inc.
 - f. International Oasis Corp.
 - g. Belson Outdoors, Inc.
 - h. Halsey Taylor.
 - i. Haws Corporation.
 - j. Most Dependable Fountains, Inc.
 - k. Murdock-Super Secur; a division of Acorn Engineering Company.
 - l. Stern-Williams Co., Inc.
 - m. Tri Palm International, LLC; Oasis Brand.
 - n. Tri Palm International, LLC; Sunroc Brand.
2. Standards: Comply with ICC A117.1 and NSF 61.
3. Pedestal: Rectangular or Round.

4. Receptor(s):
 - a. Material: Chrome-plated brass or stainless steel.
 - b. Shape: Rectangular, Round or Rounded front.
 - c. Bubbler: One for each receptor, with adjustable stream regulator.
 - d. Drain: Grid type with NPS 1-1/4 (DN 32) tailpiece.
 5. Access to Internal Components: Panel in pedestal.
 6. Supply Piping: NPS 3/8 with shutoff valve.
 7. Drain Piping: NPS 1-1/4 minimum trap and waste.
- B. Drinking Fountains Stainless steel, wall mounted.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Elkay Manufacturing Co.
 - b. Filtrine Manufacturing Company.
 - c. Halsey Taylor.
 - d. Haws Corporation.
 - e. Oasis International Corp.
 - f. Elkay Manufacturing Co.
 - g. Filtrine Manufacturing Company.
 - h. Halsey Taylor.
 - i. Haws Corporation.
 - j. Murdock-Super Secur; a division of Acorn Engineering Company.
 - k. Stern-Williams Co., Inc.
 - l. Tri Palm International, LLC; Oasis Brand.
 - m. Tri Palm International, LLC; Sunroc Brand.
 2. Standards:
 - a. Comply with ASME A112.19.3/CSA B45.4.
 - b. Comply with NSF 61.
 3. Back Panel: Stainless-steel wall plate behind drinking fountain.
 4. Drain: Grid type with NPS 1-1/4 (DN 32) tailpiece.
 5. Supply Piping: NPS 3/8 (DN 10) with shutoff valve.
 6. Drain Piping: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) chrome-plated brass P-trap and waste.
 7. Support: ASME A112.6.1M, Type III lavatory carrier.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set pedestal drinking fountains on floor.
- C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Adjust fixture flow regulators for proper flow and stream height.

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 CLEANING

- A. After installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by the State.

END OF SECTION 22 47 13

SECTION 23 01 30 – HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 – SPECIAL PROVISIONS

1.1 QUALIFICATION OF THE HVAC SYSTEM CLEANING CONTRACTOR

- A. Membership: The HVAC system cleaning Contractor shall be a certified member of the National Air Duct Cleaners Association (NADCA), or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.
- B. Certification: The HVAC system cleaning Contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.
- C. Supervisor Qualifications: A person certified as an ASCS by NADCA, or maintaining an equivalent certification by a nationally recognized program and organization, shall be responsible for the total work herein specified.
- D. Experience: The HVAC system cleaning Contractor shall submit records of experience in the field of HVAC system cleaning as requested by the State. Bids shall only be considered from firms which are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.
- E. Equipment, Materials and Labor: The HVAC system cleaning Contractor shall possess and furnish all necessary equipment, materials and labor to adequately perform the specified services.
 - 1. The Contractor shall assure that its employees have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and material safety data sheets (MSDS) as required for the work by the U.S. Occupational Safety and Health Administration, and as described by this specification.
 - 2. The Contractor shall maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements of applicable OSHA programs and this specification
 - 3. Contractor shall submit to the State all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process.
- F. Licensing: The HVAC system cleaning Contractor shall provide proof of maintaining the proper license(s), if any, as required to do work in this state. Contractor shall comply with all Federal, state and local rules, regulations, and licensing requirements.

1.2 STANDARDS

- A. NADCA Standards: The HVAC system cleaning Contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).

1. All terms in this specification shall have their meaning defined as stated in the NADCA Standards.
2. NADCA Standards must be followed with no modifications or deviations being allowed.

1.3 DOCUMENTS

- A. Mechanical Drawings: The State shall provide the HVAC system cleaning Contractor with one copy of the following documents:
 1. Project drawings and specifications.
 2. Approved construction revisions pertaining to the HVAC system.

1.4 SUBMITTALS

- A. Contractor shall submit proof of items as noted in SECTION 23 01 30, Part 1, 1.1, A-F.

PART 2 – HVAC SYSTEM CLEANING SPECIFICATIONS AND REQUIREMENTS

2.1 SCOPE OF WORK

- A. Scope: This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.

The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.

The HVAC system includes any interior surface of Central Railroad of New Jersey – Terminal Building air distribution system for conditioned spaces and/or occupied zones. This includes the entire heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The return air grilles, return air ducts to the air handling unit(s) (AHU), the interior surfaces of the AHU(s), mixing box, coil compartment, condensate drain pans, humidifiers and dehumidifiers, supply air ducts, fans, fan housing, fan blades, air wash systems, spray eliminators, turning vanes, filters, filter housings, reheat coils, and supply diffusers are all considered part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems.

2.2 HVAC SYSTEM COMPONENT INSPECTIONS AND SITE PREPARATIONS

- A. HVAC System Component Inspections: Prior to the commencement of any cleaning work, the HVAC system cleaning Contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment required to satisfactorily complete this project. The cleanliness inspection should include air

handling units and representative areas of the HVAC system components and ductwork. In HVAC systems that include multiple air handling units, a representative sample of the units should be inspected.

The cleanliness inspection shall be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification or other debris. In cases where contamination is suspected, and/or in sensitive environments where even small amounts of contaminant may be of concern, environmental engineering control measures should be implemented

1. Damaged system components found during the inspection shall be documented and brought to the attention of the State.
- B. Site Evaluation and Preparations: Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details how each area of the building will be protected during the various phases of the project.
- C. Inspector Qualifications: Qualified personnel should perform the HVAC cleanliness inspection to determine the need for cleaning. At minimum, such personnel should have an understanding of HVAC system design, and experience in utilizing accepted indoor environmental sampling practices, current industry HVAC cleaning procedures, and applicable industry standards.

2.3 GENERAL HVAC SYSTEM CLEANING REQUIREMENTS

- A. Containment: Debris removed during cleaning shall be collected and precautions must be taken to ensure that Debris is not otherwise dispersed outside the HVAC system during the cleaning process.
- B. Particulate Collection: Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, Mechanical cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.
- C. Controlling Odors: Measures shall be employed to control odors and/or mist vapors during the cleaning process.
- D. Component Cleaning: Cleaning methods shall be employed such that all HVAC system components must be Visibly Clean. Visibly Clean is defined in the applicable standards (NADCA Standards) as a condition in which the interior surface of the HVAC system are free of non-adhered substances and debris. Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.
- E. Air-Volume Control Devices: Dampers and any air-directional mechanical devices inside the HVAC system must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.
- F. Service Openings: The Contractor shall utilize service openings, as required for proper

cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection.

1. Contractor shall utilize the existing service openings already installed in the HVAC system where possible.
 2. Other openings shall be created where needed and they must be created so they can be sealed in accordance with industry codes and standards.
 3. Closures must not significantly hinder, restrict, or alter the airflow within the system.
 4. Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.
 5. Openings must not compromise the structural integrity of the system.
 6. Construction techniques used in the creation of openings should conform to requirements of applicable building and fire codes, and applicable National Fire Protection Association (NFPA), SMACNA and NADCA Standards.
 7. Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.
 8. Rigid fiberglass duct systems shall be resealed in accordance with NAIMA recommended practices. Only closure techniques that comply with UL Standard 181 or UL Standard 181a are suitable for fiberglass duct system closures.
 9. All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and shall have their location reported to the State in project report documents.
- G. Ceiling sections (tile): The Contractor may remove and reinstall ceiling sections to gain access to HVAC systems during the cleaning process.
- H. Air distribution devices (registers, grilles & diffusers): The Contractor shall clean all air distribution devices.
- I. Air handling units, terminal units (VAV, dual duct boxes, etc.), blowers and exhaust fans: The Contractor shall insure that supply, return, and exhaust fans and blowers are thoroughly cleaned. Areas to be cleaned include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies. All visible surface contamination deposits shall be removed in accordance with NADCA Standards. Contractor shall:
1. Clean all air handling units (AHU) internal surfaces, components and condensate collectors and drains.
 2. Assure that a suitable operative drainage system is in place prior to beginning wash down procedures.
 3. Clean all coils and related components, including evaporator fins.

J. Duct Systems. Contractor shall:

1. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.
2. Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Tests (see NADCA Standards).

2.4 HEALTH AND SAFETY

- A. Safety Standards: Cleaning Contractors shall comply with applicable federal, state, and local requirements for protecting the safety of the Contractor's employees, building occupants, and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) shall be followed when working in accordance with this specification.
- B. Occupant Safety: No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.
- C. Disposal of Debris: All debris removed from the HVAC system shall be disposed of in accordance with applicable federal, state and local requirements.

2.5 MECHANICAL CLEANING METHODOLOGY

- A. Source Removal Cleaning Methods: The HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is the Contractor's responsibility to select Source Removal methods that will render the HVAC system Visibly Clean and capable of passing cleaning verification methods (See applicable NADCA Standards) and other specified tests, in accordance with all general requirements. No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 1. All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment are assured.
 2. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.
 3. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.

4. All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those, which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

B. Methods of Cleaning Fibrous Glass Insulated Components

1. Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.
2. Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing Cleaning Verification Tests (see NADCA Standards).

C. Damaged Fibrous Glass Material

1. Evidence of damage: If there is any evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified for replacement.
2. Replacement: When requested or specified, Contractor must be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.
3. Replacement material: In the event fiberglass materials must be replaced, all materials shall conform to applicable industry codes and standards, including those of UL and SMACNA.
4. Replacement of damaged insulation is not covered by this specification.

D. Cleaning of Coils

1. Any cleaning method may be used which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement of, inhibit heat transfer, or erosion of the coil surface or fins, and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water to remove any latent residues.

E. Antimicrobial Agents and Coatings

1. Antimicrobial agents shall only be applied if active fungal growth is reasonably suspected, or where unacceptable levels of fungal contamination have been verified through testing.

2. Application of any antimicrobial agents used to control the growth of fungal or bacteriological contaminants shall be performed after the removal of surface deposits and debris.
3. When used, antimicrobial treatments and coatings shall be applied in strict accordance with the manufacturer's written recommendations and EPA registration listing.
4. Antimicrobial coatings shall be applied according to the manufacturer's written instructions. Coatings shall be sprayed directly onto interior ductwork surfaces, rather than "fogged" downstream onto surfaces.

2.6 CLEANLINESS VERIFICATION

- A. General: Verification of HVAC System cleanliness shall be determined by the State's Representative (USA Environmental Management, Inc.), after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including biocide agents and coatings.
- B. Visual Inspection: The HVAC system shall be inspected visually to ensure that no visible contaminants are present.
 1. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the State reserves the right to further verify system cleanliness through Surface Comparison Testing or the NADCA vacuum test specified in the NADCA standards.
 2. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
 3. NADCA vacuum testing shall be coordinated with and performed by the State's Representative (USA Environmental Management, Inc.). A minimum of 72-Hour notice is required for all cleanliness verification requests.
- C. Verification of Coil Cleaning
 1. Cleaning must restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA Standards).

2.7 PRE-EXISTING SYSTEM DAMAGE

- A. Contractor is not responsible for problems resulting from prior inappropriate or careless cleaning techniques of others.
- B. Pre-existing system damage components found shall be documented and brought to the attention of the State.

2.8 POST-PROJECT REPORT

- A. At the conclusion of the project, the Contractor shall provide a report to the State indicating the following:
 - 1. Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.
 - 2. Areas of the system found to be damaged and/or in need of repair.

2.9 APPLICABLE STANDARDS AND PUBLICATIONS

The following current standards and publications of the issues currently in effect form a part of this specification to the extent indicated by any reference thereto:

- B. National Air Duct Cleaners Association (NADCA): "Assessment, Cleaning & Restoration of HVAC Systems (ACR 2005)," 2004.
- C. National Air Duct Cleaners Association (NADCA): "Understanding Microbial Contamination in HVAC Systems," 1996.
- D. National Air Duct Cleaners Association (NADCA): "Introduction to HVAC System Cleaning Services," 2004.
- E. National Air Duct Cleaners Association (NADCA): Standard 05 "Requirements for the Installation of Service Openings in HVAC Systems," 2004.
- F. Underwriters' Laboratories (UL): UL Standard 181.
- G. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE): Standard 62-89, "Ventilation for Acceptable Indoor Air Quality".
- H. Environmental Protection Agency (EPA): "Building Air Quality," December 1991.
- I. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): "HVAC Duct Construction Standards - Metal and Flexible," 1985.
- J. North American Insulation Manufacturers Association (NAIMA): "Cleaning Fibrous Glass Insulated Air Duct Systems," 1993.

END OF SECTION 23 01 30

SECTION 230130.51 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING (SUPPLEMENTAL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components. Section pertains to the entire terminal building and excludes no piece of existing equipment.

1.3 DEFINITIONS

- A. ASCS: Air systems cleaning specialist.
- B. NADCA: National Air Duct Cleaners Association.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For an ASCS.
- B. Strategies and procedures plan.
- C. Cleanliness verification report.

1.5 QUALITY ASSURANCE

- A. ASCS Qualifications: A certified member of NADCA.
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as an ASCS by NADCA.
- B. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.
 - 1. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.
- C. Prepare written report listing conditions detrimental to performance of the Work.
- D. Proceed with work only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations.
- B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- C. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.3 CLEANING

- A. Comply with NADCA ACR 2006.
- B. Remove visible surface contaminants and deposits from within the HVAC system.
- C. Systems and Components to Be Cleaned:
 - 1. Air devices for supply and return air.
 - 2. Air-terminal units.
 - 3. Ductwork:
 - a. Supply-air ducts, including turning vanes and reheat coils, to the air-handling unit.
 - b. Return-air ducts to the air-handling unit.
 - c. Exhaust-air ducts.

4. Air-Handling Units:
 - a. Interior surfaces of the unit casing.
 - b. Coil surfaces compartment.
 - c. Condensate drain pans.
 - d. Fans, fan blades, and fan housings.
5. Filters and filter housings.
- D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- E. Particulate Collection:
 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
- F. Control odors and mist vapors during the cleaning and restoration process.
- G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- I. Clean all air-distribution devices, registers, grilles, and diffusers.
- J. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:
 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
 3. Clean evaporator coils, reheat coils, and other airstream components.
- K. Duct Systems:
 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
- L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.

M. Mechanical Cleaning Methodology:

1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.
2. Cleaning Mineral-Fiber Insulation Components:
 - a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
 - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
 - c. Fibrous materials that become wet shall be discarded and replaced.

N. Coil Cleaning:

1. Measure static-pressure differential across each coil.
2. See NADCA ACR 2006, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2006).
3. Coil drain pans shall be subject to NADCA ACR 2006, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
4. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
5. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
6. Rinse thoroughly with clean water to remove any latent residues.

O. Antimicrobial Agents and Coatings:

1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.

4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

3.4 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Verification of Coil Cleaning:
 1. Measure static-pressure differential across each coil.
 2. Coil will be considered clean if cleaning restored the coil static-pressure differential within 10 percent of, the differential measured when the coil was first installed.
 3. Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.
- E. Prepare a written cleanliness verification report. At a minimum, include the following:
 1. Written documentation of the success of the cleaning.
 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 3. Surface comparison test results if required.
 4. Gravimetric analysis (nonporous surfaces only).
 5. System areas found to be damaged.

3.5 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening.
- C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing.
- D. Replace damaged insulation.
- E. Ensure that closures do not hinder or alter airflow.
- F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

- G. Replace filters and belts in all air terminal units and air handlers.
- H. Ensure all existing equipment is properly lubricated.
- I. Inspect all and replace any damaged vibration isolation devices.

END OF SECTION 230130.51

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C at sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Re-greasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.

3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- C. Motors 1/20 HP and Smaller: Shaded-pole type.
- D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. GPT, LinkSeal[®].
 - 2. Metraflex Company (The).
 - 3. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Reinforced nylon polymer.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and

sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls below Grade:

- a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

- a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

END OF SECTION 230517

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- B. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - e. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
 - f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
 - 2. Escutcheons for Existing Piping:
 - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
 - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test Plugs.
6. Turbine flowmeters.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Ashcroft Inc.
 2. Miljoco Corporation.
 3. Nanmac Corporation.
 4. Terice, H. O. Co.
 5. Weiss Instruments, Inc.

- C. Standard: ASME B40.200.
- D. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.
- E. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- F. Connector Type(s): Union joint, adjustable angle suitable for the service, with unified-inch screw threads.
- G. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- H. Stem: 0.375 inch in diameter; stainless steel.
- I. Window: Plain glass.
- J. Ring: Stainless steel.
- K. Element: Bimetal coil.
- L. Pointer: Dark-colored metal.
- M. Accuracy: Plus or minus 1 percent of scale range.

2.2 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing: CNR.
 - 4. Material for Use with Steel Piping: CSA.
 - 5. Type: Stepped shank unless straight or tapered shank is indicated.
 - 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 - 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 - 8. Bore: Diameter required to match thermometer bulb or stem.
 - 9. Insertion Length: Length required to match thermometer bulb or stem.
 - 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 - 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. Ashcroft Inc.
 - b. Miljoco Corporation.
 - c. Trerice, H. O. Co.
 - d. Weiss Instruments, Inc.
3. Standard: ASME B40.100.
 4. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 6. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 7. Movement: Mechanical, with link to pressure element and connection to pointer.
 8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 9. Pointer: Dark-colored metal.
 10. Window: Glass.
 11. Ring: Metal.
 12. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Flow Design, Inc.
 2. National Meter, Inc.
 3. Peterson Equipment Co., Inc.
 4. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: EPDM self-sealing rubber.

2.6 FLOWMETERS

- A. Turbine Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Data Industrial Corp.
 - b. EMCO Flow Systems; a division of Spirax Sarco, Inc.
 - c. ONICON Incorporated.
3. Description: Flowmeter with sensor and indicator.
4. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
5. Sensor: Dual impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute.
 - a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water.
 - b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
 - c. Minimum Pressure Rating: 150 psig.
 - d. Minimum Temperature Rating: 250 F
6. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
7. Accuracy: Plus or minus 1-1/2 percent.
8. Display: Shows rate of flow.
9. Operating Instructions: Include complete instructions with each flowmeter.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install valve and snubber in piping for each pressure gage for fluids.
- G. Install flow indicators in piping systems in accessible positions for easy viewing.
- H. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

- I. Install flowmeter elements in accessible positions in piping systems.
- J. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.
- K. Install permanent indicators on walls or brackets in accessible and readable positions.
- L. Install connection fittings in accessible locations for attachment to portable indicators.
- M. Install thermometers in the following locations:
 - 1. Inlet and outlet of boilers, chillers, and heat exchanger.
 - 2. As indicated on drawings and details.
- N. Install pressure gages in the following locations:
 - 1. Suction and discharge of each pump, boilers, chillers and heat exchanger.
 - 2. As indicated on drawings and details.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.
- D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers each piece of hydronic equipment shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
- B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 30 to plus 130 deg F.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at suction and discharge of each pump shall be one of the following:
 - 1. Sealed, direct or remote-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 160 psi.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 160 psi.

3.8 FLOWMETER SCHEDULE

- A. Flowmeters for Chilled-Water Piping: Dual impeller turbine type.
- B. Flowmeters for Heating, Hot-Water Piping: Dual impeller turbine type.

3.9 THERMAL-ENERGY METER SCHEDULE

- A. Thermal-Energy Meters: Dual Impeller-turbine type.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Bronze ball valves.
2. Iron ball valves.
3. High-performance butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Bronze gate valves.
7. Iron gate valves.
8. Bronze globe valves.
9. Iron globe valves.
10. Balancing Valves

- B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.
4. Wrench: For plug valves with square heads. Furnish The State with 1 wrench for every 5 plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in Part 3 Execution.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.3 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nibco.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Kitz Corporation.
 - d. Sure Flow Equipment Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

2.4 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bray Controls; a division of Bray International.
 - b. Cooper Cameron Valves; a division of Cooper Cameron Corp.
 - c. Crane Co.; Crane Valve Group; Flowseal.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. DeZurik Water Controls.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Tyco Valves & Controls; a unit of Tyco Flow Control.
2. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 285 psig at 100 deg F.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.

- e. Seat: Reinforced PTFE or metal.
- f. Stem: Stainless steel; offset from seat plane.
- g. Disc: Carbon steel.
- h. Service: Bidirectional.

2.5 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.6 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Sure Flow Equipment Inc.
 - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. NPS 14 to NPS 24, CWP Rating: 150 psig.
- d. Body Design: Clear or full waterway.
- e. Body Material: ASTM A 126, gray iron with bolted bonnet.
- f. Ends: Flanged.
- g. Trim: Bronze.
- h. Gasket: Asbestos free.

2.7 BRONZE GATE VALVES

A. Class 150, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Powell Valves.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 300 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

2.8 IRON GATE VALVES

A. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.

- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Powell Valves.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. NPS 14 to NPS 24, CWP Rating: 150 psig.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Disc: Solid wedge.
- h. Packing and Gasket: Asbestos free.

2.9 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Milwaukee Valve Company.
- d. NIBCO INC.
- e. Powell Valves.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron.

2.10 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Powell Valves.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

2.11 BALANCING VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Griswold Controls.
 - e. Nexus Valve, Inc.
 - f. Taco.
 - g. Tour & Andersson; available through Victaulic Company.
2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 350 deg F.

B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Griswold Controls.
 - e. Nexus Valve, Inc.
 - f. Taco.
 - g. Tour & Andersson.
-
2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Stem Seals: EPDM O-rings.
 5. Disc: Glass and carbon-filled PTFE.
 6. Seat: PTFE.
 7. End Connections: Flanged or grooved.
 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 9. Handle Style: Lever, with memory stop to retain set position.
 10. CWP Rating: Minimum 125 psig (860 kPa).
 11. Maximum Operating Temperature: 250 deg F (121 deg C).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.

- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Check Valves: In horizontal or vertical position, between flanges.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 3. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 4. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 5. Provide chain operator for valves installed more than 7'-0" above finished floor.

3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, full port, bronze with bronze stainless-steel trim.
 - 3. Bronze Swing Check Valves: Class 150, bronze disc.
 - 4. Bronze Gate Valves: Class 150, RS, bronze.
 - 5. Bronze Globe Valves: Class 150, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:

1. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
3. High-Performance Butterfly Valves: Class 150, single flange.
4. Iron Swing Check Valves: Class 125, metal seats.
5. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.
6. Iron Gate Valves: Class 125, OS&Y.
7. Iron Globe Valves: Class 125.

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Ball Valves: Two piece, full port, bronze with bronze trim.
2. Bronze Swing Check Valves: Class 125, bronze disc.
3. Bronze Gate Valves: Class 150, RS.
4. Bronze Globe Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
3. High-Performance Butterfly Valves: Class 150, single flange.
4. Iron Swing Check Valves: Class 125, metal seats.
5. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.
6. Iron Gate Valves: Class 125, OS&Y.
7. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Metal pipe hangers and supports.
- 2. Trapeze pipe hangers.
- 3. Metal framing systems.
- 4. Thermal-hanger shield inserts.
- 5. Fastener systems.

- B. Related Sections:

- 1. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. Unistrut Corporation; Tyco International, Ltd.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Haydon Corporation; H-Strut Division.
 - c. PHD Manufacturing, Inc.
 - d. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig or

ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use

- operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
 - F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
 - G. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
 - I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
 - K. Insulated Piping:
 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3: 12 inches long and 0.048 inch thick.

- b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include reinforced insulation inserts suitable for fluid temperature of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS

- A. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- B. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 7. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 8. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 9. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 10. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 11. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 4. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 5. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 4. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Elastomeric isolation pads.
 - 2. Elastomeric isolation mounts.
 - 3. Housed-spring isolators.
 - 4. Pipe-riser resilient supports.
 - 5. Spring hangers.
 - 6. Snubbers.
 - 7. Restraint channel bracings.
 - 8. Seismic-restraint accessories.
 - 9. Mechanical anchor bolts.

1.3 DEFINITIONS

- A. IBC: International Building Code; New Jersey Edition.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
1. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
 2. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic forces required to select vibration isolators and seismic restraints and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- D. Qualification Data: For professional engineer and testing agency.
- E. Welding certificates.
- F. Field quality-control reports.
- 1.5 QUALITY ASSURANCE
- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
 - B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
 - C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on

calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: 105 mph.
2. Building Classification Category: II.
3. Minimum 10 lb/sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
 - a. Component Importance Factor: 1.
 - b. Component Response Modification Factor: 2.5.
 - c. Component Amplification Factor: 1.0 for rigid components, 2.5 for flexible components.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.516g.
4. Design Spectral Response Acceleration at 1.0-Second Period: 0.163g.
5. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.

- f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
3. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 4. Size: Factory or field cut to match requirements of supported equipment.
 5. Pad Material: Oil and water resistant with elastomeric properties.
 6. Infused nonwoven cotton or synthetic fibers.
 7. Load-bearing metal plates adhered to pads.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
3. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
4. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.

- b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 7. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top housing with attachment and leveling bolt.

2.5 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.
 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

2.6 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Eliminator Co., Inc.
 - f. Vibration Isolation.
 - g. Vibration Mountings & Controls, Inc.

3. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
10. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.7 SNUBBERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Kinetics Noise Control, Inc.
 2. Mason Industries, Inc.
 3. Vibration Mountings & Controls, Inc.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

2.8 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Cooper B-Line, Inc.
 2. Hilti, Inc.
 3. Mason Industries, Inc.
 4. Unistrut.
- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.9 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
 - 4. TOLCO.
- B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.10 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries, Inc.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- D. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- E. Install cables so they do not bend across edges of adjacent equipment or building structure.
- F. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

- I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- J. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with The State, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Valve tags.
 - 5. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 incheshigh.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting"
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 1. All Piping:
 - a. Match existing.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience connections; and

HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
 - a. Chilled Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 - c. Gas: 1-1/2 inches, round.
 2. Valve-Tag Color:
 - a. Chilled Water: Match existing.
 - b. Hot Water: Match existing.
 3. Letter Color:
 - a. Chilled Water: Match existing.
 - b. Hot Water: Match existing.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.
 - c. Primary-secondary hydronic systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

- A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 Insert number days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB or TABB.
 1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB or TABB.
 2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Engineer and the State on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide ten days' advance notice of scheduled meeting time and location.
 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

- A. Partial State Occupancy: The State may occupy completed areas of building before Substantial Completion. Cooperate with The State during TAB operations to minimize conflicts with The State's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

- B. Perform TAB after leakage and pressure tests on water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- I. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- J. Examine system pumps to ensure absence of entrained air in the suction piping.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Isolating and balancing valves are open and control valves are operational.
 - 5. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including valve position indicators, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Perform testing and balancing procedures on all existing and new Hydronic systems.
- E. Perform testing and balancing procedures on all existing and new airside systems.
- F. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.5 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.
- 3.6 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS
- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.
- 3.7 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS
- A. Balance the primary circuit flow first and then balance the secondary circuits.
- 3.8 PROCEDURES FOR HEAT EXCHANGERS
- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Check settings and operation of safety and relief valves. Record settings.
- 3.9 PROCEDURES FOR MOTORS
- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers (VFD): First, calibrate VFDs to achieve 0% to 100% operation with assistance of VFD manufacturer. Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper

operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.10 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator to within specified tolerances of indicated flow with all pumps operating. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 3. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 - 4. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 - 5. Capacity: Calculate in tons of cooling.
 - 6. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.11 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.12 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Heating-Water Flow Rate: Plus or minus 10 percent.
 - 2. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.13 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Water flow rates.
 2. Pipe and valve sizes and locations.
 3. Position of balancing devices.

E. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Service.
- d. Make and size.
- e. Model number and serial number.
- f. Water flow rate in gpm.
- g. Water pressure differential in feet of head or psig.
- h. Required net positive suction head in feet of head or psig.
- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.

2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

F. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.15 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure water flow of at least 5 percent of terminals.
 - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Verify that balancing devices are marked with final balance position.
 - d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by the State.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
3. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, the State may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.16 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230716 - HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following HVAC equipment that is not factory insulated:
 - 1. Heat exchangers.
 - 2. Chilled-water pumps.
 - 3. Heating, hot-water pumps.
 - 4. Expansion/compression tanks.
 - 5. Air separators.
 - 6. Piping system filtration unit housings.
- B. Related Sections:
 - 1. Section 230719 "HVAC Piping Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail removable insulation at equipment connections.
 - 4. Detail application of field-applied jackets.
 - 5. Detail application at linkages of control devices.
 - 6. Detail field application for each equipment type.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - 2. Sheet Form Insulation Materials: 12 inches square.
 - 3. Sheet Jacket Materials: 12 inches square.
 - 4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Breeching Insulation Schedule" and "Equipment Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
 - 2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.

- c. K-Flex USA; Insul-Sheet and K-FLEX LS.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CertaPro Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- K. Mineral-Fiber, Preformed Pipe Insulation:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.

- b. Johns Manville; MicroFlex.
- c. Knauf Insulation; Pipe and Tank Insulation.
- d. Manson Insulation Inc.; AK Flex.
- e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
 - b. - Marathon Industries; 290.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
- 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H .B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
 3. Service Temperature Range: 0 to plus 180 deg F.
 4. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 5. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering equipment.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for equipment.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated tank heads and tank side panels.
- D. Metal Jacket:
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.

- 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
- 3) Tee covers.
- 4) Flange and union covers.
- 5) End caps.
- 6) Beveled collars.
- 7) Valve covers.
- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Insulation Pins and Hangers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.

- 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
- b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy.
1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesives that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 - 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two

circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.040 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Boiler Breechings:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Heat-exchanger (water-to-water for heating service) insulation shall be one of the following:
 - 1. Manufacturer provided insulation blanket as specified.
 - 2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- C. Chilled-water pump insulation shall be one of the following:
 - 1. Cellular Glass: 3 inches thick.
 - 2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- D. Heating-hot-water pump insulation shall be one of the following:
 - 1. Calcium Silicate: 3 inches thick.
 - 2. Cellular Glass: 3 inches thick.
 - 3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- E. Chilled-water expansion/compression tank insulation shall be one of the following:
 - 1. Cellular Glass: 1-1/2 inches thick.
 - 2. Flexible Elastomeric: 1 inch thick.
 - 3. Mineral-Fiber Pipe and Tank: 1 inch thick.
- F. Heating-hot-water expansion/compression tank insulation shall be one of the following:
 - 1. Calcium Silicate: 2 inches thick.
 - 2. Cellular Glass: 1-1/2 inches thick.
 - 3. Mineral-Fiber Pipe and Tank: 1 inch thick.
- G. Chilled-water air-separator insulation shall be one of the following:
 - 1. Cellular Glass: 2 inches thick.
 - 2. Flexible Elastomeric: 1 inch thick.
 - 3. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.
 - 4. Mineral-Fiber Pipe and Tank: 1 inch thick.
- H. Heating-hot-water air-separator insulation shall be one of the following:
 - 1. Calcium Silicate: 3 inches thick.
 - 2. Cellular Glass: 3 inches thick.
 - 3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
 - 4. Mineral-Fiber Pipe and Tank: 2 inches thick.

- I. Piping system filter-housing insulation shall be one of the following:
 - 1. Cellular Glass: 3 inches thick.
 - 2. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. Aluminum, Smooth: 0.020 inch thick.
- D. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 - 1. Aluminum, Smooth with: 0.032 inch thick.

END OF SECTION 230716

SECTION 230719 - HVAC PIPING INSULATION

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Condensate drain piping, indoors.
 - 2. Chilled-water piping, indoors and outdoors.
 - 3. Heating hot-water piping, indoors.
- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230529 "Hangers & Supports for HVAC Piping & Equipment."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at pipe expansion joints for each type of insulation.
 - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Detail removable insulation at piping specialties.
 - 5. Detail application of field-applied jackets.
 - 6. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
 - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - 2. Sheet Form Insulation Materials: 12 inches square.
 - 3. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - 4. Sheet Jacket Materials: 12 inches square.
 - 5. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- D. Qualification Data: For qualified Installer.

- E. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor and Aboveground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- F. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 4. Service Temperature Range: 0 to plus 180 deg F.
 5. Color: White.

2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Metal Jacket:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.

- 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
- a. Sheet and roll stock ready for shop or field sizing.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 - 2. Width: 2 inches.
 - 3. Thickness: 3.7 mils.
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

- A. Bands:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
 - 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
 - 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt

- each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe

insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099123 "Interior Painting."
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
- B. Chilled Water, above 40 Deg F:
 - 1. NPS 12 and Smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.
- C. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
 - 1. NPS 12 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Chilled Water:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 3 inches thick.
 - b. Polyisocyanurate: 2 inches thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping:

1. PVC: 20 mils thick.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed or Exposed:
 1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.020 inch thick.
 2. Stainless Steel, Type 304 or 316, Smooth 2B Finish with Z-Shaped Locking Seam: 0.016 inch thick.

END OF SECTION 230719

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
 - 1. Section 230519 "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
 - 2. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.

3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 1 deg F.
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 1 deg F.
 - e. Ducted Air Temperature: Plus or minus 1 deg F.
 - f. Outside Air Temperature: Plus or minus 2 deg F.
 - g. Dew Point Temperature: Plus or minus 3 deg F.
 - h. Temperature Differential: Plus or minus 0.25 deg F.
 - i. Relative Humidity: Plus or minus 5 percent.
 - j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
 - k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
 - l. Airflow (Terminal): Plus or minus 10 percent of full scale.
 - m. Air Pressure (Space): Plus or minus 0.01-inch wg.
 - n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
 - o. Carbon Monoxide: Plus or minus 5 percent of reading.
 - p. Carbon Dioxide: Plus or minus 50 ppm.
 - q. Electrical: Plus or minus 5 percent of reading.

1.5 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 3. Wiring Diagrams: Power, signal, and control wiring.
 4. Details of control panel faces, including controls, instruments, and labeling.
 5. Schedule of dampers including size, leakage, and flow characteristics.
 6. Schedule of valves including flow characteristics.
 7. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 8. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
 9. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
- C. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.

1.6 INFORMATIONAL SUBMITTALS

- A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- B. Qualification Data: For Installer.
- C. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- D. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to requirements of General and Supplementary Conditions and Division 01 Specification Sections include the following:
 1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.

2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

B. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.10 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- C. Coordinate equipment with Section 262416 "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- D. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM

- A. Contractor shall evaluate condition and functionality of existing system.
- B. Utilize existing Johnson Controls Metasys N2 system. The current control system shall be upgraded as necessary and reconnected to all new and existing equipment.
- C. Existing control panels shall be replaced as necessary if they are found to be inadequate or inoperable.
- D. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.2 DDC EQUIPMENT

- A. Operator Workstation: Evaluate existing workstation and utilize if it is fully functional. Provide new workstation as add alternate. System shall be new and utilize latest generation hardware.
- B. All equipment shall be compatible with existing Johnson controls Metasys N2 system.
- C. Contractor shall supply all hardware, wiring and programming necessary to meet all performance requirements including those outlined in section 230993 "Sequence of Operations for HVAC Controls".
- D. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
 - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
 - 3. Standard Application Programs:

- a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
 - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 - c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
 - d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - e. Remote communications.
 - f. Maintenance management.
 - g. Units of Measure: Inch-pound and SI (metric).
4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
- E. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
- F. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.
- G. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

H. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.3 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
3. Enclosure: Dustproof rated for operation at 32 to 120 deg F.
4. Enclosure: Waterproof rated for operation at 40 to 150 deg F.

2.4 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

- E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.
 - 1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig.
 - 2. Proportional band shall extend from 2 to 20 percent for 5 psig.
 - 3. Authority shall be 20 to 200 percent.
 - 4. Air-supply pressure of 18 psig, input signal of 3 to 15 psig, and output signal of zero to supply pressure.
 - 5. Gages: 2-1/2 inches in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

2.5 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
 - 1. Available Manufacturers:
 - a. BEC Controls Corporation.
 - b. Ebtron, Inc.
 - c. Heat-Timer Corporation.
 - d. I.T.M. Instruments Inc.
 - e. MAMAC Systems, Inc.
 - f. RDF Corporation.
 - 2. Accuracy: Plus or minus 0.5 deg F at calibration point.
 - 3. Wire: Twisted, shielded-pair cable.
 - 4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
 - 5. Averaging Elements in Ducts: 36 inches long, flexible or 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
 - 6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
 - 7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: Exposed.
 - d. Color: white
 - e. Orientation: Horizontal.
 - 8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. RTDs and Transmitters:

1. Available Manufacturers:
 - a. BEC Controls Corporation.
 - b. MAMAC Systems, Inc.
 - c. RDF Corporation.
2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
5. Averaging Elements in Ducts: 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: Exposed.
 - d. Color: white
 - e. Orientation: Horizontal.
8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. General Eastern Instruments.
 - c. MAMAC Systems, Inc.
 - d. ROTRONIC Instrument Corp.
 - e. TCS/Basys Controls.
 - f. Vaisala.
2. Accuracy: 2 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: Exposed.
 - d. Color: white
 - e. Orientation: Horizontal.
5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.

7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- E. Pressure Transmitters/Transducers:
1. Available Manufacturers:
 - a. BEC Controls Corporation.
 - b. General Eastern Instruments.
 - c. MAMAC Systems, Inc.
 - d. ROTRONIC Instrument Corp.
 - e. TCS/Basys Controls.
 - f. Vaisala.
 2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg.
 - d. Duct Static-Pressure Range: 0- to 5-inch wg.
 3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
 4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
 5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
 6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.
- F. Room Sensor Cover Construction: Manufacturer's standard locking covers.
1. Set-Point Adjustment: Concealed.
 2. Set-Point Indication: Concealed.
 3. Thermometer: Exposed.
 4. Color: white
 5. Orientation: Horizontal.
- G. Room sensor accessories include the following:
1. Insulating Bases: For sensors located on exterior walls.
 2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
 3. Adjusting Key: As required for calibration and cover screws.

2.6 STATUS SENSORS

- A. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- B. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- C. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- D. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- E. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- F. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
 - 1. Available Manufacturers:
 - a. BEC Controls Corporation.
 - b. I.T.M. Instruments Inc.

2.7 GAS DETECTION EQUIPMENT

- A. Available Manufacturers:
 - 1. Honeywell International Inc.; Home & Building Control.
 - 2. INTEC Controls, Inc.
 - 3. MSA Canada Inc.
 - 4. Sensidyne, Inc.
 - 5. TSI Incorporated.
 - 6. Vaisala.
 - 7. Vulcain Inc.
- B. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.
- C. Oxygen Sensor and Transmitter: Single detectors using solid-state zircon cell sensing; suitable over a temperature range of minus 32 to plus 1100 deg F and calibrated for 0 to 5 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.
- D. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

2.8 FLOW MEASURING STATIONS

- A. Refer to Section 230519 "Meters and Gages for HVAC Piping" for Hydronic flow meter requirements.
- B. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.
 - 1. Available Manufacturers:
 - a. Air Monitor Corporation.
 - b. Wetmaster Co., Ltd.
 - c. Ebtron.
 - d. Or approved equal
 - 2. Casing: Galvanized-steel frame.
 - 3. Flow Straightener: Aluminum honeycomb, 3/4-inch parallel cell, 3 inches deep. (If Required.)
 - 4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.
 - 5. Piezoring for fans.

2.9 THERMOSTATS

- A. Available Manufacturers:
 - 1. Erie Controls.
 - 2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
 - 3. Sauter Controls Corporation.
 - 4. tekmar Control Systems, Inc.
 - 5. Or approved equal.
- B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.
 - 1. Label switches "FAN ON-OFF".
 - 2. Mount on single electric switch box.
- C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
- D. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.

2. Selector Switch: Integral, manual on-off-auto.
- E. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- F. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- G. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
 1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

2.10 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 3. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 4. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 1. Available Manufacturers:
 - a. Belimo Aircontrols (USA), Inc.
 - b. Or approved equal.
 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 3. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.

- e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
4. Coupling: V-bolt and V-shaped, toothed cradle.
 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 9. Temperature Rating: Minus 22 to plus 122 deg F.
 10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
 11. Run Time: 12 seconds open, 5 seconds closed.

2.11 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Hydronic system globe valves shall have the following characteristics:
 1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
 4. Sizing: 5-psig maximum pressure drop at design flow rate or the following:
 - a. Two Position: Line size.
 - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
 - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
 5. Flow Characteristics (Hydronic service): Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

- C. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
 - 1. Body Style: Lug.
 - 2. Disc Type: Non-corrosive
 - 3. Sizing: 1-psig maximum pressure drop at design flow rate.
- D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
 - 1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
 - 2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.

2.12 DAMPERS

- A. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
 - 1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that pneumatic duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install guards on thermostats in the following locations:
 1. Entrances.
 2. Public areas.
 3. Where indicated.
- E. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- F. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."
- G. Install hydronic instrument wells, valves, and other accessories according to Section 232116 Hydronic Piping Specialties."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."
- B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- D. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

- A. Field Quality control shall be performed two (2) times as follows:
 1. Initially on existing systems, controls and sensors.
 2. Post installation for all newly installed or modified systems, sensors or controls.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.
 3. Test each point through its full operating range to verify that safety and operating control set points are as required.

4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
5. Test each system for compliance with sequence of operation.
6. Test software and hardware interlocks.

D. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check DDC system as follows:
 - a. Verify that DDC controller is provided with backup power supply (UPS).
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.

E. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliamperere meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.

- b. Manually operate flow switches to verify that they make or break contact.
 6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 8. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 9. Provide diagnostic and test instruments for calibration and adjustment of system.
 10. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature set points.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.
- 3.6 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. Related Sections include the following:
 - 1. Section 230900 "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.3 SUBMITTALS

- A. Sequence of Operation: Submit Shop Drawings for each of the systems being controlled and include a written sequence of operation as it appears in these specifications. Any deviation from the written sequences shall be highlighted by the Temperature Controls Contractor (TCC) so that the A/E of Record can review, comment and respond to each change. Omission of a sequence or modification of a sequence does not relieve the TCC from providing the specified sequence.

1.4 DEFINITIONS

- A. DDC: Direct digital control.

1.5 EXISTING CONTROL SEQUENCES

- A. Controls contractor shall re-commission the existing BMS and utilize the current sequences in place for all existing to remain equipment as well as equipment replaced in kind and ensure proper operation. All equipment previously integrated with the BMS shall be reconnected as necessary.
- B. All existing or replaced in kind equipment shall operate according to existing sequences except where modified herein.
- C. Boilers, chillers, heat exchanger, pumps and appurtenances shall have new sequences integrated with existing systems to achieve intended operation.

1.6 HVAC SEQUENCE OF OPERATION

A. Chilled Water System

1. Overview: The chilled water system consists of one modular chiller with four (4) 60 Ton chiller modules and one (1) pump module with pumps. The chillers are piped up in a common header and operate under a variable flow sequence. Each module is controlled by a packaged integral controller that shall interface with the BMS. Other components consist of the chemical feed tank and expansion tank as well as a low-flow bypass.
2. Normal Operational Sequence:
 - a. Each module start/stop via the integral local chiller control panel upon a call for cooling from the BMS.
 - b. Modules shall stage BMSed on manufacturer's provided sequencing.
 - c. The chiller runs to meet the chilled water temperature set-point. The BMS reads the primary chilled water flow rate, chiller entering and leaving temperatures as well as total system load from the local controller.
 - d. The variable speed drive of the chiller pumps are controlled by a pressure transmitter located in the building piping as indicated on M-115.
 - e. The chiller pumps will modulate to control system pressure at the point of measurement.
 - f. The system bypass will modulate to maintain the required minimum differential pressure across the chiller.
3. Power Failure Operation
 - a. The chiller shall be off and a BMS alarm shall be activated indicating the chiller is not running. When power is restored, the normal startup sequence shall be followed by the local controller.

B. Heating Water System & Boiler Interface - Primary Loop

1. Overview: The Boiler control interface with the BMS system shall refer to control diagram M-403 & M-405. The heating water system consists of two (2) 3,000 MBH condensing boilers. The boilers are piped up in a "variable primary pumping" arrangement. Heating water pump force heating water through the boilers into distribution loop. The primary loop consists of two (2) pumps.
2. Boiler Plant Controller(s) (BPC) shall be interfaced to the existing BMS by the controls contractor. The boiler and boiler plant shall be controlled and sequenced through the Boiler Plant Controller (BPC) furnished by the unit manufacturer (OEM). When the BCP is herein referred to, it includes the local OEM controller on the boiler and the OEM master lead/lag controller in which ever configuration is furnished by the OEM. The controls contractor shall provide VFD Speed control of all hot water circulating pumps, and other points as coordinated by the MC through the use of pump controllers.
3. The BPC system has an internal plant automatic start adjustment that can be set and adjusted BMSed on outdoor air temperature; however, the boiler plant shall be started manually. When a given boiler is activated, its associated circulating pump shall be started simultaneously.
4. The BPC shall stage and control auxiliary equipment such as isolation valves, system bypass, etc. VFD speed control of all hot water circulating pumps is by the controls

- contractor pump controllers, which receives their enabling contact signals from the BCP thus starting the control sequence for the pumps.
5. Once the system flow switch, provided by the controls contractor, is proven open and the current status switch of the lead hot water circulating pump indicates the lead pump motor is drawing power, the boiler plant controller (BPC) shall stage on the first lead boiler and increase the boiler input as required until a preset adjustable percentage of input, nominally 40-50%, is reached as determined by the OEM. At that point, the BPC shall start a second boiler (after proving its associated combustion air damper is open and associated circulating pump is drawing power as evidenced by the associated current status switch) and decrease input on the first boiler, then modulating both boilers simultaneously in unison, to equalize both boiler inputs to maximize heating plant efficiency. The OEM lead/lag control system shall utilize the turndown ratio, run time and/or other features on each boiler as part of their lead/lag sequencing system.
 6. On a drop in heating demand, the boilers shall be sequenced by the BPC in a reverse manner. The boiler shall come off-line at the transfer setpoint (as determined by the OEM) to maximize condensing. Whether the BPC is set in a constant temperature or modulating temperature mode, it shall use the modulating ability to prevent header temperature fluctuation and maximize efficiency.
 7. The BPC shall provide adjustable reset control of the hot water supply temperature setpoint BMSed upon the outside air temperature, in accordance with a programmed outdoor air temperature reset schedule. Maximum design hot water supply temperature shall not exceed 200°F. The hot water supply temperature setpoint shall be automatically reset BMSed on primary loop control valve positions down to 140°F (adj.).
 8. The pump controllers shall automatically adjust all pump VFD speeds to maintain the differential pressure setpoint as determined by the balancing contractor, (adj.). The pumps shall be sequenced in a lead/lag fashion BMSed on run time, as the boilers are sequenced, by the BPC. Upon a call from the OEM BPC heating plant controller to enable a pump, the lead hot water pump (HWP) shall be started through its respective variable frequency drive (VFD). If the lead HWP fails, the lag HWP shall be started.
 9. On a rise in pressure, the pump speed (or pump speeds if more than one pump has been enabled by the boiler plant master controller) shall be reduced. On a further rise in pressure, the VFD(s) shall be adjusted to their minimum allowable speed to avoid motor over-heating. On a further rise in differential pressure, the pump controllers shall open the bypass valve (after no further reduction in VFD speed is allowed in order to avoid motor overheating and to maintain required minimum flow through boiler). On a drop in differential pressure the reverse sequence shall occur. Note that the hot water piping system is designed with a constant minimum flow to accommodate the hot water pumps running at their minimum speed to prevent overheating of the pump motors.
 10. Controls contractor shall provide the BMS I/O points as shown on control schematics and point lists on the contract drawings and as required accomplishing the described sequence of control. Mechanical Contractor (MC) shall coordinate with the Controls Contractor AND the Boiler Vendor/Manufacturer (OEM) for a complete system.
 11. Parallel positioning control or combustion fan speed modulation or common combustion air/fuel valve shaft arrangement (linkage-less) shall operate according to OEM's control sequence.
 12. Modulating Controller: On each boiler, a modulating temperature controller consisting of an analog temperature sensor firing rate controller, On/Off Cut-In/Cut-Out controller, and Limit controller with manual reset shall modulate the burners. Varying boiler temperatures will actuate the air/fuel metering system to maintain constant supply temperature.

C. Heat Exchanger.

1. Overview: One (1) plate and frame heat exchanger located in the boiler room provides glycol-hot water for rooftop AHUs.
2. Control Valve will modulate to maintain Glycol-heating water setpoint 161°F.

D. Boiler Room Ventilation

1. Overview: Exhaust fan EF-1 provides normal ventilation for the boiler room. Fan isolation is provided with electric actuator operated dampers provided at the intake of the fan. Two additional dampers provide pressure relief to the room.
2. Fan Status: A current switch in the motor starter provides a signal to indicate status of the fan and activate an alarm on fan failure.
3. Normal operation: Exhaust fan EF-1 shall run continuously to provide ventilation to the boiler room at low speed (250 CFM). While EF-1 is online, the relief damper on the ground floor shall remain open. If space temperature rises above 80°F EF-1 shall increase to high speed (500 CFM) and the roof gooseneck mounted relief damper shall open. Upon space temperature returning to 75°F the opposite shall occur.

E. Boiler Room Unit Heaters

1. Overview: The unit heaters will provide heat to maintain the space temperature 55°F (adj.).
2. Heating: The unit heater fan will start if there is a call for heating. Heating coil control valve will cycle on/off to maintain the room temperature setpoint via the local line voltage DPDT electric thermostat.

F. Cabinet Unit Heater, Hydronic:

1. Overview: The unit heaters will provide heat to maintain the space temperature.
2. Heating: The unit heater fan will start if there is a call for heating. Heating coil control valve will modulate open to maintain the room temperature setpoint via the local thermostat.

G. Radiators, Hydronic:

1. Local thermostatic control valves will be utilized for first floor elements fed from crawl space.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 23 11 23

FUEL GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes fuel gas piping within the building. Products include the following:
 - 1. Pipe, tube, fittings, and joining materials.
 - 2. Protective pipe and fitting coating.
 - 3. Piping specialties.
 - 4. Specialty valves.
 - 5. Service meters.
 - 6. Pressure regulators.

1.2 PROJECT CONDITIONS

- A. Gas System Pressure: Verify available pressure with local utility company.
- B. Design values of fuel gas supplied for these systems are as follows:
 - 1. Nominal Heating Value: 1000 Btu/cu. ft.
 - 2. Nominal Specific Gravity: 0.6.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Specialty valves: Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 2. Pressure regulators: Include pressure rating, capacity, and settings of selected models.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- B. Electrical Components and Devices: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. NFPA Standard: Comply with NFPA 54, "National Fuel Gas Code."
- D. Comply in strict accordance with the New York City Building Code, New York City Mechanical Code, New York City Plumbing Code and New York City Fuel Gas Code.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify fuel gas supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day.

1.6 COORDINATION

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the State or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect/Landlord not less than two days in advance of proposed utility interruptions. Do not proceed with utility interruptions without Architect's/Landlord's written permission.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 PIPES, TUBES, FITTINGS, AND JOINING MATERIALS

- A. Steel Pipe: ASTM A 53/A 53M; Type E or S; Grade B; black. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.
- B. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
- C. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
- D. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
- E. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
- F. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
- G. Joint Compound and Tape: Suitable for natural gas.
- H. Steel Flanges and Flanged Fittings: ASME B16.5.
- I. Gasket Material: Thickness, material, and type suitable for natural gas.

2.3 PROTECTIVE COATING

- A. Furnish pipe and fittings with factory-applied, corrosion-resistant polyethylene coating for use in contact with materials that may corrode the pipe.
- B. All gas piping shall be painted in yellow.

2.4 PIPING SPECIALTIES

- A. Flexible Connectors: ANSI Z21.24, copper alloy.

- B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connector.

2.5 SPECIALTY VALVES

- A. Valves, NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
- B. Valves, NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
- C. Appliance Connector Valves: ANSI Z21.15 and CSA International listed.
 - 1. Manufacturers:
 - a. Conbraco Industries, Inc.
 - b. B&K Industries, Inc.
 - c. Mueller Co.; Mueller Gas Products Div.
 - d. Watts Industries, Inc.; Water Products Div.
- D. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig minimum pressure rating.
- E. Gas Valves, NPS 2 and Smaller: ASME B16.33 and CSA International-listed bronze body and 125-psig pressure rating.
 - 1. Manufacturers:
 - a. Crane Valves.
 - b. Conbraco Industries, Inc.
 - c. Grinnell Corp.
 - d. Honeywell International Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 - 2. Tamperproof Feature: Include design for locking.
- F. Plug Valves, NPS 2-1/2 and Larger: ASME B16.38 and MSS SP-78 cast-iron, lubricated plug valves, with 125-psig pressure rating.
 - 1. Manufacturers:
 - a. Flow Control Equipment, Inc.
 - b. Milliken Valve Co., Inc.
 - c. Walworth Co.
 - 2. Tamperproof Feature: Include design for locking.
- G. General-Duty Valves, NPS 2-1/2 and Larger: ASME B16.38, cast-iron body, suitable for fuel gas service, with "WOG" indicated on valve body, and 125-psig pressure rating.
 - 1. Gate Valves: MSS SP-70, OS&Y type with solid wedge.
 - 2. Butterfly Valves: MSS SP-67, lug type with lever handle.
- H. Gas Solenoid Valves, NPS 1-1/4" and 2": UL listed, CSA certified, FM approved, CE, stainless steel 305, suitable for fuel gas service, and 25-psig pressure rating.
 - 1. Manufacturers:

- a. ASCO series 8040, 8215

2.6 PRESSURE REGULATORS

- A. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent. All pressure regulators shall be located on the roof.
 - 1. Manufacturers:
 - a. Service Pressure Regulators:
 - 1) National Meter Industries, Inc.
 - 2) Actaris Metering Systems.
 - b. Line Pressure Regulators:
 - 1) American Meter Company.
 - 2) Maxitrol Company.
 - 3) Actaris Metering Systems.
 - c. Appliance Pressure Regulators:
 - 1) Actaris Metering Systems.
 - 2) Maxitrol Company.
 - 2. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
 - 3. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 - 4. Service Pressure Regulators: ANSI Z21.80. Include 100-psig- minimum inlet pressure rating.
 - 5. Line Pressure Regulators: ANSI Z21.80 with 2-psig- minimum inlet pressure rating.
 - 6. Line Pressure Regulators: ANSI Z21.80 with 10-psig inlet pressure rating, unless otherwise indicated.
 - 7. Appliance Pressure Regulators: ANSI Z21.18. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
- B. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for fuel oil piping system to verify actual locations of piping connections before equipment installation.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off fuel gas to premises or section of piping. Perform leakage test as specified in "Field Quality Control" Article to determine that all equipment is turned off in affected piping section.

3.3 PIPING APPLICATIONS

- A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.
- B. Fuel Gas Piping, 2 psig or Less:
 - 1. NPS 1/2 and Smaller: NPS 3/4 steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 2. NPS 3/4 and NPS 1: Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 3. NPS 1-1/4 to NPS 2: Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 4. NPS 2-1/2 and Larger: Steel pipe, steel welding fittings, and welded joints.
- C. Fuel Gas Piping 2 to 5 psig:
 - 1. NPS 4 and Smaller: Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 2. Larger Than NPS 4: Steel pipe, steel welding fittings, and welded joints.
- D. Underground Fuel Gas Piping: Steel pipe, steel welding fittings, and welded joints. Encase in containment conduit.
- E. Containment Conduits: Steel pipe, steel welding fittings, and welded joints.
- F. Gas Service Piping at Meters and Regulators, More Than 5 psig: Steel pipe, steel welding fittings, and welded joints.

3.4 VALVE APPLICATIONS

- A. Appliance Shutoff Valves for Pressure 0.5 psig or Less: Appliance connector valve or gas stop.
- B. Piping Line Valves, NPS 2 and Smaller: Gas valve.
- C. Piping Line Valves, NPS 2-1/2 and Larger: Plug valve or general-duty valve.
- D. Valves at Service Meter, NPS 2 and Smaller: Gas valve.
- E. Valves at Service Meter, NPS 2-1/2 and Larger: Plug valve.

3.5 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Gas piping shall not be installed in public corridors providing access to required exits. If gas piping is run in these corridors, it shall be enclosed in a fire rated enclosure providing proper separation from the corridor.
- C. Concealed Locations: Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe with welded joints. Vent conduit to outside and terminate with screened vent cap. Portions of a piping system installed in concealed locations shall not have unions, tubing fittings, bushings, compression couplings or swing joints made by combinations of fittings.

1. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves above ceilings.
 2. In Floors: Gas piping with welded joints and protective wrapping specified in Part 2 "Protective Coating" Article may be installed in floors, subject to approval of authorities having jurisdiction. Surround piping cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 3. In Floor Channels: Gas piping may be installed in floor channels, subject to approval of authorities having jurisdiction. Channels must have cover and be open to space above cover for ventilation.
 4. In Partitions: Do not install concealed piping in solid partitions. Protect tubing from physical damage when installed inside partitions or hollow walls.
 - a. Exception: Tubing passing through partitions or walls.
 5. In Walls: Gas piping with welded joints and protective wrapping specified in Part 2 "Protective Coating" Article may be installed in masonry walls, subject to approval of authorities having jurisdiction.
 6. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, dumbwaiter shafts, elevator shafts or concealed spaces of fire rated partition.
- D. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- E. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.
- F. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.
- G. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- H. Connect branch piping from top or side of horizontal piping.
- I. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- J. Install corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
- K. Install strainer on inlet of each line pressure regulator and automatic and electrically operated valve.
- L. Install pressure gage downstream from each line pressure regulator. Pressure gages are specified in Division 15 Section "Meters and Gages."
- M. Install flanges on valves, specialties, and equipment having NPS 2-1/2 and larger connections.
- N. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.
- O. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches outside building, and vented to atmosphere. Terminate vents with turned-down,

reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar, epoxy-polyamide paint according to SSPC-Paint 16.

3.6 JOINT CONSTRUCTION

- A. Basic piping joint construction is specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Use materials suitable for fuel gas.
 - 1. Brazed Joints: Make with brazing alloy with melting point greater than 1000 deg F. Brazing alloys containing phosphorus are prohibited.
- C. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 15 Section "Hangers and Supports."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.
- B. Install piping adjacent to appliances to allow service and maintenance.
- C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.
- E. Ground equipment according to Division 16 Section "Grounding and Bonding."
 - 1. Do not use gas pipe as grounding electrode.
- F. Connect wiring according to Division 16 Section "Conductors and Cables."

3.9 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator, and specialty valve.
 - 1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

2. Nameplates, pipe identification, and signs are specified in Division 15 Section "Mechanical Identification."

3.10 PAINTING

- A. Use materials and procedures in Division 9 painting Sections.
- B. Paint exterior service meters, pressure regulators, and specialty valves.
 1. Color: Gray.
- C. Paint vertical gas piping at exterior wall to match the wall color.
- D. Paint horizontal piping the color required by authorities having jurisdiction.

3.11 FIELD QUALITY CONTROL

- A. Test, inspect, and purge piping according to NFPA 54 and requirements of authorities having jurisdiction.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.
- D. Verify correct pressure settings for pressure regulators.
- E. Verify that specified piping tests are complete.

END OF SECTION 23 11 23

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Glycol Heating-water piping.
 - 4. Makeup-water piping.
 - 5. Condensate-drain piping.
 - 6. Air-vent piping.
 - 7. Safety-valve-inlet and -outlet piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Plastic pipe and fittings with solvent cement.
 - 2. RTRP and RTRF with adhesive.
 - 3. Pressure-seal fittings.
 - 4. Chemical treatment.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Other building services.
 - 3. Structural members.
- B. Qualification Data: For Installer.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. Hot-Water Heating Piping: 100 psig at 200 deg F.
 - 2. Chilled-Water Piping: 100 psig at 200 deg F.
 - 3. Glycol Heating-Water Piping: 100 psig at 200 deg F.
 - 4. Makeup-Water Piping: 80 psig at 150 deg F.
 - 5. Condensate-Drain Piping: 150 deg F.
 - 6. Air-Vent Piping: 200 deg F.
 - 7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be the following:
1. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
 2. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
- D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- E. Glycol Heating-water piping, aboveground, NPS 2 and smaller, shall be the following:
1. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- F. Glycol Heating-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- G. Makeup-water piping installed aboveground shall be either of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- H. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- I. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- J. Air-Vent Piping:
1. Inlet: Same as service where installed.
 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- K. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.
- 3.2 PIPING INSTALLATIONS
- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet.
 - 2. NPS 1: Maximum span, 7 feet.
 - 3. NPS 1-1/2: Maximum span, 9 feet.
 - 4. NPS 2: Maximum span, 10 feet.
 - 5. NPS 2-1/2: Maximum span, 11 feet.
 - 6. NPS 3 and Larger: Maximum span, 12 feet.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.6 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232115 – CONDUIT PIPING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

This Section includes piping for Chilled Water (CHW) and Hot Water (HW) distribution systems inside of buildings. Piping includes pipes, fittings, insulation, and specialties for the following:

1. Manufactured, pre-insulated, pre-fabricated conduit piping systems.

1.2 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula $\text{Btu} \times \text{in./hr} \times \text{sq. ft.} \times \text{deg F}$ or $\text{W/m} \times \text{K}$ at the temperature differences specified. Values are expressed as Btu or W.
- B. Carrier Pipe: Hydronic service pipe used to carry fluid media such as water for the purpose of chilled water distribution.
- C. Inner Conduit: Metal casing material used to contain service piping leaks and maintain carrier pipe insulation system. Inner conduit also contains pipe support and expansion spacing.
- D. Outer Jacket: Non-metallic jacket used to contain insulation layer applied to the exterior surface of the inner metal conduit system.

1.3 ACTION SUBMITTALS

- A. Product Data: Include carrier piping, conduit and jacket insulation type and k-value, inner conduit, outer jacket, end seals, and major components for each cased piping system.
- B. Shop Drawings: Detail fabrication of anchors, alignment guides, supports, end seals, gland seals, and expansion joints and loops.
- C. Installer Certificates: Welders' certificates for welding processes and operators.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Warranties: Special warranties specified in this Section

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Qualify welding processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

- B. ASME Compliance: Comply with ASME B31.1, "Power Piping," for materials, products, and installation. PRODUCTS

1.5 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the State of other rights the State may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty, executed by Contractor, to repair dry, testable, conduit systems and replace components damaged by failure.
 - 1. Warranty Period: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - MANUFACTURERS

- 2.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - A. Prefabricated Conduit Piping Systems:
 - 1. Perma-Pipe, Inc. (Polytherm)
 - 2. Or approved equal

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

2.3 PIPES

- A. General: Applications of the following pipe materials are indicated in schedules at the end of Part 3.
- B. Copper Carrier Pipe: Drawn-Temper Copper Tubing: ASTM B 88, Type L

- C. Steel Carrier Pipe: ASTM A 53 or A106; Type S; Grade B; Schedule 80

2.4 PIPE FITTINGS

- A. General: Applications of the following fitting materials are indicated in schedules at the end of Part 3.
- B. Steel Welding Fittings: ASTM B16.9 (Buttweld), seamless.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

2.5 CONDUIT PIPING SYSTEMS

- A. Description: Factory-fabricated and -assembled, airtight and watertight, drainable, pressure-tested piping system including steel inner conduit with outer insulation and jacket, carrier pipe supports, and insulated carrier piping. Fabricate so insulation can be dried in place by forcing dry air through conduit. Factory-fabricated system shall be designed to maintain steel conduit temperature below 250F rating of polyurethane foam insulation and outer jacket system.
- B. All straight sections, fittings, anchors and other accessories shall be factory fabricated to job dimensions. Each system layout shall be computer analyzed by the piping system manufacturer to determine stresses and pipe and anticipated thermal movement of the service pipe. The system design shall be in strict conformance with ANSI B31.1, latest edition. Factory trained field technical assistance shall be provided for critical periods of installation such as unloading, field joint instruction and testing.
- C. Design Criteria:
 - 1. Maximum Temperature: 250 F.
 - 2. Maximum Pressure: 150 psig.
 - 3. Minimum Temperature: 40 F.
 - 4. Average Soil Temperature: 50 F.
 - 5. Burial Depth: 48 - 52 inches.
 - 6. Soil Conductivity Factor: 12 BTU-in/sq ft-hr-F
- D. Service Pipe: Internal piping shall be standard weight carbon steel for chilled water and copper for heating hot water. All steel joints shall be butt-welded for 2½ inches and greater, and socket or butt-welded for 2 inches and below.
- E. Clearance between Carrier Pipe Insulation and Conduit: as required by insulation thickness.
- F. Inner Conduit: Internal piping shall be standard weight carbon steel. All joints shall be butt-welded for 2½ inches and greater, and socket or butt-welded for 2 inches and below. Where possible, straight sections shall be supplied in 40-foot random lengths with piping exposed at each end for field joint fabrication. Finish interior/exterior of conduit with one coat of oven-cured epoxy, 6 mils thick. Oversized casing shall be provided to allow for carrier pipe expansion. Changes in casing size shall be accomplished by eccentric and/or concentric fittings and shall provide for continuous drainage.

G. Outer Jacket And Insulation: The outer jacket shall be fiberglass (FRP) and shall be filament wound directly onto a urethane foam insulation applied to the exterior surface of the inner conduit. No PVC or polyethylene jackets shall be allowed. All straights and fittings shall be factory jacketed. Fiberglass jacket shall be a multi-directional filament wound process for high strength, high temperature jacket.

1. All straight sections of the insulated piping system shall be filament wound, fiberglass reinforced polymer (FRP) directly applied on the insulating foam. Thermoplastic casing material such as PVC or HDPE shall not be allowed.
2. The minimum thickness for FRP jacket shall be as follows:

<u>Jacket Diameter (in)</u>	<u>Thickness (in)</u>
Less than 16	0.100
16.1 to 30	0.150

3. All fittings of the insulated piping system shall be prefabricated to minimize field joints and jacketed in a chopped spray-up, polymer (FRP), directly applied onto the insulating foam to a thickness related to the filament-wound jacket thickness.

H. Conduit Piping Supports: All piping within the inner casing (steel conduit) shall be supported at not more than 10 foot intervals. Supports shall be designed to allow continuous airflow and drainage of the conduit in place. The straight supports shall be designed to occupy not more than 10 percent of the annular air space. Supports shall be of the type where insulation thermally isolates the carrier pipe from the outer conduit. The surface of the insulation shall be protected at the support by a sleeve not less than 12 inches long, fitted with traverse and, where required, rotational arresters.

I. Fittings: Factory-fabricated fittings and tees.

J. Expansion Loops: Size casing to contain piping expansion.

K. Pressure Test of Inner (Steel) Conduit: Factory test to 15 psig (105 kPa) for four hours using soap solution. Furnish test certificates.

L. Conduit accessories include the following:

1. End seals, gland seals and anchors shall be designed and factory fabricated to prevent the ingress of moisture into the system.
2. Guides and Anchors: Steel plate welded to carrier pipes or pipe sleeves and to casing, complete with vent and drainage openings inside casing.
3. End Seals: Steel plate welded to carrier pipes and to casing, complete with drain and vent openings on vertical centerline. Terminate minimum 6 inches inside wall penetration; unless otherwise indicated.
4. Gland Seals: Packed stuffing box and gland follower mounted on steel plate, welded to end of casing, permitting axial movement of carrier piping, with drain and vent connections on vertical centerline. Terminate minimum 6 inches inside wall penetration; unless otherwise indicated.
5. Leak Plates: Steel-plate flange, 4 inches (100 mm) larger than casing and welded to casing only.
6. Drain and Vent Connections: Provide threaded drain port on conduit system drain port with valved galvanized outlet pipe and fittings and threaded end cap same size as drain port. Provide galvanized vent piping extended from conduit system vent port to

underside of top of the valve vault. Inside building entrances, extend vent piping minimum of 12 inches above conduit. Vent piping shall terminate with goose neck configuration with outlet turned down and as indicated.

2.6 FACTORY-APPLIED PIPE INSULATION

- A. Service pipe insulation shall be spray applied 0.16 k-factor, and minimum 2lb/ft³ density, polyurethane foam for straight sections and preformed polyurethane foam for all fittings. All polyurethane foam insulation shall be minimum 90% closed cell. Open cell foams shall not be allowed. To ensure no voids are present, all insulation shall be inspected by one of the following methods: visually checked prior to application of the protective jacket or infrared inspection of the entire length twenty-four hours after foaming is complete. The insulation shall be applied to the minimum thickness specified below. The insulation thickness shall not be less than indicated in these specifications.
- B. Insulation Thickness for Chilled Water Piping.
 - 1. 6" to 8" pipe: 2"
- C. Insulation Thickness for Hot Water Piping.
 - 1. 1" to 4" pipe: 1.5"

2.7 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in schedules at the end of Part 3.
- B. Welding Materials: Comply with the ASME Boiler and Pressure Vessel Code: Section II, Part C, for materials appropriate for pipe being welded.
- C. Bonding Adhesive for Fiberglass Conduit: Piping manufacturer's standard.
- D. Couplings for Fiberglass Conduit and Fittings: Piping manufacturer's standard.
- E. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

PART 3 - EXECUTION

3.1 JOINT CONSTRUCTION

- A. The internal pipe shall be hydrostatically tested to 150 psig or 1½ times the operating pressure, whichever is greater. Insulation shall then be poured in place into the field weld area. All field applied insulation shall be placed only in straight sections. Field insulation of fittings shall not be acceptable. The installer shall seal the field joint area with a heat shrinkable adhesive backed wrap or with wrappings of glass reinforcement fully saturated with a catalyzed resin identical in properties to the factory-applied resin. Backfilling shall not begin until the heat shrink wrap has

cooled or until the FRP lay-up has cured. All insulation and coating materials for making the field joint shall be furnished by the piping system manufacture and installed according to manufacturer's instructions.

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.
- B. Install components with pressure rating equal to or greater than system operating pressure.
- C. Install piping free of sags and bends.
- D. Install fittings for changes in direction and branch connections.
- E. Install couplings according to manufacturer's written instructions.
- F. Install pipe anchors to prevent stresses from exceeding those permitted by ASME B31.1 to prevent transfer of loading and stresses to connected equipment.
 - 1. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.1 and AWS D1.1.

3.3 FIELD QUALITY CONTROL

- A. Prepare hydronic carrier piping for testing according to ASME B31.1 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Isolate equipment. Do not subject equipment to test pressure.
 - 3. Install relief valve set at pressure not more than one-third higher than test pressure.
- B. Test hydronic carrier piping as follows:
 - 1. General: Tests shall be conducted before, during, and after the installation of the system. All instruments, equipment, facilities, and labor required to properly conduct the tests shall be provided by the Contractor. Test pressure gauges for a specific test shall be approved by the Engineer and shall have dials indicating not less than one and one-half (1-1/2) times nor more than three (3) times the test pressure.
 - 2. Cleaning of Piping: Prior to the hydrostatic and operating tests, the interior of the piping shall be flushed with clean water until the piping is free of all foreign materials. Flushing and cleaning out of system pipe, equipment, and components shall not be considered completed until witnessed and accepted by the State's Representative. After flushing the system is completed, the system shall be drained and filled with clean water. Temporary bypasses or temporary strainers shall be provided around equipment and control valves to prevent clogging.
 - 3. Field Tests: The following field tests shall be conducted when applicable to the system involved. If any failures occur, the Contractor shall make such adjustments or replacements as the State's Representative may direct, and the tests shall be repeated until satisfactory tests are completed.

- a. Hydrostatic Tests of Service Piping: Service piping shall be tested hydrostatically before insulation is applied at field joints, and shall be proved tight at a pressure of 100 psig. Hydrostatic test pressure shall not exceed 150 psig. Hydrostatic test pressures shall be held for a minimum of four (2) hours. If the hydrostatic test pressure cannot be held, the Contractor shall make such adjustments or replacements and the tests repeated until satisfactory results are achieved. Use ambient temperature water.
 - b. Equipment Tests: All valves and any other operable item of equipment shall be operated to verify proper operation and compliance with the specifications. Isolate equipment not rated for pipe test pressure.
 - c. Operational Tests: After installation of the prefabricated conduit system, or testable portion thereof, operational tests shall be conducted. Operational tests shall consist of operating the system at the pressure and temperature expected for the system when in normal service, and shall demonstrate satisfactory operating effectiveness. The test on each system, or portion thereof, shall last a minimum of 24 hours.
4. Use ambient temperature water.
 5. Use vents installed at high points to release trapped air while filling system. Use drains installed at low points for complete removal of liquid.
 6. After hydrostatic test pressure has been applied for 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.
 7. Prepare a written report of testing.

3.4 COMMISSIONING

- A. Open valves to fully open position.

3.5 PIPING SYSTEM SCHEDULE

- A. Chilled Water (CHW) Supply, Carrier Pipe Materials and Joining Method: Include the following:
 1. Pipe: Steel pipe.
 2. Fittings: Steel welding.
 3. Joining Method: Welding.
 4. Carrier Pipe Insulation Material and Thickness: Polyurethane 2 inches (75 mm) thick.
- B. Hot Water, Carrier Pipe Materials and Joining Method: Include the following:
 1. Pipe: Copper pipe.
 2. Fittings: Brazed.
 3. Joining Method: Brazed.
 4. Carrier Pipe Insulation Material and Thickness: Polyurethane 1.5 inch (75 mm) thick.

END OF SECTION 232115

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes special-duty valves and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Makeup-water piping.
 - 4. Condensate-drain piping.
 - 5. Air-vent piping.
 - 6. Safety-valve-inlet and -outlet piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air-control devices.
 - 3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 1. Hot-Water Heating Piping: 150 psig at 200 deg F.
 2. Chilled-Water Piping: 150 psig at 200 deg F.
 3. Glycol Heating-Water Piping: 150 psig at 200 deg F.
 4. Makeup-Water Piping: 80 psig at 150 deg F.
 5. Condensate-Drain Piping: 150 deg F.
 6. Air-Vent Piping: 200 deg F.
 7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping.
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Instrumentation and Control for HVAC."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong.
 - b. Bell & Gossett.
 - c. Griswold Controls.
 - d. Nexus Valve, Inc.
 - e. Taco.
 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Plug: Resin.
 5. Seat: PTFE.
 6. End Connections: Threaded or socket.
 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 8. Handle Style: Lever, with memory stop to retain set position.
 9. CWP Rating: Minimum 125 psig .

10. Maximum Operating Temperature: 250 deg F .

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Armstrong.
- b. Bell & Gossett.
- c. Griswold Controls.
- d. Nexus Valve, Inc.
- e. Taco.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig .
11. Maximum Operating Temperature: 250 deg F .

E. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. AMTROL, Inc.
- b. Armstrong.
- c. Bell & Gossett.
- d. Conbraco Industries, Inc.
- e. Spence Engineering Company, Inc.
- f. Watts Regulator Co.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AMTROL, Inc.
 - b. Armstrong.
 - c. Bell & Gossett.
 - d. Nexus Valve, Inc.
 - e. Taco, Inc.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/8.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AMTROL, Inc.
 - b. Armstrong.
 - c. Bell & Gossett.
 - d. Nexus Valve, Inc.
 - e. Taco, Inc.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2 .
6. Discharge Connection: NPS 1/4 .
7. CWP Rating: 150 psig .
8. Maximum Operating Temperature: 240 deg F .

C. Bladder-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong.
 - c. Bell & Gossett.
 - d. Taco, Inc.

2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong.
 - c. Bell & Gossett.
 - d. Taco, Inc.
2. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

B. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig .
5. Maximum Operating Temperature: 250 deg F

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- C. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- D. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet or air separator to expansion tank with a 2 percent upward slope toward tank.
- D. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- E. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.
- F. Pipe automatic and manual air discharge vent piping to closest floor drain.

END OF SECTION 232116

SECTION 232513 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following water treatment for closed-loop hydronic systems:
 - 1. Chemicals.

1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:
 - 1. Bypass feeders.
 - 2. Water meters.
 - 3. Inhibitor injection timers.
 - 4. pH controllers.
 - 5. TSS controllers.
 - 6. Chemical solution tanks.
 - 7. Injection pumps.
 - 8. Chemical test equipment.
 - 9. Chemical material safety data sheets.
- B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to hydronic systems.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.
- C. Field quality-control reports.
- D. Other Informational Submittals:
1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.
 2. Water Analysis: Illustrate water quality available at Project site.
 3. The Water Treatment Firm shall be approved by the State. The Contractor shall submit a list of at least three (3) installations of similar capacity, which have been successfully tested by the proposed water treatment firm for a period of five (5) consecutive years.
 4. Submit an outline of the Propylene Glycol installation procedure and condition of the water system.
 5. Written guarantee by the Water Treatment Firm and the Contractor
 6. Maintenance Materials: Test cabinet accessories, test kits and chemicals.
 7. Provide the proposed separate treatment plan for the control of biocides with hot water condensing type boilers.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.
- B. The water treatment firm shall train operating personnel in the procedures required to maintain chemical control.
- C. The water treatment firm shall be approved by the State.

1.8 GUARANTEE

- A. The Consultant Water Treatment Firm and the Contractor shall guarantee in writing, that the water systems and any component parts thereof, will experience no more than minimal scale

formation, biocides, corrosion, pitting, algae and slime growth, for a period of one year from the date of Substantial Completion of this Project, when treated in strict accordance with the Water Treatment Firm's recommendations. The initiation of the one-year warranty period shall not include the time prior to Substantial Completion. Water treatment shall be performed on the hydronic equipment as soon as it is filled with water. Bi-weekly testing and reporting of the test results shall continue for the one-year duration of the warranty period and also during any time period that the equipment is used for temporary heat.

1.9 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion and scale formation for hydronic piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:
1. Initial water analysis and HVAC water-treatment recommendations.
 2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 3. Periodic field service and consultation.
 4. Customer report charts and log sheets.
 5. Laboratory technical analysis.
 6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.
 7. Extra Materials: Furnish a one-year supply of water treatment chemicals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Champion Corp.
 2. Anderson Chemical Company.
 3. Aqua-Chem, Inc.
 4. Barclay Water Management, Inc.
 5. Cascade Water Services, Inc.
 6. Earthwise Environmental Inc.
 7. General Electric Company; GE Water & Process Technologies.
 8. Nalco; an Ecolab company.
 9. Water Services Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.

- B. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- C. Closed hydronic systems, including hot-water heating chilled water and glycol cooling, shall have the following water qualities:
 - 1. pH: Maintain a value within 8.5 to 9.5.
 - 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 - 3. Boron: Maintain a value within 100 to 200 ppm.
 - 4. Chemical Oxygen Demand(Non-Glycol Systems): Maintain a maximum value of 100 ppm.
 - 5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 - 6. TSS: Maintain a maximum value of 10 ppm.
 - 7. Ammonia: Maintain a maximum value of 20 ppm.
 - 8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
 - 9. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
 - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
 - d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
 - e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

2.3 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
 - 1. Capacity: 5 gal.
 - 2. Minimum Working Pressure: 125 psig.

2.4 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install water testing equipment on wall near water chemical application equipment.
- D. Install interconnecting control wiring for chemical treatment controls and sensors.
- E. Mount sensors and injectors in piping circuits.
- F. Bypass Feeders: Install in closed hydronic systems, including hot-water heating, chilled water and glycol heating, and equipped with the following:
 - 1. Install bypass feeder in a bypass circuit around circulating pumps unless otherwise indicated on Drawings.
 - 2. Install water meter in Chilled Water makeup-water supply.
 - 3. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
 - 4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below the feeder inlet.
 - 5. Install a swing check on the inlet after the isolation valve.

3.3 CONNECTIONS

- A. Where installing piping adjacent to equipment, allow space for service and maintenance.
- B. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Comply with requirements in Section 232116 "Hydronic Piping Specialties."
- C. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 230523 "General-Duty Valves for HVAC Piping."
- D. Comply with requirements in Section 221119 "Domestic Water Piping Specialties" for backflow preventers required in makeup-water connections to potable-water systems.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of hydronic systems' startup procedures.
 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
 8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- C. Equipment will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. At six-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising the State of changes necessary to adhere to "Performance Requirements" Article.
- F. Comply with ASTM D 3370 and with the following standards:
1. Silica: ASTM D 859.
 2. Acidity and Alkalinity: ASTM D 1067.
 3. Iron: ASTM D 1068.
 4. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train State's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.
- B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

END OF SECTION 232513

SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Listed double-wall vents.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Factory fabricated double wall vent systems.
- B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Manufacturer Seismic Qualification Certification: Submit certification that factory-fabricated breeching, chimneys, and stacks; accessories; and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Breeching, Chimneys, and Stacks: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of anchorage devices on which the certification is based and their installation requirements.

C. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain listed system components through one source from a single manufacturer.
- B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.
 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PREFABRICATED DOUBLE WALL METAL VENT FOR GAS FIRED HOT WATER CONDENSING BOILERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Selkirk Inc.
 2. Simpson Dura-Vent FasNSeal W2
 3. Van Packer Model CS
 4. Or approved equal
- B. Prefabricated double-wall metal vents shall comply with NFPA 211-2000 and NFPA 54-2006, suitable for use with natural gas fired hot water condensing boilers.
- C. Prefabricated double wall metal vents shall listed to UL 1738-93, "Venting Systems for Gas-Fired Appliances, Categories II, III and IV with Revisions through December 2000" for up to 550°F for use with low heat appliances burning natural gas.
- D. The system shall withstand without rupture an internal air pressure of 2½ times the manufacturer's rated positive pressure. The system, when sealed properly, shall maintain airtight integrity at pressures up to 5" of water column at room temperature.
- E. The double wall metal vents shall be fabricated with AL-29-4C stainless steel inner wall and Type 304 or Type 430 stainless steel outer wall to eliminate the requirement for future painting or maintenance. Between the inner and outer shells there shall be a minimum concentric 1/2"

airspace. The inner pipe and outer jacket shall be joined at the factory and shipped as a factory-assembled unit. Pipe which has the outer jacket attached during the field installation will not be approved. The gauges of the walls shall be as follows:

Inner Vent Diameter	Wall Thickness–Inner Vent	Wall Thickness-Outer Jacket
5-7”	0.015” (28ga.)	0.015” (28ga.)
8-12”	0.018” (26ga.)	0.018” (26ga.)
13-24”	0.024” (24ga.)	0.024” (24ga.)
24-32”	0.035” (20ga.)	0.030” (22ga.)

- F. The condensing boiler double wall vent from the boiler outlet to the termination above the roof shall be designed to eliminate on-site welding through the use of internal gaskets and connecting tabs/locking bands. Field sealing of any inner joints is not permissible.
- G. The stack shall be terminated with a stack cap.
- H. The prefabricated double wall metal vent system’s manufacturing company shall provide all tees, elbows, increasers, hood connectors, termination, adjustable roof flashings, storm collars, support assemblies, thimbles, flexible connectors, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Included unique components are required to comply with NFPA 54.
- I. For installation of condensing boilers in rooms where the stack penetrates the roof, provide flashing and through the roof assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

- A. Listed Special Gas Vent: Condensing gas appliances.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

- A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- B. Double Wall Metal Vents for hot water condensing boilers:

1. Install in accordance with manufacturer's installation and UL listing. Maintain minimum clearances from combustibles specified in UL listing.
 2. Seal joints between sections of positive pressure vents in accordance with manufacturer's installation instructions, and using only sealants recommended by manufacturer.
 3. Support vents at intervals recommended by the manufacturer to support the weight of the vent and all accessories, without exceeding loading of appliances.
 4. For the gas fired hot water condensing type boilers, provide a condensate drain pipe from the bottom of the boiler stack to the acid waste "pH" neutralization system. The acid neutralization system shall treat condensate drainage from the boilers' stack, condensate drain pan at each boiler module and from the "Y" test efficiency connection at each boiler module.
 5. Installations of boiler stack systems extending through the roof of the boiler room require provision of a penetration assembly or roof support assembly at the roof level.
- C. General: For prefabricated double wall vents, the manufacturer's representative shall provide on-site instructions and technical support services as required, prior to and during installation of all double wall vents. Upon completion of the installation, the manufacturer's representative shall certify in writing, that the double wall vents have been installed properly and in accordance with the manufacturer's installation instructions. The certification in writing, from the authorized manufacturing company representative, for the final field installation is a requirement from the manufacturer in order to provide the ten (10) year warranty for the system. Seal between sections of positive-pressure vents and grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- D. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- E. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- F. Lap joints in direction of flow.
- G. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to bottom.
- 3.4 CLEANING
- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
 - B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
 - C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 238229 - RADIATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes flat-pipe steel radiators.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Indicate location and size of each field connection.
 - 4. Indicate location and arrangement of piping valves and specialties.
 - 5. Indicate location and arrangement of integral controls and other accessories.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Color Samples for Initial Selection: For radiators with factory-applied color finishes.
- E. Color Samples for Verification: For each type of exposed finish.
- F. Field quality-control reports.

PART 2 - PRODUCTS

2.1 FLAT-PIPE STEEL RADIATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Hydro-Air Components Inc.

2. Quincy Hydronic Technology Inc.
 3. Runtal North America, Inc.
- B. Heating Elements: Steel, welded and formed into flat, square, steel header with minimum thickness of 0.109 inch. Include threaded piping and air-vent connections.
1. Working Pressure: 56 psig; 0.048 inch.
- C. Mounting: Wall brackets or Floor pedestals with maximum spacing of 36 inches.
- D. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.
- E. Accessories:
1. Steel piping covers finished to match radiator finish.
 2. Flexible Expansion Compensation Hoses: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F.
 - a. Length: 24 inches.
 - b. Minimum Diameter: Equal to connection size.
 3. Provide thermostatic control valves.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive radiators for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of radiators.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units level and plumb.
- B. Install expansion compensation hoses.
- C. Install piping covers.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect radiators and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."
 - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install control valves as required by Section 230900 "Instrumentation and Control for HVAC."
- D. Install piping adjacent to radiators to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 238229

SECTION 238236 - FINNED-TUBE RADIATION HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hydronic and electric baseboard radiation heaters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include details and dimensions of custom-fabricated enclosures.
 - 4. Indicate location and size of each field connection.
 - 5. Indicate location and arrangement of piping valves and specialties.
 - 6. Include enclosure joints, corner pieces, access doors, and other accessories.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Color Samples for Initial Selection: For radiation heaters with factory-applied color finishes.
- E. Color Samples for Verification: For each type of exposed finish.
- F. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HOT-WATER BASEBOARD RADIATION HEATERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings :

1. Weil-McLain:

- B. Performance Ratings: Rate baseboard radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Baseboard Radiation."
- C. Heating Elements: Cast iron active enclosure with evenly spaced, rear facing fins resting. Enclosure ends shall be threaded.
 - 1. Average Water Temperature: 190 deg F.
 - 2. Minimum Water Velocity: 1/2 fps.

2.2 ELECTRIC FINNED-TUBE RADIATION HEATERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Berko; Marley Engineered Products.
 - 2. Chromalox.
 - 3. Marley Engineered Products.
 - 4. Qmark; Marley Engineered Products.
 - 5. Trane Inc.
- B. Description: Factory-packaged units constructed according to UL 499, UL 1030, and UL 2021.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Heating Elements: Nickel-chromium-wire heating element enclosed in metallic sheath mechanically bonded to fins, with high-temperature cutout and sensor running the full length of the element. Element supports shall eliminate thermal expansion noise.
- D. Rust-Resistant Front Panel: Minimum 0.052-inch-thick, ASTM A 653/A 653M, G60 galvanized steel.
- E. Wall-Mounted Back Panel: Minimum 0.0329-inch-thick steel, full height, with full-length channel support for front panel without exposed fasteners.
- F. Floor-Mounted Pedestals: Conceal conduit for power and control wiring at maximum 36-inch spacing. Pedestal-mounted back panel shall be solid panel matching front panel.
- G. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element.
- H. Finish: Baked-enamel finish in manufacturer's custom color as selected by Architect.
- I. Damper: Knob-operated internal damper at enclosure outlet.
- J. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches, integral with enclosure.

- K. Enclosure Style: Flat top.
 - 1. Front Inlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.
 - a. Mill-finish aluminum.
 - b. Anodized finish, color as selected by Architect from manufacturer's standard colors.
 - c. Painted to match enclosure.
 - 2. Top Outlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.
 - a. Mill-finish aluminum.
 - b. Anodized finish, color as selected by Architect from manufacturer's standard colors.
 - c. Painted to match enclosure.
- L. Unit Controls: Integral line-voltage thermostat with minimum range of 60 to 90 deg F.
- M. Accessories: Integral disconnect switch, filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic-piping and electrical connections to verify actual locations before installation of finned-tube radiation heaters.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BASEBOARD RADIATION HEATER INSTALLATION

- A. Install units level and plumb.
- B. Install enclosure continuously around corners, using outside and inside corner fittings.
- C. Join sections with splice plates and filler pieces to provide continuous enclosure.
- D. Install access doors for access to valves.
- E. Install enclosure continuously from wall to wall.
- F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.
- G. Install valves within reach of access door provided in enclosure.

- H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

3.3 FINNED-TUBE RADIATION HEATER INSTALLATION

- A. Install units level and plumb.
- B. Install enclosure continuously around corners, using outside and inside corner fittings.
- C. Join sections with splice plates and filler pieces to provide continuous enclosure.
- D. Install access doors for access to valves.
- E. Install enclosure continuously from wall to wall.
- F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water radiation heaters and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."
 - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install control valves as required by Section 230900 "Instrumentation and Control for HVAC."
- D. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.
- E. Ground electric finned-tube radiation heaters according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 238236

SECTION 238239.13 - CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cabinet unit heaters with centrifugal fans and hot-water coils.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CWP: Cold working pressure.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include location and size of each field connection.
 - 4. Include details of anchorages and attachments to structure and to supported equipment.
 - 5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 6. Indicate location and arrangement of piping valves and specialties.
 - 7. Indicate location and arrangement of integral controls.
 - 8. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

- E. Samples for Verification: Finish colors for each type of cabinet unit heater indicated with factory-applied color finishes.
- F. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Airtherm; a Mestek company.
 - 2. Berko; Marley Engineered Products.
 - 3. Carrier Corporation; a UTC company.
 - 4. Chromalox, Inc.
 - 5. Dunham-Bush, Inc.
 - 6. Engineered Air.
 - 7. Indeeco.
 - 8. International Environmental Corporation.
 - 9. Markel Products Company; TPI Corporation.
 - 10. Marley Engineered Products.
 - 11. McQuay International.
 - 12. Ouellet Canada Inc.
 - 13. QMark; Marley Engineered Products.
 - 14. Rosemex Products.
 - 15. Trane Inc.
 - 16. USA Coil & Air.

2.2 DESCRIPTION

- A. Factory-assembled and -tested unit complying with AHRI 440.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 COIL SECTION INSULATION

- A. Insulation Materials: ASTM C 1071; surfaces exposed to airstream shall have aluminum-foil facing to prevent erosion of glass fibers.
 - 1. Thickness: 1/2 inch.
 - 2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
 - 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - 4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.5 CABINETS

- A. Material: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
 - 1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
 - 2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- thick sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
 - 3. Control Access Door: Key operated.
 - 4. Extended Piping Compartment: 8-inch- wide piping end pocket.

2.6 FILTERS

- A. Minimum Arrestance: According to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Washable Foam: 70 percent arrestance and MERV 3.

2.7 COILS

- A. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

2.8 CONTROLS

- A. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- B. Factory, Hot-Water Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
1. Two-way, modulating control valve.
 2. Two-Piece, Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
 3. Calibrated-Orifice Balancing Valves: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature; with calibrated orifice or venture, connection for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
 4. Y-Pattern, Hot-Water Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig minimum working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 threaded pipe and full-port ball valve in strainer drain connection.
 5. Wrought-Copper Unions: ASME B16.22.
- C. Control devices and operational sequences are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls."
- D. Basic Unit Controls:
1. Control voltage transformer.
 2. Unit-mounted thermostat with the following features:
 - a. Heat-off switch.
 - b. Fan on-auto switch.
 - c. Manual fan-speed switch.
 - d. Adjustable deadband.
 - e. Concealed set point.
 - f. Exposed indication.
 - g. Deg F indication.
 3. Unit-mounted temperature sensor.
 4. Data entry and access port.
 - a. Input data includes room temperature and occupied and unoccupied periods.
 - b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.
- E. DDC Terminal Controller:
1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.

2. Unoccupied Period Override: Two hours.
 3. Unit Supply-Air Fan Operations:
 - a. Occupied Periods: Fan runs continuously.
 - b. Unoccupied Periods: Fan cycles to maintain setback room temperature.
 4. Heating-Coil Operations:
 - a. Occupied Periods: Modulate control valve to provide heating if room temperature falls below thermostat set point.
 - b. Unoccupied Periods: Start fan and modulate control valve if room temperature falls below setback temperature.
- F. BAS Interface Requirements:
1. Interface relay for scheduled operation.
 2. Interface relay to provide indication of fault at central workstation.
 3. Interface shall be BAC-net compatible for central BAS workstation and include the following functions:
 - a. Adjust set points.
 - b. Cabinet unit-heater start, stop, and operating status.
 - c. Data inquiry, including supply-air and room-air temperature.
 - d. Occupied and unoccupied schedules.
- G. Electrical Connection: Factory-wired motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

- D. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping," Section 232116 Hydronic Piping Specialties. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Comply with safety requirements in UL 1995.
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 238239.13

SECTION 238239.16 - PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes propeller unit heaters with hot-water coils.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CWP: Cold working pressure.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include location and size of each field connection.
 - 4. Include details of anchorages and attachments to structure and to supported equipment.
 - 5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 6. Indicate location and arrangement of piping valves and specialties.
 - 7. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Airtherm; a Mestek company.
 - 2. Engineered Air.
 - 3. McQuay International.
 - 4. Rosemex Products.
 - 5. Ruffneck Heaters; a division of Lexa Corporation.
 - 6. Trane Inc.

2.2 DESCRIPTION

- A. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 2021.

2.3 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 HOUSINGS

- A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.5 COILS

- A. General Coil Requirements: Test and rate hot-water propeller unit-heater coils according to ASHRAE 33.
- B. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

2.6 FAN AND MOTOR

- A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- B. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install propeller unit heaters to comply with NFPA 90A.
- B. Install propeller unit heaters level and plumb.
- C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping," Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.

- C. Connect piping to propeller unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Comply with safety requirements in UL 1995.
- E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of propeller unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 238239.16

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Division of the Specifications requires the furnishing and installing of all items, including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include, but are not limited to, materials, labor, supervision, supplies, equipment, transportation, rigging, storage, tools, scaffolding, machinery, appliances, utilities, testing, commissioning, and all required permits and licenses.
- B. Before submittal of bid, examine all drawings, specifications, addenda, alternates, special conditions, and all other Contract Documents of all Division and Sections of this project, verify all governing conditions at the site, and become fully informed as to the extent and character of the work required, as well as its relation to other work in the building. Submittal of a bid is an agreement to all requirements of the Contract Documents, and no consideration will be granted for any claimed misunderstanding thereof.
- C. Submittal of a bid is deemed a representation by the bidder that it is qualified in all respects properly to perform the work for which it is bidding and has experience with similar work. Bidders are deemed to be aware, on the basis of their background and experience, of materials which may be required in the discharge of their responsibilities, even if unspecified. For example, claims for extras for unspecified shoring or supporting materials will not be considered if the need for such materials would have been reasonably obvious to bidders skilled and experienced in the work to be done and the submittal of a bid shall be deemed a waiver of any such claims.
- D. All statements, requirements, and contractual obligations imposed upon the Contractor awarded this Division of the Contract Documents shall also be applicable to his Subcontractors, Agents acting on behalf of the Contractor, servants and/or employees. All correspondence, agreements, and final responsibility for completion of work shall rest solely with this Contractor.

1.2 REFERENCES

- A. The entire installation and all equipment, materials and methods shall comply with the currently enforced versions of all applicable laws, rules, regulations, standards, legislation, codes and ordinances of the State of New Jersey, Underwriters Laboratory and the State of New Jersey Electrical Code. All equipment shall be approved for use in the State of New Jersey by the Authorities Having Jurisdiction. Modifications required by the above said authorities having jurisdiction shall be made without additional cost to the State.
- B. Secure and pay for necessary approvals, permits, inspections carting, legal dumping, etc., and deliver the official records of the granting of permits to the State without additional cost to the State.

- C. All equipment, materials, and methods to be furnished and/or installed by this Division shall comply with all applicable requirements of laws, codes, ordinances, legislation, standards, etc., of all federal, state, and local authorities, whether indicated on the Contract Documents or not.
- D. Where Contract Document requirements are in excess of rules, regulations and Code requirements, and are permitted under the Code, the Contract Documents shall govern. In the event of a conflict between the Contract Documents and the applicable laws, rules, regulations, codes, and ordinances of federal, state, and local authorities having jurisdiction, the latter shall govern.
- E. Where alterations to and/or deviations from the Contract Documents are required by the Authorities Having Jurisdiction, report the requirements to the Architect and Engineer and secure his written approval before starting the required modifications.
- F. Pay royalties or fees required in connection with the use of patented devices, or systems, and save the State, the Architect, and the Engineer harmless from any claims or lawsuits arising from such use and indemnify each thereof against attorneys in connection therewith.

G. Abbreviations of Regulatory Bodies

AABC	American Association of Balancing Contractors.
ADA	Americans with Disabilities Act.
AGA	American Gas Association.
AHJ	Authorities Having Jurisdiction.
AISC	American Institute of Steel Construction.
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute.
ARI	Air Conditioning and Refrigeration Institute.
ASA	Acoustical Society of America.
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers.
ASME	American Society of Mechanical Engineers.
ASPE	American Society of Plumbing Engineers.
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials.
AWS	American Welding Society.
AWWA	American Water Works Association.
CDA	Copper Development Association.
CISPI	Cast Iron Soil Pipe Institute.
EPA	Environmental Protection Agency.
ETL	Electric Testing Laboratory.
FM	Factory Mutual.
IBC/NJ	International Building Code New Jersey Edition.
IECC/NJ	International Energy Conservation Code New Jersey Edition.
IEEE	Institute of Electrical and Electronic Engineers.
IRI	Industrial Risk Insurers.
MCAA	Mechanical Contractors Association of America.
MSDS	Materials Safety Data Sheet.
MSS	Manufacturers' Standardization Society Standards.
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code

NEMA	National Electrical Manufacturers Association.
NETA	National Electrical Testing Agency
NFPA	National Fire Protection Association.
NUSIG	National Uniform Seismic Installation Guidelines.
NJSEC	The State of New Jersey Electrical Code.
OSHA	Occupational Safety Health Administration.
PDI	Plumbing and Drainage Institute.
TEMA	Tubular Exchangers Manufacturers Association.
UL	Underwriters Laboratories.

H. Definitions: For purposes of these Specifications the following definitions apply:

1. “ARCHITECT”:
the Architect of record.
2. “ENGINEER”:
the Engineer of record.
3. “CONTRACTOR”:
the individual, partnership or corporation to whom has been awarded the contract for providing the work associated with this Division.
4. “CONSTRUCTION MANAGER”
an individual or group that contracts with another organization or individual (State) for the scheduling and coordination of all design and construction processes including the selection, hiring and oversight of specialty trade contractors for a building or other structure.
5. “LIGHTING DESIGNER”:
the primary project Lighting Designer.
6. “PROVIDE”:
to “furnish” and “install”
7. “INSTALL”:
to join; unite; fasten; link; attach; set up or otherwise connect together; complete, tested and ready for normal satisfactory operation.
8. “FURNISH”:
to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application.
9. “AS DIRECTED”:
as directed by the Architect or the Engineer.
10. “CONCEALED”:
embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed within hung ceilings or accessible raised floor cavities.

11. "SUBMIT": submit to the Architect and/or the Engineer for review.
12. "FINISHED SPACES": spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
13. "EXPOSED": exposed to view.
14. "SUPPLY": to purchase, procure acquire, and deliver complete with related accessories.
15. "WORK": includes labor, materials, equipment, services, and all related accessories necessary for the proper and complete installation of complete systems.
16. "PIPING": includes pipe, tube, fittings, flanges, valves, controls, strainer, hangers, supports, unions, traps, drains, insulation, and all related accessories.
17. "WIRING": includes raceway, fittings, wire, boxes, and all related accessories.
18. "BALLAST FACTOR": ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.
19. "CRI": color rendering index; a measure of the degree of color shift objects undergo when illuminated by the light source, as compared with those same objects when illuminated by a reference source of comparable color temperature.
20. "INDICATED": as shown or noted on the drawings or specifications.
21. "CONTRACT DOCUMENTS": all documents associated with the project, including all drawings and specifications of all trades.
22. "BENEFICIAL USE": the state of installation in which all equipment related to the system being described is installed, functional, tested, and has been signed off by the State.

1.3 RELATED DOCUMENTS

- A. The General and Supplementary General Conditions accompanying these Specifications are hereby made a part of the requirements for the work under this Division. Where General Conditions and Supplementary General Conditions clauses are repeated in these Specifications, it is to call special attention to them, or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this Division shall be considered waived unless specifically stated herein.
- B. The following specification sections apply to all Work herein:
1. Section 26 05 07 - Access Doors and Color Coded Identification in General Construction.
 2. Section 26 05 10 - Electrical General.
 3. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 4. Section 26 05 20 - Heating Cable.
 5. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 6. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 7. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 8. Section 26 05 36 - Cable Trays for Electrical Systems.
 9. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 10. Section 26 05 53 - Identification for Electrical Systems.
 11. Section 26 09 23 - Lighting Control Devices.
 12. Section 26 22 13 - Low-Voltage Distribution Transformers.
 13. Section 26 24 13 - Switchboards.
 14. Section 26 24 16 - Panelboards.
 15. Section 26 27 26 - Wiring Devices.
 16. Section 26 28 13 - Fuses.
 17. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 18. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
 19. Section 26 43 00 - Surge Protective Device System
 20. Section 26 51 00 - Interior Lighting.

 21. Section 28 31 00 - Fire Detection and Alarm
- C. Certain materials will be furnished, installed, or furnished and installed, under other Sections of the Contract Documents. Examine the Contract Documents to ascertain these requirements.
- D. Refer to Divisions 21, 22, 23, 25, 27 and 28 for the scope of work related to systems furnished and installed under Divisions 21, 22, 23, 25, 27 and 28.

1.4 QUALITY ASSURANCE

- A. After completion of installation, but prior to Final Completion, this Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB's), in a format acceptable to the State. In the event no product or material is available that does not contain asbestos, PCB or hazardous materials as determined by the State, a "Materials Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

- B. All adhesives specified herein or utilized in the manufacture of equipment or components which are specified herein shall meet or exceed the VOC limits of South Coast Air Quality Management District Rule No. 1168. All sealants specified herein or utilized in the manufacture of equipment or components which are specified herein shall meet or exceed Bay Area Resources Board Reg. 8, Rule 51. Submit as part of the shop drawing process for review by the Engineer and/or State, supporting documentation which demonstrates conformance with these requirements.
- C. In the event that materials, products, and/or processes being proposed for this Project contain, or may emit, any volatile organic compounds (VOC), formaldehyde formulations, or hazardous out-gassing, as determined by the manufacturer, a “Materials Safety Data Sheet”, as described above, shall be submitted as part of the shop drawing process for review by the Engineer and/or State.
- D. Make every effort to furnish all equipment of any equipment type (such as switchboards, panelboards, distribution boards, etc.) from one manufacturer.
- E. Furnish all equipment, materials and accessories new and free from defects.
- F. All equipment and material to be furnished and installed on this Project shall be approved for use in the State of New Jersey, listed by UL, ETL or any other recognized agency, listed in accordance with the requirements of the the State of New Jersey or any other Authority having jurisdiction, and be suitable for their intended use on this Project.

1.5 ENGINEERING REFERENCE POINTS

- A. The General Contractor shall provide benchmarks, monuments, and other reference points on the job which will be available for this Contractor's use.
- B. Maintain all existing benchmarks, monuments and other reference points and perform all field engineering required to insure that work under this Section shall conform with grades, elevations and lines required.

1.6 GUARANTEE

- A. Submit a single guarantee stating that all portions of the work are in accordance with Contract requirements. Guarantee all work against faulty and improper material and workmanship for a period of one year from date of final acceptance by the State; except that where guarantees or warranties for longer terms are specified herein, such longer term shall apply. At no additional cost to the State, within 24 hours after notification, correct any deficiencies which occur during the guarantee period, all to the satisfaction of the State and Architect.
- B. Guarantee that the materials and workmanship supplied under this Division will be of the best quality currently available, that the apparatus will be erected in a practical manner and in accordance with best practices, that it will be complete in operation, nothing being omitted in the way of labor and material required to make this so, although not specifically shown or mentioned herein and that it will be delivered in proper working order, complete and perfect in every respect without additional cost – whether or not shown in detail on the drawings or described in detail in this Specification.

- C. Be responsible for all damage to or caused by the Work performed under this Division for a period of one year from date of the acceptance of work under this Contract. Repair at no cost to the State all such damage which occurs within 24 hours notice thereof by the State. Damage which occurs prior to the completion of this Work shall be repaired at once. Be responsible for any damage and repair thereof and reimburse State for all expense incurred thereby. Indemnify the State, the Architect, the Engineer against loss, liability, damage or expense, including reasonable attorneys' fees, in connection with any claim resulting from such deficiencies which may be asserted by any third party, including tenants.

1.7 COMPLETE PERFORMANCE OF WORK

- A. This Contractor under this Section of the Specifications shall provide all labor, materials, supervision, supplies, tools, scaffolding, machinery, equipment, appliances, and services (including transportation, rigging, storage utilities, etc.) and all required permits and licenses necessary to complete the Work under this Contract. All systems and equipment shall be complete in every respect and all items of material, equipment and labor shall be furnished, installed, tested and commissioned for a fully operational system.
- B. This Contractor shall coordinate his Work with the Work of the other trades so as to resolve conflicts without impeding job progress or the Project construction schedule. Provide notice with the bid proposal of any concrete work required by this Section that is not indicated on the Structural or Architectural Drawings or Drawings of other trades.
- C. This Contractor shall examine all Contract Documents for all Sections of the Specifications in order to determine the extent of Work required to be completed under this Section. Failure to examine all the Contract Documents for this Project will not relieve this Contractor of the responsibility to perform all the Work required for a complete, fully operational and satisfactory installation.
- D. Work shall be executed in strict accordance with the best practice of the trades in a thorough, workmanlike manner by competent skilled technicians and trade personnel.
- E. This Contractor shall provide a competent, experienced full-time Superintendent who is authorized to make decisions on behalf of the Contractor.
- F. Provide all temporary services and standby for power and lighting as required by the General Contractor.
- G. All labor, materials, apparatus, and appliances essential to the complete and proper functioning of the systems described and/or indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Documents or not, shall be furnished and installed by this Contractor. The entire installation shall be ready in every respect for satisfactory and efficient operation when completed.
- H. In cases of doubt as to the work intended, or in the event of need for explanation thereof, request supplementary written instructions in the form of a Request For Information (RFI) from the Architect and/or Engineer.
- I. Coordinate the work specified and shown on the Contract Documents with all other trades.

- J. Be responsible for material and workmanship until completion and final acceptance. Replace any of same which may be damaged, lost or stolen, without additional cost to the State. Guard the building and its contents against damage by this Contractor and repair any damage free of charge.
- K. Where, due to union regulations or trade agreements, any of the work shown on the drawings or specified herein is not considered this trade's work, subcontract the work in question, but assume full responsibility for the complete installation. Except for such changes as may be specifically approved by the Architects and Engineer, in accordance with alternates or options stated hereinafter, all work must be in full accordance with the intent of the plans and specifications, complete in every way and ready for satisfactory and efficient operation when delivered to the State.
- L. Provide all signage required by the authorities having jurisdiction (e.g., on electrical equipment, on doors to/from Electrical Room, etc.).
- M. Provide all rigging required for complete installation and furnish drawings showing necessary points of support, loads imposed, reactions and supplementary bracing. This shall be submitted to State for approval. Should any shoring be required, provide same after State's approval.
- N. Become thoroughly acquainted with the work involved, obtain and verify, at the building, all measurements necessary for the proper installation of work. Furnish to other contractors any information relating to work of this Division necessary for the proper installation of their contracts. Confer with other contractors for finish work adjacent to work of this section and arrange to have visible portions of the work (such as access doors, grilles, escutcheons, etc.) fit in and harmonize with the finish work of other Sections in a manner satisfactory to the Architect and State.
- O. Transmit to trades doing work of other Sections all information required for work to be provided under their respective sections (such as fresh water connections, foundations, electric wiring, access doors, and the like) in ample time for installation.
- P. Wherever this Contractor's work interconnects with work of other Contractors, this Contractor shall coordinate his work with these Contractors to ensure that all Contractors have the information necessary so that they may properly install all the necessary connections and equipment. Identify all work items (valves, dampers, pull boxes, junction boxes, etc.) in an approved manner in order that the other Trades may know where to install such items such as access doors, panels, etc.
- Q. Provide required supports and hangers for conduit, busduct, cable tray, ladder rack and equipment so that loading will not exceed allowable loadings of structure. Submittal of a bid shall be deemed a representation that the Contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports. Submit drawings showing all points of support, loads imposed, etc., to the Architect for review.
- R. Field drilling, cutting and/or reinforcing of all openings, including holes in structural metal deck, structural slabs, or structural walls, required for work under this Section shall be coordinated through the General Contractor and approved by the Structural Engineer. All such drilling, cutting and reinforcing costs shall be borne by this Contractor.

- S. Make every effort to furnish all equipment of any equipment type (such as conduit, busduct, cable tray, ladder rack and equipment) from one manufacturer. Consult with Trades doing the work of other Divisions, supplying similar equipment so that wherever possible motors, motor controls, pumps, valves switchboards, panelboards, and overcurrent protective devices, are of the same manufacture.
- T. Provide a heavy field coat of black asphaltum paint on all steel pipe, cradles, supports, vibration isolating mounts, or the like, that will be encased or partially encased in the building construction set in cement or fill, before items are built into the general construction.
- U. Sidewalks and streets adjoining the property shall be kept broom clean and free of debris, rubbish, trash and obstructions of any kind caused by work of this Contractor, which will affect the condition and safety of streets, walks, utilities and property.
- V. Comply with and install all equipment in accordance with all recommendations and requirements of the manufacturer.
- W. As part of this Project, some equipment may be furnished by the State, prepurchased, or otherwise furnished by other parties for installation as part of the Division. It is the responsibility of this Contractor to obtain a copy of the Prepurchase specification, shop drawing, and/or documentation from the furnishing party, prior to bid in order to ascertain the extent of the work required under this Division. All work required shall be provided by this Contractor.

1.8 DESCRIPTION OF BID DOCUMENTS

- A. The Drawings show the general layout of the various items of equipment. However, layout of equipment, accessories, specialties, ductbanks and conduit systems are diagrammatic unless specifically dimensioned, and do not necessarily indicate every required fitting, support, or similar items required for a complete installation. Consult the Architectural Drawings and details for exact locations of fixtures and equipment located in finished construction and/or surfaces. Where same is not definitively located, obtain the information from the Architect before proceeding by submitting a dimensioned submittal for review. Any reasonable changes in locations indicated shall be made by this Contractor without additional cost to the State.
- B. The Contractor shall follow the Drawings in laying out the Work and check drawings of all trades to verify spaces in which Work will be installed. Maintain maximum headroom and where space conditions appear inadequate, the Architect shall be notified before proceeding with the installation. (See "Submittals" Article below.)
- C. Specifications in general, describe quality and type of materials and equipment.
- D. The drawings show the various systems schematically. No added compensation will be permitted for variations due to field conditions.
- E. Where disagreements occur within the Contract Documents, the item or arrangement of better quality, greater quantity or higher cost shall be included in the base bid. Request, through the General Contractor, clarification in writing from the Architect or Engineer on which item and manner in which the work shall be installed.

- F. Work not shown on the drawings but called for in the Specifications, or vice versa, shall be provided by the Contractor without additional expense to the State.
- G. The commercially standard items of equipment and the specific names mentioned herein are intended to identify standards of quality and performance necessary for the proper functioning of the work.
- H. Equipment shown on the Drawings with particular manufacturers identified has been coordinated for structural penetrations, utility connections, operating and service (maintenance) requirements, and physical size with regard to the space where the equipment is shown. If they comply with the Project specifications, these and the other specified manufacturers of this equipment will be acceptable contingent on the Contractor providing a complete installation and maintaining full responsibility to provide, at no additional cost, any modifications to the structure, mechanical connections or electrical service that are required to properly install, operate, and service the equipment being used. These modifications shall not include additional area for equipment unless approved by the Architect.
 - 1. Note these changes on the equipment submittal and show all differences in equipment being supplied from that shown in the Contract Documents. Failure of the Contractor to provide this information with the submittal will indicate the submitted equipment meets or exceeds the equipment shown in the Contract Documents in performance and is physically no larger in housing size.
 - a. Failure of the Contractor to comply with the above and any discrepancies found shall result in the Contractor providing equipment equal to that specified at the Contractor's expense.

1.9 SUBMITTALS

- A. The term "shop drawings" shall include layout, detail, and assembly drawings, diagrams, schedules, catalogue sheets, printed descriptive matter, and tabular and graphical presentations of operating and performance data that describe work required by the Contract Documents. Catalogs and catalog sheets shall be clearly annotated indicating the specific items being proposed.
- B. Prior to Final Acceptance, the following data shall be furnished in accordance with the Conditions of the Construction Contract, Division 01 Specifications, and this Division of the Specifications, and shall include but not be limited to:
 - 1. Record Drawings.
 - 2. Operating and Maintenance Manuals.
 - 3. Contractor Coordination Drawings.
- C. In addition, during the installation period, submit detailed shop layout drawings for each floor of the project, including all Equipment Rooms, showing equipment and conduit work and other distribution services described herein, including locations and sizes of all openings in cellular steel floor decks, walls and floors. Shop drawings with multiple parts shall be submitted as a package. Shop drawings shall be 3/8 inch equal to 1 ft. 0 in. scale. Conduit shop drawings shall also indicate the point loading and spacing of each hanger and the method of support. Drawings shall include full

coordinated plans and sections for Equipment Rooms, floor plans and risers. In addition, required detail drawings, such as anchor and guide details, housekeeping pads for floor-mounted equipment, etc., shall be submitted.

- D. While the Contractor shall have access to the Engineer's drawings, neither these Engineer's drawings nor electronic files nor any other reproduced copy of the Engineer's drawings at any scale shall be used by the Contractor to generate any shop drawings. Shop drawings shall be completely drawn at the appropriate scale on clean sheets by this Contractor and/or any Subcontractor retained by this Contractor for any purpose on the project.
- E. Shop drawings for Equipment Rooms, and for conduit and similar distribution services shall show by dimension the exact size and location of each element of the system in both the horizontal and vertical plane, as well as relationship to the building structure, architectural construction, (existing and new) equipment, and the work of other Trades. Where new work is added to an existing structure, the shop drawings shall show the location of all existing services and equipment. Pads, foundations, anchorages, supports and attachments to the building structure where required for the installation of the work shall be shown in layout and detail with sizes, dimensions, materials and methods of construction noted. The work described in any shop drawing submission shall be carefully checked by this Contractor for all clearances (including those required for maintenance and servicing, e.g., racked-out position of equipment), field conditions, maintenance of architectural conditions and proper coordination with all Trades on the job. Each submitted shop drawing shall include a certification by the General Contractor that all related job conditions have been checked and that no conflict exists. Shop drawing submissions will either be rejected without such certification or the General Contractor shall remedy all conflicts without any costs to the State.
- F. Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable information. Note specified features and all applicable accessories, options, trip settings, sizes, materials, painting, etc.
- G. Prepare and submit detailed shop drawings for major conduit duct banks (more than 3 conduit run together) and other distribution services in 3/8 in. = 1 ft. 0 in. scale, including sections and locations and sizes of openings in floors, walls, roofs and beams.
- H. For each room or area of the building containing switchboards, panelboards, motor control centers, transformers, emergency generators, substations, dimming cabinets, sound system cabinets, bus ducts, telephone backboards, signal system backboards, fire alarm terminal cabinets, fire alarm control panels, consoles, etc., the following is required to be submitted for review and acceptance at the time of the equipment submittal.
 - 1. Floor Plans
 - a. Plan views (including sections and elevations) of equipment indicated in the exact location in which it is intended to be installed. These plans shall be of a scale not less than 1/4 in. = 1 ft. 0 in. They shall be prepared in the following manner:
 - 1) Indicate the physical boundaries of the space, including door swings, ceiling/clear heights and ceiling types (as applicable).

- 2) Note all Code-required clearances from all equipment by dimensions, including all service and maintenance requirements (e.g., racked-out position of equipment, etc.).
- 3) Illustrate all electrical equipment proposed to be contained herein. Include top and bottom elevations of all electrical equipment. The drawings must be prepared utilizing the dimensions contained in the individual equipment submittals.
- 4) Illustrate all other equipment therein, such as conduits, detectors, luminaires, ducts, registers, pull boxes, crown boxes, splice boxes, wireways, structural elements, etc.
- 5) Note the operating weight of each piece of equipment.
- 6) Note the heat release from each piece of electrical equipment in terms of Btu per hour. This information shall be that which is supplied by the respective manufacturers.
- 7) Illustrate all concrete pads, curbs, etc.
- 8) Indicate maximum normal allowable operating temperature for each piece of equipment (as per each respective manufacturer's recommendation).
- 9) On engine-generator layout plans, indicate position of radiator and direction of air movement and provide manufacturer's signed statement that engine will operate within approved temperature ranges and acoustical constraints.

b. Equipment Removal Routes

- 1) Provide, in conjunction with the above, a set of documents reproduced from the then current Contract Documents indicating the methods of equipment removal for all major pieces of equipment, including size of equipment when disassembled into smallest components.
- 2) Indicate on floor plans by means of arrows, the complete path for equipment removal.
- 3) Where equipment will be required to be hung temporarily from a slab or beam, note same on the submission, including the weight of the equipment to be hung and the weight of the hoisting equipment.
- 4) Note all heights of conduits, ductwork, link beams, doorways, transoms, piping, etc., in the proposed path assuring that adequate headroom is provided.

I. The Contractor shall submit shop drawings of the following work for review

1. Equipment pads, foundations and supports

2. Routing of underground services.
 3. Construction details for conduit, including routing, racking, risers, etc.
 4. Control and alarm systems.
 5. All items of manufactured material and equipment for associated systems.
 6. Other specific items of work as required by the provisions of the technical sections of the Contract Documents should be included in Submittal section.
- J. Submit manufacturer's data or shop drawings of all proposed equipment, including, but not limited to, the following:

Switchboards	Submeters
Switchboards Devices	Distribution Switchboards
Diesel Generator, Controls and Accessories	Firesafing/Firestopping
Disconnect Switches/Enclosed	Fire Detection System
Circuit Breakers	Fuses
Panelboards	Cable
Dry-Type Transformers	Luminaires
Wiring Devices	Lamps
Cable Supports	Lighting Ballast/Transformer/Power Source
Vibration Isolation Devices	Cable Identification Tags
Seismic Restraints	Conduit and Conduit Fittings
Transient Voltage Surge Suppression/ Surge Protection Device	Security System
Grounding Equipment	Nameplates
Receptacles and Switches	Heating Cable
Cable Supports	Utility CT Cabinets
	Meters

- K. Names, sizes, catalogue numbers and/or samples of the following specialties shall also be submitted for review, unless otherwise directed:

Cable and Wire	Firesafing/Firestopping
Conduit Fittings	Switches
Receptacles and Plugs	Receptacle Plates
Switchplates	Cable Identification Tags
Fire Alarm System Devices	Luminaires

- L. This Contractor shall provide a Compliance Review of all Specifications and drawings with submittals.

1. The first section of the Compliance Review will be a review of the drawings.

2. The second section will be a paragraph-by-paragraph review of the Specifications with the following information, “C”, “D”, or “E”, marked in the margin of the original Specification and any subsequent addenda.
 - a. “C”: Comply with no exceptions.
 - b. “D”: Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the specification can be satisfied.
 - c. “E”: Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives.

Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the submission is in complete compliance with the plans and Specifications. Deviations or exceptions taken in cover letters, subsidiary documents, by omission, or by contradiction do not release this Contractor from being in complete compliance, unless the exception or deviation has been specifically noted (explicitly, not by implication) in the Compliance Review.

1.10 ARCHITECT'S AND/OR ENGINEER'S REVIEW

- A. The Architect and/or Engineer will review shop drawings and samples for conformance with the design concept of the project and the information contained in the Contract Documents.
- B. The Architect's and/or Engineer's review of shop drawings and samples is only for the convenience of the State in following the work and does not relieve the Contractor of responsibility for deviations from the requirements of the Contract Documents.
- C. The Architect's and/or Engineer's review shall not be construed as a complete or detailed check of the work submitted, nor shall it relieve the Contractor of responsibility for errors of any sort in the shop drawings and samples, or from the necessity of furnishing any work required by the Contract Documents which may have been omitted from the shop drawing submittals. The review of a separate item shall not indicate review of the complete assembly in which it functions. Nothing in the Architect's and/or Engineer's review of shop drawings and samples shall be considered as authorizing 1) a departure from Contract Documents, or 2) additional cost to the State, or 3) a deviation from Code requirements, or 4) increased time for completion of the work.
- D. The Architect and/or Engineer will review shop drawings and samples with reasonable promptness and will return them to the Contractor stamped to indicate the appropriate action as follows:
 1. “NO EXCEPTIONS TAKEN” means that fabrication, manufacture or construction may proceed providing the submittal complies with the Contract Documents.
 2. “MAKE CORRECTIONS NOTED” means that fabrication, manufacture or construction may proceed providing the submittal complies with the Architect's and/or Engineer's notations and the Contract Documents. A copy of the

corrected submittal shall be returned to the Architect and/or Engineer for record. If, for any reason, the Contractor cannot comply with the notations, the Contractor shall resubmit as described for submittals stamped "REVISE AND RESUBMIT".

3. "REVISE AND RESUBMIT" means that the Contractor must comply with the Architect's and/or Engineer's notations and resubmit before fabrication, manufacture or construction may proceed. Submittals stamped in this manner are not permitted on the job site.
4. "REJECTED" means that the submittal does not comply with the Contract Documents and that fabrication, manufacture or construction shall not proceed. Submittals stamped in this manner are not permitted on the job site.
5. "REVIEWED" means the submittal has been subjected to a limited review for completeness of intended use. Submittals stamped in this manner need not be resubmitted unless review by the Architect or other Consultants has indicated otherwise.

E. All shop drawings and samples shall be identified as follows:

1. Date of submittal
2. Title of project (including floor and room designations where applicable).
3. Name of Contractor and date of his approval.
4. Name of Subcontractor, manufacturer, or supplier and date of submittal to Contractor.
5. Number of submission
6. Any qualification, departure or deviations from the requirements of the Contract Documents.
7. Federal specification, UL or other nationally recognized listing agency standard number (including a copy of each standard), or any local listing or approval where required.
8. Such additional information as may be required by the Specifications for the particular material being furnished.
9. When the submitted materials modify components, styles, etc., on the same drawing, or alternate or options available for the intended material, the material shall be appropriately annotated in a manner to avoid any misunderstanding of the submission.

F. Architect's and/or Engineer's review is for general compliance with the design concept and contract documents. Markings or comments or the lack thereof shall not be construed as relieving the Contractor from compliance with the project Contract Documents. The Contractor remains solely responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication

processes, for techniques of construction, for performing his work in a safe manner, and for coordinating his work with that of other Trades.

- G. No part of the work shall be started in the shop or in the field until the Architect and/or Engineer have reviewed the shop drawings and samples for that portion of the work. Thereafter, the work shall be executed in accordance with the Contract Documents and the indicated status of the reviewed shop drawing.
- H. Shop drawings and samples shall be submitted for review sufficiently in advance of the scheduled start of the work in the shop or in the field to allow ample time, in consideration of the number and complexity of the drawings in the submittal, for the Architect and/or Engineer to make an orderly review. No extension of the time to complete the work will be granted to the Contractor by reason of his failure in this respect.
- I. The Contractor shall carefully check shop drawings and samples, including those received by him from Subcontractors and vendors, for accuracy, completeness of required information and conformance with the Contract Documents. Shop drawings found to be inaccurate, incomplete or not in conformance with the Contract Documents shall be corrected before being submitted to the Architect and/or Engineer for review.
- J. Each submitted shop drawing shall bear the Contractor's stamped and signed certification that the work has been checked for all related job conditions, for maintenance of architectural conditions, for Code requirements, and coordinated with the shop drawings of other affected trades for interrelated work, as required for the proper and complete performance of the work. No shop drawing submittal will be reviewed without this certification.
- K. Shop drawings for manufactured material and equipment shall include model numbers, dimension drawings, operating weights, material specifications, operating features and controls, wiring diagrams, performance characteristics, service procedures, including clearance requirements for maintenance work, and conformance to specified Codes and Code ratings. Note that in addition to these requirements, other specific submittal data, and forms of data submission, are required by the Contract Documents for particular items of equipment and material.
- L. Samples shall be identical in all respects to the material which is to be installed or applied in the execution of the work, and shall be of sufficient size or quantity to permit proper evaluation and review. Manufacturer's descriptive labels and printed application instructions which are normally attached to the material or its packaging shall be furnished with the sample. Samples shall be submitted for review when requested by the Architect and/or Engineer.
- M. Within six (2) weeks after award of the Contract, the Contractor shall submit a schedule listing all shop drawings and samples with the projected date that each item will be submitted to the Architect and/or Engineer for review.
- N. Since manufacturing methods vary, reasonable minor variations are expected; however, performance and material requirements specified herein are the minimum standards acceptable. The Engineer retains the sole right to judge the equality of equipment that deviates from the Contract Documents, to reject any alternative submitted by the Contractor, and to require the specified materials and equipment which conform to the requirements of the Contract Documents be furnished.

1.11 MANUFACTURER'S RECOMMENDATIONS

- A. With the exceptions as specified and/or indicated on the Contract Documents, the Contractor shall provide or install equipment per Manufacturer's current printed instructions and recommendations. Copies of such printed recommendations shall be kept at the Project site and made available as required.
- B. Where the manufacturer's recommendations conflict with the Contract Documents, the conflict shall be brought to the Engineer's attention immediately.

1.12 SPACE LIMITATIONS

- A. The equipment selections used in the preparation of the Contract Documents will fit into the physical spaces provided and indicated, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearance in accordance with Code requirements, the requirements of the Local Authorities Having Jurisdiction, and the equipment manufacturer's recommendations.
- B. In the preparation of Drawings, a reasonable effort to accommodate acceptable equipment manufacturer's space requirements has been made. However, since space requirements and equipment arrangement vary according to each manufacturer, the responsibility for initial access, maintenance access, code required access, and proper fit rests with this Contractor.
- C. Physical dimensions and arrangements of equipment to be installed shall be subject to the Architect's and Engineer's review.
- D. Carefully check space requirements with other Sections of the Contract Documents to insure that all material can be installed in the spaces allotted thereto.
- E. Coordinate the installation of overhead conduit, busduct, cable tray, ladder rack, equipment, etc., with lighting fixtures, special ceiling construction, air distribution equipment and the structure. Provide additional rises, drops and offsets as required. If work provided under this Division is found to be in conflict with the architecture, structure, or other trade Work which is either existing or shown on the Contract Documents, the work provided under this Division shall be relocated without additional cost to the State.
- F. No piping, equipment, ductwork, conduit, etc., shall be installed in the eight (8) inch high zone directly above the proposed finished ceiling to allow for future build-out and flexibility unless otherwise specifically shown on the Drawings or prior written authorization is received from the Engineer. Wherever possible, electrical equipment distribution and branch lines shall be installed tight to structure.
- G. To avoid conflicts with the installation of future roof decking fasteners, no conduit, equipment, piping, ductwork, etc., shall be installed within 6 inches of the bottom of a metal roof deck. Whenever conduit, equipment, piping, ductwork, etc., is required to penetrate the deck, such equipment must pass through the roof at a 90 degree angle so as to preserve the 6 inch zone below the bottom of the metal deck around the penetration.
- H. Architectural drawings shall be checked for ceiling height requirements. Where no ceiling height is stated, request direction from Architect prior to commencing work.

- I. The Contractor shall follow the Drawings in laying out the Work and check drawings of all trades to verify spaces in which Work will be installed. Maintain maximum headroom and where space conditions appear inadequate, the Architect and Engineer shall be notified before proceeding with the installation.

1.13 CONTRACTOR'S COORDINATION DRAWINGS

- A. Contractor shall furnish (in writing, with copies to the Architect and General Contractor) any information necessary to permit the Work of all trades to be installed satisfactorily and with the least possible interference or delay.
- B. This Contractor shall prepare a complete set of construction "Coordination Drawings" indicating the equipment actually purchased and the exact routing and elevations for all lines such as piping, busway, conduit, ductwork, etc., including conduit embedded in concrete. All dimensions shall be referenced to building structural center lines. The "Coordination Drawing" preparation and completion shall comply with the requirements of the project construction schedule. The sheet metal drawings, prepared on electronic media (CAD) at a scale not less than 3/8 in. = 1 ft. 0 in., shall serve as the base drawings to which all other Contractors will overlay and add their work. Each trade shall draw their work on separate layers represented by individual colors. Each "Coordination Drawing" shall be completed and signed off by the other Contractors and this Contractor prior to the installation of the work in the area covered by the specific coordination drawing. The Contractor's work shall be installed in accordance with the shop drawings and the "Coordination Drawings". If the Contractor allows one trade to install their work before coordinating with the work of other trades, the Contractor shall make necessary changes to correct the condition without extra cost to the State. The Contractor's "Coordination Drawings" indicating piping, conduit, busway, and equipment support points and loads exceeding 200 lb. imposed on the building structure shall be submitted to the Project Structural Engineer for review and approval. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support, and anchor points, and the size of all lines shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. All work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated. This requirement for "Coordination Drawings" shall not be construed as authorization for the Contractor or Subcontractor to make any unauthorized changes to the Contract Drawings.

1.14 COMPOSITE WIRING DIAGRAMS

- A. For each item or piece of equipment furnished as part of this Division where there is joint wiring interface responsibility, the project-specific wiring and interlock diagrams shall be provided to the other Division Contractors which are required to make interconnections to the system.
- B. For each item or piece of equipment furnished as part of the work of other Divisions where there is joint wiring interface responsibility which includes work for this Contractor, the project-specific wiring and interlock diagrams shall be requested from the other Division Contractors. This Contractor shall modify the wiring and interlock diagram as required for his portion of the work and return it.
- C. All diagrams shall be generated based on shop drawings and submitted, revised and modified in a timely fashion. Coordinate the timing with the construction schedule.

- D. The following systems, items, etc., at a minimum, will require composite wiring diagrams. This list is in no way exhaustive and should include any and all systems which require wiring by multiple Contractors.
1. Fire alarm and detection system.
 2. Security system.
 3. Motor/pump controllers.
 4. Starters.
 5. Variable frequency drives.
 6. Emergency power system.
 7. Loading dock equipment.
 8. Electric doors.
- E. One diagram shall be provided for each piece of equipment. Diagrams shall be suitable for insertion in a three-ring binder. This process shall be completed prior to commencement of work on the particular piece of equipment or in the area within which the equipment is located.
- F. This Contractor shall review the completed diagram and verify that work provided by other Contractors will be in compliance with applicable Codes and that the system will function and operate as intended. The completed diagram shall include all line and low voltage system inter- and intra-wiring, including wiring from/to sensors, motors, starters, etc. Any errors or omissions shall be brought to the attention of the Engineer immediately.
- G. All internal wiring of panels shall be included in the composite wiring diagram in detail. For items such as motor starters, etc., any jumpers added or removed shall be labeled "added" or "removed."
- H. This Contractor shall coordinate his Division with the requirements of all other Division Contractors as to the need for terminal strips, etc., required by them to interface with and/or control equipment furnished under this Division. Each conductor termination on the composite wiring diagram shall be suitably identified by a termination number or symbol. In addition, each conductor termination shall be suitably indexed to identify the termination location of the other end of the wire.
- I. The composite wiring diagrams shall include description of the interlock sequence of operation. The description shall include complete identification of each item shown (relay, motor controller, etc.), and each item's exact operation shall be related to the interlock sequence.

1.15 RECORD DRAWINGS

- A. The Contractor shall maintain on a daily basis at the Project site a complete set of "Record Drawings". The "Record Drawings" shall consist of a set of black and white prints and AutoCAD files of the Contractor Coordination Drawings for this Division.

The prints shall include the updated AutoCAD files which shall be periodically electronically updated to show the precise location of all buried or concealed work and equipment, including embedded work, and all changes and deviations in the work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without written definite instructions from the Architect or Engineer.

- B. Dimensions shall clearly and accurately delineate the work as installed; locations shall be suitably identified by at least two dimensions to permanent structures.
- C. Upon completion of the Work, the Contractor shall certify all "Record Drawings" on the front lower right hand corner adjacent to the above marking with a rubber stamp impression or an electronic image that states the Project name, the Contractor's name, the area covered and the date.
- D. Prior to final acceptance of the Work of this Division, the Contractor shall submit properly certified "Record Drawings" to the Architect and Engineer for review and shall make changes, corrections, or additions as the Architect and/or Engineer may require to the "Record Drawings". Submit four (4) prints of each version until accepted.

1.16 ELECTRICAL EQUIPMENT AND EQUIPMENT ROOM PRECAUTIONS

- A. In general, piping or ductwork shall not be installed in any switchboard, switchgear, transformer, elevator equipment, telephone, telecommunications, or electrical equipment rooms unless this piping or ductwork serves only these rooms. Installation is strictly prohibited where it violates the requirements of the applicable Code.
- B. No piping, ducts or other equipment foreign to the electrical installation shall be installed within the dedicated zone above switchboards, panelboards, distribution boards, and motor control centers to a height of six (6) feet above the equipment or the structural ceiling whichever is lower. The area above the dedicated space shall not be permitted to contain foreign systems unless acceptable per Code, reviewed by the Engineer, and provided with leak protection.
- C. Caution workers both verbally and in writing as to the dangers involved in doing work within or adjacent to electrical equipment within electrical closets on various floors, the Mechanical Rooms and the Switchgear Rooms, elevator machine rooms, etc., due to dangers caused by presence of high voltages and currents in these spaces.
- D. Provide all necessary personal protective equipment to OSHA requirements when working in areas within live electrical equipment.

1.17 EQUIPMENT PADS AND MOUNTING

- A. Provide concrete pads for all floor-mounted equipment.
 - 1. Pads shall be provided in all equipment rooms. This shall include floor mounted equipment, equipment mounted on legs and support stands. Equipment pads shall generally conform to the shape of the piece of equipment it serves with a minimum 3 in. margin around the equipment and supports. Pads shall be a minimum of 3-1/2 in. high with all external corners bull nosed to a tooled radius. Provide equipment pad layouts to the Division furnishing the pads. Shop

drawings stamped "REVIEWED" shall be used for dimensional guidance in sizing pads anchor bolt locations, etc.

2. Concrete waterproof curbs shall be provided around all vertical utility floor penetrations. These curbs shall be identical in height to the adjacent raised floor and shall be poured as part of the floor slab. Coordinate exact dimensions of slab penetration and curb with the bus duct manufacturer.
 3. Pads or floor stands shall be provided under this Contract for all floor-mounted transformers located in electric closets. These floor stands shall be anchored to the floor slab and shall be identical in height to the adjacent raised floor.
 4. See Article titled "Submittals" for additional information required.
- B. Furnish and install galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Bolts shall be of the size and number recommended by the Manufacturer of the equipment and as required for seismic restraint. Anchor bolts shall be located by means of suitable templates. When equipment is placed on vibration isolators, the equipment shall be secured to the isolator and the isolator secured to the floor, pad, or supported as recommended by the vibration isolation manufacturer.
- C. Where allowed by the Architect and the Structural Engineer, equipment may be mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and be securely attached to the partition studs or framework. At the Contractor's option, the mounting screws may pass through the gypsum board and be securely attached to 8 in. high, continuous length, 16 gauge galvanized metal backplates which are attached to a minimum of three (3) metal studs. Toggle bolts installed in gypsum board partitions will not be acceptable. Submit all loads imposed to the Architect for review.

1.18 CUTTING AND PATCHING

- A. Coordinate all required cutting and patching with other Divisions of the Specifications.
- B. Furnish to the General Contractor necessary information so that openings for this work can be built into the floors and walls in sufficient time.
- C. Set sleeves for pipes and conduits accurately before concrete floors are poured, or set boxes on the forms to leave openings in the floors and subsequently set required sleeves in the openings.
- D. Should Contractor neglect to perform preliminary work, and should cutting be required in order to install equipment, the expense of this cutting and restoring of surfaces to their original condition shall be borne by this Contractor.

1.19 UTILITY CONNECTIONS

- A. Arrange and pay costs for all specified utilities including the following:
 1. Connection to electrical utility.
 2. Payment of service charges.

3. Provisions for temporary utilities.
4. Connections to electric and other utility points of service interface.

1.20 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Protect from damage, water, dust, etc., material and equipment provided under this Division, both in storage and installed, in accordance with manufacturer's recommendations, until Notice of Completion has been filed and accepted.
- B. Arrange with General Contractor for storage facilities for materials and equipment.
- C. All products stored off site and delivered to the site must be kept in factory packing with shipping bars, retainers and positioning devices in place until installation. Equipment which is subject to damage from moisture and/or dust must be wrapped, covered and protected, and stored indoors in a suitable environmentally-controlled area with factory covering in place until the room in which the equipment is to be placed is ready (i.e., conditioned, concrete sealed, floor finished, walls painted, etc.).
- D. Material, equipment or apparatus damaged because of improper storage or protection will be rejected.
- E. Wrap, cover and protect equipment from damage due to moisture, water, dust, spray on fireproofing and construction debris during construction
- F. Cover and protect all openings left in floor for passage of pipes or conduits. Protect conduits/pipes with suitable coverings as soon as set. Close all open ends of pipes or conduits with a plug fitting and conduits with caps to prevent obstruction and damage.
- G. Protect equipment and all systems against freezing in cold weather.
- H. Prior to starting equipment, remove all protective materials, shipping bars, retainers, positioning devices.
- I. Protect the work, equipment, and material of all other Divisions from damage by work of this Division or this Division's personnel, and correct all damage thus caused without additional cost to the State.
- J. Be responsible for all work, materials and equipment until finally inspected, tested, commissioned and accepted; protect work against theft, injury or damage; and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of dust, dirt, and obstructing material.
- K. No equipment rated for indoor use (NEMA 1) shall be set or stored in areas that are not fully enclosed and protected. If required by the schedule to deliver this equipment before the space is completed, assume all responsibility to provide a weatherproof enclosure with temporary heating and/or cooling to prohibit the entrance of moisture (condensation, etc.). Enclosure shall be built for use while working on the equipment (i.e., plastic wrap that is removed to work on the equipment shall NOT be acceptable).
- L. All equipment surfaces shall be free of moisture or water.

1.21 CONSTRUCTION REVIEW

- A. Work may be reviewed at any time by the Architect or Engineer.
- B. Advise the Architect and/or Engineer that work is ready for review with a minimum of two (2) weeks notice, at the following times:
 - 1. Prior to backfilling buried work.
 - 2. Prior to concealment of work in walls and above ceilings.
 - 3. When all requirements of Contract have been completed.

1.22 EQUIPMENT NOISE AND VIBRATION

- A. Equipment and systems, as defined herein, shall be quiet and free of apparent vibration while in operation.
- B. Vibration shall not be apparent to the senses in occupied areas of the building. To this end, both the balancing of rotating machinery and the installation of vibration isolation at various locations are required.
- C. It shall be the responsibility of this Contractor to obtain equipment that is quiet in operation as compared to other available equipment of its size, capacity, and type; to install equipment so that a minimum amount of noise and/or vibration is transmitted to the building; and to fabricate all systems so that noises generated in the systems are held to an absolute minimum.
- D. Any additional precautions deemed necessary to provide a quiet installation shall be done as part of the Work of this Division, subject to review by the Engineer and without additional cost to the State. After the systems are in operation, it shall be the responsibility of the Contractor to make any changes to equipment or Work installed that may be required to provide systems which are quiet in operation and comply with the acoustic requirements as specified herein.
- E. Except in various special areas listed herein, the system noise level, in occupied spaces, shall be equal to or less than the “lowest value in the range” of the noise criteria curves for the particular space in accordance with the current edition of Applications Volume of the ASHRAE Handbook. The noise criteria curves shall be based on ANSI Standard S1.6-1984 (R-1990) octave bands and a sound pressure level in decibels referenced to 0.002 microbars. Sound levels within the occupied spaces must meet the criteria described above and with all building, wall partition, floor, ceiling plenum depth, and ceiling construction in place as they exist for the individual spaces. The attenuation through boundary construction of Equipment Rooms must be considered in selecting equipment for acceptable noise level as described herein.
- F. The system noise level in the Tenant occupied or future Tenant-occupied spaces of the Project shall not exceed NC-35 (except as noted hereinbelow). This shall include all areas occupied by the Tenant, including areas directly under piping or any equipment.
- G. Areas that shall conform to noise criteria other than NC-35 shall include the following:
 - Lobby, Toilets, Corridors, General Offices and Cafeteria NC-40

1.23 ELECTRONIC MEDIA REQUIREMENTS

- A. All information, including, but not limited to, shop drawing submittals, “as-built” drawings, test results, and Operation and Maintenance Manuals shall be submitted on CD-ROM or DVD prior to the completion of the project.
 - 1. All cut sheets, submittals, manuals and associated information shall be in .pdf format.
 - 2. Each CD-ROM or DVD shall be indexed to allow ready access to all information.
- B. Provide a minimum of six (6) copies of each CD-ROM or DVD, unless additional copies are requested elsewhere in the Contract Documents.

1.24 RUBBISH REMOVAL

- A. Comply with the project’s Construction Waste Management Plan.
- B. At the conclusion of each day’s work, clean up and stockpile on site, at location designated by the General Contractor, all rubbish, debris and trash, which may have accumulated during the day as a result of work of this Division and of this Contractor’s presence on the job. General Contractor will then remove stockpiled rubbish.

1.25 VERIFYING EXISTING CONDITIONS

- A. Before commencing work, examine all adjoining work on which this work is in any way dependent for perfect workmanship according to the intent of this Specification, and report to General Contractor any condition which prevents performance of first-class work. No “waiver of responsibility” for incomplete, inadequate or defective adjoining work will be considered unless sufficient notice has been filed prior to commencing work.

1.26 FINAL REVIEW

- A. At a time designated, the entire installation shall be reviewed for compliance with the Contract Documents. The Contractor shall be available at all times during this Review.
- B. The Contractor shall demonstrate prior to the Final Review that all systems and all equipment have been properly installed, balanced and adjusted and are in compliance with the requirements of the Contract Documents. After these demonstration tests are completed satisfactorily, but prior to the Final Review field visit by the Engineer, submit to the Engineer a written certification that 1) attests to Contract Document compliance for this Project, and 2) certifies that the equipment and materials installed in this Project under this Division contain no asbestos or PCB’s.
- C. Certificates and Documents required herein shall be in order and presented to the Architect and Engineer at least two (2) weeks prior to the Final Review.

- D. After the Final Review, any changes or corrections noted as necessary for the Work to comply with the Contract Documents shall be accomplished without delay in order to secure final acceptance of the Work.

1.27 EARLY OCCUPANCY

- A. All Divisions are responsible for completing those systems which are necessary to allow partial occupancy of the buildings even if systems in the unoccupied areas are incomplete. Partial or early occupancy schedules will be developed by the General Contractor. Specific attention is necessary for any areas involving special spaces such as technology areas, fire alarm systems, smoke control systems, elevators, generators, etc., which will require early operation to allow the occupancy to be arranged on a schedule consistent with the needs of the project. Refer to the construction schedule for this Project for the schedule of completion dates assigned to the various portions of the Project and schedule all work accordingly.
- B. Requirements for temporary occupancy shall be verified with the Authorities Having Jurisdiction.

1.28 DATE OF COMPLETION

- A. The date for the final performance and acceptance testing shall comply with the Project construction schedule and shall be sufficiently in advance of the Contract completion date to permit the execution of the testing and commissioning by this Division prior to occupancy and the close-out of the Contract. Any adjustments and/or alterations which the final acceptance tests indicate as necessary for the proper and satisfactory functioning of all equipment and systems shall be completed prior to the close-out of the Contract. Re-tests shall not relieve this Division of completion date responsibility.
- B. Provide a detailed schedule of completion indicating when each system component and entire system is to be completed outlining when tests will be performed. Completion schedule shall be submitted to the Architect, Engineer, and State for review at a time requested by the General Contractor after the notice to proceed has been given. This schedule shall be updated periodically by this Contractor as the Project progresses. Each update shall be submitted to the General Contractor, Architect, Engineer, and State for review.

1.29 TESTING OF ELECTRICAL SYSTEMS

- A. The entire installation provided by this Contractor shall be inspected by the manufacturer and tested by this Contractor to ensure safety to building occupants and operating personnel, conformity to Code Authorities and to the Contract Documents, including the General Conditions for design services and construction procedures. Obtain, at no cost to the State, a certificate of completion.
- B. Recognized safety procedures and techniques shall be used during energizing and de-energizing of all equipment to ensure employee safety and protect the work.
- C. During the progress of the Work and upon completion, tests shall be made as specified and as required by authorities having jurisdiction including inspectors, State, State's Insurance Agency, Architect, Commissioning Authority, or Engineer. Tests shall be conducted by this Contractor and shall include the services of qualified personnel as well as all equipment, apparatus, and services required.

- D. Each wiring system with devices connected must test free from short circuits and from grounds and must have an insulation resistance between conductors and ground, based on maximum load, not less than the requirements of the relevant industry standards such as NETA, IEEE, ANSI, etc.
- E. As directed by the General Contractor, prior to the execution of testing, submit in writing proposed test procedures, recording forms, list of personnel and qualifications, and test equipment for the Engineer's and State's review.
- F. Each factory test and/or inspection shall be attended by this Contractor. The factory testing will familiarize this Division with the equipment and testing procedures that will be required at the site and allow this Division to inspect the equipment to be installed prior to shipment.
- G. Load banks, cables and connections for all (testing, heat runs, etc.) shall be provided for all tests, as part of this Contract.
- H. Provide all testing as required by Code and the authorities having jurisdiction of the electric system, equipment and components as specified herein, and in accordance with the requirements of the Contract Documents. Tests shall include but not be limited to the items specified in this Division.
- I. Coordinate all work with the State's Commissioning Authority and Commissioning Agent.
- J. Provide standby and support services to the State's Commissioning Authority and Commissioning Agent.
- K. Submit evidence to show that the testing personnel are qualified to perform the required work.
- L. All test procedures shall be in accordance with the manufacturer's recommendations for the equipment being tested.
- M. The submittal data to be furnished shall include, but not be limited to, the following:
 - 1. Method of Procedures (MOP's) for all tests proposed.
 - 2. Recording Forms.
 - 3. Test Data and Results, including the following:
 - a. Test performed.
 - b. Test procedure.
 - c. System and area tested.
 - d. Date(s) and time(s) of test.
 - e. Ambient environmental conditions.
 - f. Test criteria.

- g. Test results.
 - h. Additional pertinent data.
 - 4. Instruments, including documentation that such instruments were properly calibrated at the time of the testing.
 - 5. Personnel to be present and qualifications.
- N. Provide all materials, including fuels where appropriate, supplies, services and temporary equipment, including test equipment required for testing of specified electrical system components as well as integrated system tests, including any re-tests required to obtain acceptable results.
- O. Testing materials that fail to provide acceptable test results shall be repaired or replaced with suitable materials as required to obtain acceptable test results.
- P. Phase Balancing
 - 1. Balance, as equally as possible, the loads connected to each phase of all circuits connected to panelboards.
 - 2. At the completion of the work, check the load current in each phase of each feeder and make such adjustments as are necessary to correct load imbalance. Maximum imbalance shall not exceed 10% and shall result only from single phase loads.
 - 3. After all adjustments are made and the premises are fully occupied, take current readings on each phase at the feeders to each panelboard, lighting panel, distribution board, transformer, etc., using clamp-on ammeter(s). The readings should be taken for 30 minutes at full load (all fans, pumps, air conditioning units, etc., should run at full capacity) during normal working hours. Submit the readings to the Engineer for review and approval.
- Q. Following the short circuit, coordination and arc-flash study of the complete electrical installation, all breaker adjustable settings shall be calibrated accordingly. Primary and secondary injection testing shall not be performed until final breaker settings are calibrated. Lastly, all final site tests shall not be performed until breaker settings are adjusted and primary and secondary injection testing is complete. Provide all labels.
- R. Whenever full load tests or “burn-ins” are being performed as part of this testing scope, infrared thermoscanning of all equipment involved in the test shall be performed continuously during the full duration of the test.
- S. Check torque values of all lugs in the presence of the State or his authorized representative and provide lamacoid plates indicating proper torque in each termination compartment.
- T. Submit copies (see Article titled “Electronic Media Requirements” for quantity) of each complete test report specified herein to the Engineer for review and send a minimum of two (2) copies of each report to the State. The Contractor shall submit individual test reports for each individual system within two (2) weeks after completion of testing.

- U. The foregoing shall in no way relieve the Contractor of any warranty requirements.
- V. Prove the capacity and performance and/or demonstrate operating controls and safety devices of each piece of equipment by field tests as requested and/or specified in various Divisions of the Contract Documents. Notify the Engineer and State in writing at least two (2) months prior to the day of each test.
- W. Submit proposed commissioning process and test procedures, recording forms and test equipment for review at least six (6) months prior to the execution of the commissioning and testing.
- X. All instruments used for testing must have been calibrated within a period of three (3) months prior to testing. Written confirmation of the calibration and the method of calibration shall be submitted to the Engineer one (1) month prior to the start of the testing commencement.
- Y. After testing and/or commissioning systems, remove all dirt, dust, smears, stains, paint spots, and the like; clean and touch up finishes; and leave in like-new condition.

1.30 OPERATING INSTRUCTIONS

- A. Provide the services of a factory-trained specialist to supervise the commissioning and testing, startup, and operation of all equipment specified herein and to instruct the State's operators during a five (5) day operating instruction period at or near the Project site. The operating instruction period shall be defined as straight time working hours and shall not include nights, weekends, or travel time to and/or from the Project and shall include a period for videotaping of the operating instructions. See individual sections of these specifications for additional instructions by manufacturer trained specialists.
- B. The State shall be notified in writing at least two (2) weeks before each operating instruction period begins. Do not commence the instruction period until the State has issued his written acceptance of the starting time.

1.31 OPERATION AND MAINTENANCE MANUALS

- A. Provide operating instructions and maintenance data books for all equipment and materials furnished under this Division.
- B. Submit six (6) copies of operation and maintenance manuals for review at least ten (10) weeks before Final Review of the Project. Assemble all data in a completely indexed electronic volume(s) and identify the size, model, and features indicated for each item. Include the Project Name and Logo printed on the outside of the CD-ROM or DVD. The media shall be submitted and subjected to the same approval process as detailed for shop drawings and samples as described hereinbefore, but shall be returned as "Reviewed". Submit six (6) copies of the "Reviewed" operation and maintenance books to the State upon Project completion.
- C. Operation and Maintenance manuals shall include complete lubrication, cleaning, and servicing data compiled in clearly and easily understandable form. Data shall show serial numbers and model numbers of each piece of equipment, complete lists of replacement parts (including part numbers), motor ratings, and actual loads. Manuals

shall include information specific to the actual equipment model installed, including all options.

D. Include the following information where applicable:

1. Identifying name and mark number.
2. Locations of major equipment (where several similar items are used, provide a list).
3. Complete nameplate data.
4. "Reviewed" submittals.
5. Parts lists.
6. Performance curves and data.
7. Wiring diagrams.
8. Lubrication charts.
9. Manufacturers' recommended operation and maintenance instructions with all non-applicable information deleted.
10. List of spare parts recommended for normal service requirements.
11. Assembly and disassembly instructions with exploded view Drawings where available.
12. Troubleshooting diagnostic instructions where available.
13. Description of alarm and trouble codes for software-based systems.
14. Set points.

1.32 CERTIFICATION

- A. Any certifications required by the Contract Documents, in addition to those required for shop drawings, product data, equipment and other items, shall be so certified by the State, a Partner, or a Corporate Officer of the firm required to provide the Certification, or by another person duly authorized to sign binding agreements for and in behalf of the State, Partner, or Corporation.

1.33 WARRANTY PERIOD

- A. The warranty period shall be no less than two (2) full years, unless specified otherwise hereinafter.
- B. During the warranty period, the Contractor shall guarantee the following in a form satisfactory to the State:
1. All work installed will be free from any and all defects in workmanship and/or materials.

- 2. All equipment, systems and apparatus will develop capacities and performance characteristics specified.
- 3. The systems shall operate without malfunction.
- C. Remedy, without cost to the State, any defects within a reasonable time to be specified in notice from the Architect or Engineer. In default thereof, the State may have such work done and charge back all costs.
- D. The start of the warranty period, as defined in the General Conditions, shall commence on the issue of a "Certificate of Substantial Completion" by the State or the State's Representative for each item of material, equipment, or system.
- E. Confer with the State or State's Representative prior to the bid date concerning the project schedule and determine if there is a need to operate any items of equipment or systems for temporary light, power, heating and/or cooling or other reasons prior to "Substantial Completion". All required extended warranty costs for equipment, materials, and systems shall be included in the bid.
- F. Provide complete documentation of all prefunctional, functional, component, and system tests prior to State acceptance and turnover of components or systems. In addition, the State reserves the right to review all test objectives, test plans and test cases, and witness all preoperational tests. Provide the State with a comprehensive schedule detailing the preparation of testing documentation and the conduct of all component or system tests.
- G. Warrant that all components, subsystems and systems will perform their specified functions from the date of turnover and commercial operation through the useful life of the system, as determined by the various equipment manufacturers and installing Contractor(s). In the event components fail for any reason, be responsible to repair, replace and reimburse the State for all costs associated with the component, subsystem or system that failed to perform the specified function.

1.34 DELIVERY, DRAYAGE AND HAULING

- A. Include all drayage, hauling, hoisting, shoring, and placement in the building of equipment and materials specified herein, including any equipment prepurchased by the State or State's Representative for installation by this Contractor. Be responsible for the timely delivery, introduction and placement of equipment to the Project as required by the construction schedule for this Project. If any item of equipment is received prior to the time it is required, be responsible for its proper storage and protection until such time as it may be required. Pay for all costs of demurrage or storage in a bonded warehouse.
- B. If any item of equipment is not delivered to or installed at the Project site in a timely manner as required by the Project construction schedule, this Contractor shall be solely responsible for disassembly, re-assembly, manufacturer's supervision, shoring, general construction modifications, delays, overtime costs, manufacturer's re-certification, etc. No additional cost or delays shall be incurred by the State.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Refer to all other Divisions for additional equipment requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation shall be in accordance with the Contract Documents for all Divisions pertaining to the individual equipment and/or systems.

END OF SECTION 260500

SECTION 260507 - ACCESS DOORS AND COLOR-CODED IDENTIFICATION IN

GENERAL CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all access doors herein specified and where required. Access doors in general construction will be installed by the General Contractor, and in accordance with the requirements of the Contract Documents.
- B. Section includes:
 - 1. Access Door Construction.
 - 2. Access Door Sizes and Types.
 - 3. Color Coded Identification.

1.2 RELATED DOCUMENTS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 10 - Electrical General.
 - 3. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 4. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 5. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 6. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 7. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 8. Section 26 05 53 - Identification for Electrical Systems.
 - 9. Section 26 09 23 - Lighting Control Devices.
 - 10. Section 26 27 26 - Wiring Devices.
 - 11. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. All access doors shall be designed and manufactured in accordance with the latest applicable codes, including the following:
 - 1. IBCNJ - International Building Code New Jersey Edition.
 - 2. NEC - National Electrical Code with New Jersey Amendments.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:
 - 1. Access Doors, including construction, sizes, types, fire ratings and locations superimposed on conduit layout shop drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the Division 01 and Section 26 05 00

1.6 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not allow the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of these Specifications.
- B. Any and all substitutions must be included in the Contractor's Base Bid, as a voluntary DEDUCT alternate in the Contractor's Bid Proposal, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be all inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project Specifications/documents will not be revised to reflect the substitution should the substitution be approved.
- C. If it complies with these Specifications, cable tray and fittings manufactured by one of the following manufacturers will be acceptable:
 - 1. J.L. Industries.
 - 2. Karp Associates, Inc.
 - 3. Milcor Inc.
 - 4. Nystrom, Inc.

2.2 ACCESS DOOR CONSTRUCTION

- A. Provide frame to match surrounding surface.
- B. Provide recessed type as required to accept matching tile, etc.
- C. Provide UL rated doors for fire-rated construction.
- D. Provide flush-type steel framed panel with concealed hinges.
- E. Provide cam-type locking device.

- F. Provide locked access doors located in public corridors and washrooms complete with master keys.

2.3 ACCESS DOOR SIZES AND TYPES

- A. Furnish access doors of proper size for access to concealed equipment. Access doors in general construction shall be installed under another Section. Unless otherwise indicated, minimum size shall be 12 in. x 12 in. for hand access and minimum 18 in. x 18 in. for arm access in conformance with the following schedule:

- | | |
|------------------------------------|--|
| 1. Rated Walls and Vertical Shaft | - Inryco/Milcor fire-rated Enclosures
access door - UL label on door. |
| 2. Non-rated Dry Wall Construction | - Inryco/Milcor Style DW. |
| 3. Non-rated Masonry, Concrete | - Inryco/Milcor Style M Standard. |
| 4. Non-rated Ceramic Tile | - Inryco/Milcor Style M - Stainless. |
| 5. Non-rated Plaster Wall | - Inryco/Milcor Style K. |
| 6. Non-rated Plaster Ceilings | - Inryco/Milcor Style AP. |

2.4 COLOR-CODED IDENTIFICATION

- A. Furnish color-coded buttons or tabs to indicate the location of equipment above removable-type acoustical ceilings where access doors are not required. Provide color-coded dots on access doors to indicate type of service as herein specified.

PART 3 - EXECUTION

3.1 ACCESS DOOR INSTALLATION

- A. All access doors shall be installed in accordance with the latest industry standards, per the manufacturer's recommendations, where required for equipment needing access concealed by construction.
- B. Provide direction in locating and setting of access doors in hung ceilings, furred spaces, walls, etc., to provide access to concealed work items requiring maintenance and/or adjustment. No access door in general construction shall be installed until the location and type have been reviewed and approved by the Architect.
- C. Locate and group equipment requiring access doors so that access door locations are aesthetically acceptable. Prepare drawings of junction boxes, pull boxes, and equipment locations indicating proposed access door locations for review by the Architect prior to installation of junction boxes, pull boxes, equipment, etc. Coordinate location of equipment with other trades to minimize number of access doors in one area.
- D. Provide access doors for maintenance or adjustment purposes for electrical system components, including but not limited to the following:
 - 1. Junction Boxes.
 - 2. Pull Boxes.
 - 3. Switches and Contactors.

4. Motor Controllers.

E. Improperly located or sized access doors shall be corrected prior to final review.

3.2 COLOR CODED IDENTIFICATION

A. Removable ceiling tile and access doors to be marked by small color markings at corner of tile or door in accordance with the following color assignments:

1. Electrical - Green.
2. Fire Alarm System - Red.

B. Improperly located or sized color coding identification shall be corrected prior to final review.

3.3 FACTORY TESTING

A. All access doors shall be tested in accordance with the latest applicable industry standards.

3.4 FIELD TESTING

A. Refer to Section 26 08 00 for additional testing requirements for access doors.

END OF SECTION 260507

SECTION 260510 - ELECTRICAL GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The Work includes but is not limited to providing (i.e., furnishing and installing) and testing and commissioning of the following systems, equipment, and services:
1. All work associated with the introduction of electrical services.
 2. Service switchboards and PSE&G electric metering provisions.
 3. Distribution, and panelboards for lighting and power.
 4. Feeders, and branch circuiting for light, power and control wiring, including connections to all service switchboards, distribution switchboards, transfer switches, panelboards, transformers, motor starter groups, motor control equipment, disconnect devices, outlets, motors and equipment included in the Contract Documents.
 5. Fire alarm and detection system.
 6. Provide smoke detector elements in the ductwork in cutouts provided under another Division. Obtain the necessary approvals for installed detectors. Closely coordinate the installation of all smoke detector elements with the work of the Heating, Ventilating and Air Conditioning Section of the Contract Documents.
 7. Lighting equipment, luminaires, lamps, ballasts (if not integral to the fixture), contactors, power supplies, etc.
 8. Lighting control equipment, including, but not limited to, factory pre-assembled and pre-wired lighting control cabinets, wall-mounted control stations, remote control devices and peripheral equipment (if not integral to the system), control interfaces, system network wiring, mounting hardware, and plug boxes for portable lighting fixtures, etc.
 9. Power and raceways for telecommunications, security and audio/visual equipment.
 10. A complete electrical grounding system.
 11. Heating cable for freeze protection of all piping.
 12. Standby/emergency light and power system, installation and testing of the prepurchased standby/emergency power system, including automatic transfer switches.
 13. Installation and wiring of individual motor controllers and motor control centers, including variable speed/frequency drives furnished by other Divisions.

14. Connection of all motors, equipment, interlocks, safety devices, and other components as specified herein or as specified in other Divisions.
15. All interlock wiring not provided by Division 21, 22, 23 and 25, including all 120 volt and 120/208 volt power circuits (coordinate with other Sections).
16. Wiring and connection to all conveying systems equipment being furnished or provided under Division 14.
17. Connection of all equipment furnished under other Divisions and/or by the State.
18. Remove the plastic coverings on the lighting fixtures when required by the Air Balancing Contractor.
19. Miscellaneous items as required for complete and functioning systems as specified herein and indicated on the Contract Documents.
20. All excavation and back-fill required for the work of this Division.
21. Supports, vibration isolation and seismic restraint devices.
22. Labor and/or standby assistance in testing and commissioning of all equipment and systems, including modification to existing equipment and/or systems, provided by this and other Divisions, including:
 - a. Prefunctional test.
 - b. Functional test.
 - c. System test.
 - d. Integrated test.
23. All time required for the detailed development and review of the commissioning documents and process as required by the Commissioning Agent, Engineer and/or State.
24. Participate in and provide labor for all "off hour" (nights and/or weekends) testing and/or commissioning of equipment and systems, as required by working conditions, the schedule, or the Authorities Having Jurisdiction for all testing/commissioning, including that required to obtain the "Temporary Certificate of Occupancy (TCO)" and final "Certificate of Occupancy" (CO).
25. Complete all tests required by the Contract Documents and by all rules, regulations, etc., of all authorities having jurisdiction and prepare, complete and file all forms, tabulations, plans, etc., including Special Inspections, pertinent thereto with the referenced authorities and accomplish such work with personnel of proper caliber, in particular Professional Engineers, where so required.
26. All testing instruments, as required, for operating, testing and commissioning the various systems.
27. All diesel fuel required for initial fill of the system upon completion of installation, for testing as specified and as required by the authorities having jurisdiction, and to fill the tanks upon Project completion.

28. Sleeves for all electrical work, complete with seals and firestop as specified herein and as required by the Authority Having Jurisdiction.
29. Patching or replacement of all firestop if it is damaged or removed during the installation of the work in this Division.
30. All access doors in finished construction.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Finished painting except touchup painting and as otherwise specified hereinafter.
- B. Concrete foundations, curbs, pads and blocks for equipment mounting (except as otherwise noted hereinafter), except that anchor bolts and templates shall be furnished to the appropriate Contractor. Drawings of equipment foundations, curbs, pads and blocks (with required reinforcing rods, etc., indicated) shall be furnished for approval.
- C. Installation of access doors in finished building construction.
- D. Base flashing for all roof equipment and roof penetrations.
- E. Cutting and patching.
- F. Furnishing of motors, variable speed drives and motor controlling devices including motor control centers.
- G. Individual motor controllers that are factory-mounted and integral parts of pieces of equipment, variable speed/frequency drives and integral system controllers.
- H. Furnishing, installing and connecting telecommunications conduit, wiring, cables and equipment.
- I. Furnishing the lighting fixtures and lighting control systems, as specified under Sections of the Specifications.
- J. Furnishing of all variable speed/frequency drives, starters and motor control devices.
- K. Automatic temperature and humidity control system as specified under Division 25 of the Specifications, including furnishing of all motorized valves, control valves and providing all damper actuators. (Note: All power provisions shall be provided under this Section.)
- L. Furnishing of any prepurchased equipment specified under other Sections of the Specifications.

1.3 MOTOR WIRING AND CONTROLS

- A. Connect the motor starting devices for all motors, except where otherwise specifically provided for; furnish all necessary connections between variable speed/frequency drives, starters, motor control devices, controllers and motors, in conduit, and leave motors ready to start. Change connections, if necessary, to secure proper rotation of motors. The power supply leads to the motors, from the controllers, shall be of the same size as the feeds indicated.

- B. Include the erection and connection of all motor control groups or centers, variable speed/frequency controllers, pushbuttons, relays, controllers, etc. Single starters shall be suitably mounted either on wall or separately on angle iron racks. Unless noted on plans, all motor starting equipment shall be furnished under other Divisions for installation by this Division.
- C. Motors in outdoor locations shall be provided with weatherproof disconnect switches.
- D. Include being responsible for the exact location of the motor controllers or control center and motors as far as wiring is concerned. Ascertain the proper location of the controllers, control groups, or groups and motors in each case before installing the circuit work.
- E. Perform all the necessary wiring in connection with the motor starting and remote control equipment. Where control or starting equipment is sent to the job as individual units they shall be installed, wired up complete and left ready for operation.
- F. All motor controllers shall have circuit protection fusible switches either in combination with the starter or as separate units.
- G. Unit heaters will be furnished under other Divisions. Work under this Division shall include making all the electrical connections between motors, starters, controllers, aquastats and thermostats, and leaving unit heaters ready to operate.
- H. For elevators, escalators and all conveying systems and equipment, provide and install power conduit and cables connecting to control panels with sufficient slack in conductors to reach control terminals. Provide wiring and outlets in Machine Rooms for lighting, relay and signal controls. Provide ground fault receptacles, outlets and lighting fixtures in each elevator shaft and pit.
- I. The Division 23 (and/or Division 25) Contractor will provide all wiring in connection with the automatic and safety control of the refrigerating machines. All power wiring to the equipment and all auxiliary equipment shall be provided by this Contractor.

1.4 HARMONIC DISTORTION

- A. Provide a harmonic distortion analysis for the entire electrical system installation to verify compliance with IEEE 519 at the point of common coupling. Obtain all shop drawing data and information on all lighting, variable/speed/frequency drives, motors, UPS systems, etc., in order to provide complete electrical system harmonic distortion analysis.
- B. The manufacturer and/or supplier of any equipment drawing current from the electrical distribution system in a manner which would result in the distortion of the voltage waveform at the input of the equipment supplied shall provide means to conform to the limits established by the latest adopted edition of the IEEE 519 Standard at the point of common coupling, which is defined by these Specifications as the line side of the connected equipment.
- C. If the specified equipment is fabricated to standards which are less stringent than IEEE 519, modifications must be incorporated which shall render the end product in compliance. The nature of this modification must be noted so any operating impact can be evaluated.

- D. The manufacturer of such equipment must also be responsible to advise of any special consideration that should be given in the design and specification of support services and materials commonly used to supply the subject equipment (i.e., wire size, wire type, grounding, conductor operating temperature, temperature limits of equipment, etc.).

1.5 PAINTING

- A. Painting, except as specified herein or indicated otherwise, shall be done by another Division. This Division shall cooperate with the other Contractors to determine the size of equipment, sizes and lengths of conduits, etc., to be painted.
- B. Equipment furnished under this Division shall be factory-finished. If the factory finish is damaged during shipment, storage, installation, etc., it shall be repainted by this Division subject to the Engineer's approval. Touch-up painting is acceptable only for minor finish damage.
- C. Provide a heavy field coat of "Anchor Paint" asphaltic paint on all steel conduit, cradles, hangers, supports, vibration isolating mounts, or the like, that will be partially or totally encased in the building construction, set in concrete or fill before items are integrated into the general construction.
- D. All field-applied architectural coatings shall meet the VOC requirements of the project. For bituminous paints, the maximum allowable VOC content is 34,250 grams/liter, less water, exempt compounds, and colorant. For flat topcoats, the maximum allowable VOC content is 50 grams/liter, less water, exempt compounds, and colorant. For non-flat topcoats, the maximum allowable VOC content is 150 grams/liter, less water, exempt compounds, and colorant.

1.6 SLEEVES AND FIREPROOFING (FIRESTOPPING)

- A. This Contractor shall be responsible for the timely placement of sleeves and boxouts for all conduit, wiring, cable tray, bus ducts, etc., passing through walls, partitions, beams, floors, and roofs while the same are under construction.
- B. Penetrations through waterproof membranes shall be accomplished in a manner that maintains their integrity. Submit details of proposed method prior to installation.
- C. Field drilling, cutting and/or reinforcing of holes in structural metal deck required for work under this Division shall be coordinated through the General Contractor and approved by the Structural Engineer. All such drilling, cutting and reinforcing costs shall be included as work of this Division of the Contract Documents.
- D. Sleeves for conduit shall be at least one size larger than the size of conduit it is intended to accommodate, except where "Link Seal" casing seals are used in sleeves through walls below grade. Sleeves shall be sized such that the annular space between the sleeve and the conduit will not be less than 1/2 in. or more than 1 in. unless otherwise required by the listed firestop system or governing Codes.
- E. All conduit passing through concrete or masonry walls above grade shall have at least 18 gauge galvanized steel sleeves. Sleeves shall be set flush with finished wall. Sleeves set in concrete floor construction shall be at least 16 gauge galvanized steel. All sleeves in floors shall be flush with the underside of slab and extend a minimum of two inches above the finished floor, a

minimum of 4 in. in Mechanical Rooms, and a minimum of 6 in. in Data Centers and Technology Rooms ($\pm 1/2$ in.). Sleeves installed in fire rated construction shall be of suitable length and diameter to accommodate the listed fire safing system used. Where the conduit passes through a sleeve, no point of the conduit shall touch the sleeve and the conduit shall be centered in the sleeve.

- F. Seal all penetrations of fire-rated construction with factory-built devices or with manufactured fill, void, or cavity materials classified for use as a Through-Penetration Firestop. All firestop devices and systems shall be approved for such use by the Authority having jurisdiction. The firestop system used shall maintain the fire resistance rating of the building component that is penetrated. Firestop systems and devices shall comply with ASTM E-814 (UL 1479) and the State of New Jersey Building Code for all types of penetrations being sealed. Submittal data for firestop systems shall include the standards to which they comply. The firestop system or device used shall not require de-rating the ampacity of electrical conductors. Excessive shrinkage of the firestop materials which would permit the transmission of smoke or water prior to exposure to a fire condition is unacceptable. Where a mastic is used to seal the surface of the firestop, the mastic shall be non-hardening. All sealants and adhesives used in firestop systems shall meet the VOC requirements of the project. The firestop system used shall accommodate expansion and contraction of the electrical raceway systems and busways without damaging the firestop or reducing its effectiveness as a smoke barrier or water seal. The firestop manufacturer's authorized representatives shall instruct the Contractor's representatives in the proper installation procedure so that the material will be installed in accordance with the UL listing and the manufacturer's recommendations.
- G. If it complies with these Specifications, firestop sealing component/system as manufactured by one of the following manufacturers will be acceptable:
1. Tremco Fire-Resistive Joint System using Dymeric sealant and Cerablanket-FS mineral filler.
 2. Specified Technologies, Inc. SpecSeal Systems.
 3. 3M Fire Barrier Penetration Sealing Systems (CS-195 + composite sheet, etc.).
 4. GE Pensil Firestop Sealant by General Electric.
 5. International Protective Coatings Corp. Flame-Safe Systems.
 6. Thermal Ceramics FireMaster Firestop Fire Protection Systems.
 7. Hilti FS 601 Systems.
- H. Except as may be noted on the drawings, sleeves penetrating walls below grade shall be standard weight black steel pipe with 1/4 in. thick steel plate water seal secured to the sleeve with continuous fillet weld. The water seal plate shall be located in the middle of the wall and shall be two (2) inches wider all around than the sleeve it encircles. The entire assembly shall be hot dipped galvanized after fabrication. Seal off annular opening between pipe or conduit and sleeve with "Link Seal" casing seal as manufactured by Thunderline Corporation, Wayne, Michigan. The sleeve shall be sized to accommodate the Thunderline casing seal. Casing seals shall be Series 300 for sizes 3/4 in. through 4 in. and Series 400 for sizes 5 in. and larger.

- I. If holes and/or sleeves are not properly installed and cutting and patching becomes necessary, it shall be done at no additional expense to the State. The Contractor shall undertake no cutting or patching without first securing the Architect's written approval.
 - J. All unused sleeves shall be sealed with firestop devices and systems to maintain the fire rating of the construction penetrated. See Architectural drawings for locations and ratings of ceilings, floors and walls.
 - K. Set sleeves as construction progresses and secure in place during pouring of concrete.
 - L. Where structural steel flooring is used, furnish and locate sleeves, cut holes through deck, reinforce deck and set sleeves. Coordinate the locations of sleeves with work of other trades, including flooring and electrical distribution. Submit drawings showing locations of proposed holes and reinforcing for Architect's and Structural Engineer's approval prior to installation.
 - M. Do not support conduit or piping by resting clamps or other types of supports on sleeves. Supports must extend beyond sleeve and be supported outboard of sleeve in an approved manner.
 - N. Provide waterproof type sleeves, Zurn Z-197, with galvanized Schedule 40 pipe extensions where penetrating membrane waterproofed floors. Cut, extend and repair membrane.
 - O. For materials passing through roofs, provide roof couplings (Zurn Z-196-3) at suitable level above roof to terminate flashings.
 - P. Where loose cabling penetrates fire or smoke rated walls, partitions, floor slabs, etc., provide sleeves (as described hereinbefore) through the rated construction. All cabling shall be run through these sleeves. Sleeves shall be located as required and shall be filled with a UL listed, intumescent type, firestop system approved for use in the State of New Jersey. Quantity of cables, configuration of cables, etc., shall be in accordance with the manufacturer's requirements for the type of rated construction for which the system is to be used. The firestop systems shall be as manufactured by 3M Fire Protection Products, Spec Seal Firestop Products or as approved.
 - Q. Coordinate support for all conduit, equipment and structural wall/floor penetrations with the Structural Engineer.
- 1.7 MISCELLANEOUS STRUCTURAL SUPPORT MEMBERS
- A. Where, conduits (including concrete encasements where specified and/or required), etc., are routed horizontally and vertically, the Contractor shall provide and install all necessary miscellaneous structural members to support the loads imposed by the feeders and encasements.
 - B. Where equipment (transformers, conduit racks, etc.) are supported from slabs or structure, the Contractor shall provide all miscellaneous structural members to support the loads plus a 250 lb. live load.
 - C. Submit for review Shop Drawings of all loads imposed (feeders, risers and/or equipment) and support system to the Project Structural Engineer for approval, including details of attachment to the building structure, prior to installation of any support system components.

- D. Miscellaneous structural support members shall be hot-dipped galvanized.
- E. Provide required supports for conduit, piping, etc., and equipment so that loading will not exceed allowable loadings of structure. Submittal of a bid shall be deemed a representation that such bid has included in bid the costs associated with providing such supports and any required modifications to the structural system.

1.8 ESCUTCHEONS

- A. Provide heavy chrome-plated or nickel-plated escutcheons of approved pattern on all conduit passing through walls and ceilings in finished areas. Escutcheons shall be B&C No. 10 or approved equal chrome-plated or nickel-plated steel plates with concealed hinges. Unless finished areas are specifically indicated on the Drawings, they are areas that are normally accessible to either the Tenant or the Public.
- B. Provide sheet metal escutcheons at all penetrations, other than finished areas, where required by Code.

1.9 COORDINATION OF WIRING AND OUTLETS

- A. Coordinate work so that exact locations may be obtained for all outlets, apparatus, appliances and wiring.
- B. The location of all electrical work shown on diagrammatic wiring plans shall be considered as approximate. Before installing electrical work, all pertinent drawings shall be studied and precise information obtained from the architectural schedules, scale drawings, large scale and full size details of finished rooms, reviewed shop drawings or from the Architect. It shall be understood that any electrical work may be relocated a distance not exceeding five feet from the location shown, if so directed by the State. Make any necessary adjustment of the work to fit conditions for recessed fixtures and for outlets, including those occurring in glazed tile, block, wood paneling or other special finish material in order that all boxes may register flush with initial or intended future finish and shall be centered properly. In centering outlets make due allowance for overhead piping, ducts, window and door trim, variations in thicknesses of furring, plastering, etc., as erected, regardless of conditions which may be otherwise shown on small scale drawings. Work incorrectly located shall be properly relocated without expense to the State. Locate local switches which are shown near doors at the strike side of the door, unless specifically noted on plans to be beyond the open door.
- C. In Mechanical Rooms, electric closets, Elevator Machine Rooms, Pump Rooms, Communications Rooms, etc., light fixture arrangement shall be adjusted to suit the final coordinated equipment layout. Fixtures shall be mounted approximately 8 feet 0 inches above the finished floor (unless otherwise noted). Layout of proposed future locations, including mounting height and support method, shall be submitted for review prior to installation.

END OF SECTION 260510

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all 600 volt electrical conductors as specified herein and as required for proper distribution of power, lighting, and receptacle loads throughout the Project as indicated on and in accordance with the requirements of the Contract Documents.
- B. Section includes:
 - 1. Ratings.
 - 2. Conductor Sizes.
 - 3. Type "AC" and "MC" Conductor Cable.
 - 4. Type RHH/RHW Emergency Power Cable (EPC).
 - 5. Mineral insulated Cable (MI).
 - 6. Connectors.
 - 7. Adapters.
 - 8. Reducers.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 07 - Access Doors and Color Coded Identification in General Construction.
 - 3. Section 26 05 10 - Electrical General.
 - 4. Section 26 05 20 - Heating Cable.
 - 5. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 6. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 7. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 8. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 9. Section 26 05 53 - Identification for Electrical Systems.
 - 10. Section 26 22 13 - Low-Voltage Distribution Transformers.
 - 11. Section 26 24 13 - Switchboards.
 - 12. Section 26 24 16 - Panelboards.
 - 13. Section 26 27 26 - Wiring Devices.
 - 14. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 - 15. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
 - 16. Section 26 43 00 - Surge Protective Device System
 - 17. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. All 600 volt electrical conductors and all components shall be designed, manufactured, and tested in accordance with the latest applicable codes and standards, including the following:
- B. Codes:
1. IBCNJ - International Building Code New Jersey Edition.
 2. NEC - National Electrical Code with New Jersey Amendments.
- C. Reference Standards:
1. NEMA WC70 - Nonshielded 0-2kV Cables.
 2. UL Standard 4 - Armored cable.
 3. UL Standard 44 - Thermoset-Insulated Wires and Cables.
 4. UL Standard 83 - Thermoplastic - Insulated Wires.
 5. UL Standard 486A-B - Wire Connectors.
 6. UL Standard 486C - Splicing Wire Connectors.
 7. UL Standard 486D - Sealed Wire Connector Systems.
 8. UL Standard 486E - Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
 9. UL Standard 493 - Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables.
 10. UL Standard 1479 - Fire Tests of Through-Penetration Firestops.
 11. UL Standard 1569 - Metal Clad Cables.
 12. UL Standard 1581 - Electrical Wires, Cables and Flexible Cords.
 13. UL Standard 2196 - Tests for Fire Resistive Cables.
 14. UL Standard 2225 - Cables and Cable Fittings for Use in Hazardous (Classified) Locations.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:
1. Electric conductors, complete with material list, samples, etc.
 2. Lugs, taps, and splice materials, etc.
 3. Matrix indicating where each type of equipment is to be used.
 4. Cable pulling lubricant.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the Division 01 and Section 26 05 00

1.6 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All conductors shall be copper, unless specifically and individually noted to be aluminum.

2.2 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution.
- C. If it complies with the Contract Documents, electrical conductors manufactured by one of the following manufacturers will be acceptable:
 - 1. Electrical Conductors, 600 Volt or Less
 - a. American Insulated Wire.
 - b. Colonial Wire & Cable Co.
 - c. General Cable.
 - d. Prysmian.
 - e. Republic Wire Inc.
 - f. Southwire.
 - g. United Copper Industries.
 - 2. Type "AC" and "MC" Conductor Cables, 600 Volts or Less
 - a. AFC.
 - b. Southwire.
 - 3. Type "RHH/RHW" Emergency Power Cable
 - a. Draka-Lifeline.
 - b. Raychem.
 - 4. Flat Conductor Cable
 - a. Hubbell.
 - b. Thomas & Betts.
 - c. Tyco Electronic/AMP.
- D. If it complies with the Contract Documents, wire connectors and lugs manufactured by one of the following manufacturers will be acceptable:

1. Hubbell/Burndy.
 2. Ideal.
 3. MAC Products.
 4. Thomas & Betts/Blackburn.
 5. Thomas & Betts/Homac
 6. Tyco Electronic.
 7. Union Connector Co.
- E. If it complies with the Contract Documents, cable pulling lubricants manufactured by one of the following manufacturers will be acceptable:
1. American Polywater Corporation.
 2. Electro-Compound Company.
 3. Ideal Industries.
- F. If it complies with the Contract Documents, Type “AC” and “MC” steel jacketed cable termination fittings manufactured by one of the following manufacturers will be acceptable:
1. O-Z Gedney C5.
 2. Steel City Series XC400.
 3. Thomas & Betts No. 253.

2.3 RATINGS

- A. Copper Conductors: Copper conductors shall be soft-drawn annealed copper, having a conductivity of not less than 98% of that of pure copper.
1. All electrical conductors shall be copper, using an ampacity as described for a 75°C rating.
 2. Conductor Insulation
 - a. All copper conductor insulation shall be Type “THHN” or “THHN/THWN”, except as specified hereinafter.
 - b. Field-installed conductors within lighting fixtures, fixture bodies, sections of fixtures unless used as a branch circuit conductor, used as raceways, or within 3 inches of a ballast, shall be type SFF-2. Where use of SFF-2 is not allowed by the manufacturer or fixture assembly listing, fixture wiring meeting the temperature rating of the fixture assembly listing shall be provided by the Contractor, in coordination with the manufacturer.
 - c. All conductors installed vertically for a distance in excess of 35 ft. shall be Type “XHHW”. (Where XHHW conductors are required for circuits installed with such a vertical run, the conductor shall be continuous, from equipment termination to equipment termination, without a splice.)
 - d. All conductors installed in conduit that is in contact with earth (e.g., run below a slab on grade; run below a Basement or Cellar Level; or run outside of the building, etc.) shall be Type “THWN”. Provide a splice transition box at the conduit's point of “exit” from the building, where required to transition cable type.

3. Fire Rating: Where required by the IBCNJ, NEC - Article 700, NFPA 20 or NFPA 101, a fire-rated system shall be utilized as described herein. 2-hour rated RHH/RHW or MI cable shall be utilized.

2.4 CONDUCTOR SIZES

- A. All feeders and branch circuits shall be sized as indicated on the Drawings or as specified herein. Fixture tap conductors shall not be smaller than No. 14 AWG and shall be in lengths not greater than 6 ft. 0 in. or less than 4 ft. 0 in. All feeders and branch circuits shall be No. 12 AWG or larger.
- B. Solid and Stranded Requirements: All wire No. 8 AWG and larger shall be stranded. All conductors in sizes No. 10, No. 12 and No. 14 AWG shall be solid, except Class 1, 2 or 3 wiring, which may be stranded if terminated and spliced as specified hereinafter.

2.5 TYPE "AC" AND "MC" CONDUCTOR CABLE

- A. If agreeable to the Authority Having Jurisdiction, Types "AC" and "MC" conductor cables may be used in the following applications:
 1. Conductors connecting receptacle and switch circuits to lighting and power home-run boxes in finished areas may be multi-wire, steel jacketed, type "AC" or "MC" cable, consisting of one (1), two (2), three (3) or four (4) No. 12 AWG copper "THW", "THHN" or "THHN/THWN" insulated phase and neutral conductors and one (1) No. 12 AWG insulated ground conductor.
 2. Type "AC" and "MC" steel-jacketed cable termination fittings shall be clamp-type, malleable iron locknut type fittings. Die cast fittings shall not be acceptable.
 3. Type "AC" and "MC" cables may not be utilized where they will be exposed after completion of base building construction.
 4. Home runs shall be made from the outlet closest to the electric closet, utilizing one of the non-flexible conduit systems described above.

2.6 MINERAL INSULATED CABLE (MI)

- A. General
 1. Mineral insulated (MI) cable shall have 2-hour fire rating as classified by Underwriters Laboratories, Inc. (UL). The details of this fire rated system appear in the UL Electrical Circuit Protective System (FHIT), System Number 10.
 2. MI cable shall be used at a 75°C ampacity rating and be rated for 600 volts.
 3. All wiring shall be in accordance with the manufacturer's requirements and recommendations.
 4. MI cable shall be in compliance with the NEC.
- B. Storage

1. Cables are to be shipped from the manufacturer with ends temporarily sealed against moisture ingress.
2. When cables are cut in the field, the ends are to be sealed by means of standard sealing compound and PVC tape or equivalent means acceptable to the manufacturer.
3. Cables shall be stored in a dry location.

C. Handling

1. Cable shall be uncoiled by rolling, or by means of a supply reel (available from the manufacturer) rather than pulling from the periphery or the center of the coil. This will greatly ease the handling and prevent possible snarling and kinking.
2. Reasonable precautions shall be taken to prevent damage to the cable from damaging blows with sharp instruments and pulling over sharp objects.

2.7 CONNECTORS

- A. All No. 6 AWG and larger copper conductors shall be connected with high conductivity, wrought copper, color-keyed concentric compression connectors.
1. Terminations: Thomas & Betts Series 54200 (or approved equal) two-hole long barrel type connectors shall be used. Exceptions are as follows:
 - a. Where equipment or device cannot be provided by the manufacturer to accept two-hole connectors, T&B Series 54100 (or approved equal) single-hole connectors with anti-rotation lug or restraint shall be used.
 - b. Where equipment or devices cannot be provided by the manufacturer to accept either two-hole or single-hole compression connectors, set-screw (mechanical) type connectors may be submitted. Set-screw connectors for No. 4/0 AWG and larger sizes must be approved in writing by the Engineer, prior to equipment purchase. For a set-screw connector to be considered by the Engineer, the manufacturer shall certify his equipment will not accommodate the required compression connectors. See Section 26 05 00 for certification requirements.
 2. Copper to copper splices, if allowed, shall be with T&B Series 54500 (or approved equal) compression connectors. All splices shall be insulated with T&B heat shrink insulation tubing, HF Series using T&B heat gun.
 3. Tapping of copper conductors shall be with T&B Series 54700 (or approved equal) compression taps.
 4. A universal crimping tool and die is not acceptable. The approved connector manufacturer's recommended installation tool and procedures shall be used. Where the connector manufacturer does not manufacture their own tooling, documentation shall be submitted which will demonstrate dimensional compatibility with tooling manufacturer's lugs.

- B. All No. 8 AWG and smaller solid conductors shall be spliced with pre-insulated spring connectors. Connectors shall be Skotchlok, Ideal B-Cap, or approved equal. All No. 10 AWG and smaller stranded conductors for Class 1, 2, or 3 wiring shall be terminated with AMP, Inc. "PIDG", UL listed premium grade insulated compression fork connectors, or approved equal, and shall be spliced in a junction box with AMP, Inc. "Plastic-Grip" UL listed, standard grade insulated butt splices, or approved equal.
- C. No modifications to any connector or fitting shall be permitted.
- D. Mechanical equipment motor terminations shall be made with compression connectors which accommodate only copper conductors and have a hole sized to fit the mechanical equipment motor connection stud. Contractor shall coordinate the compression connector with the mechanical equipment manufacturer's termination requirements. Field modification to the compression lug or the motor stud shall not be permitted.
- E. All bolt and screw connections shall be torqued in accordance with the manufacturer's recommendations. Contractor shall include a copy of the manufacturer's recommendations with all applicable submittals.

2.8 ADAPTERS

- A. Provide copper adapters for highly stranded flexible cable (locomotive, welding, etc.) connection to circuit breakers, transformers, panels, safety switches, etc. Adapter shall be Greaves PT-FX Series (compression type) with insulating covers, or approved equal.

2.9 REDUCERS

- A. Provide copper cable reducers for oversized cable connections to safety switches, panels, circuit breakers, etc., which can only be manufactured with mechanical lugs as defined hereinbefore. Reducer shall be compression type, similar to Greaves PT-R Series, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Circuit Identification: All circuits shall be identified in accordance with Section 26 05 53.
- B. Conductor Pulling: Conductor pulling tensions shall not exceed manufacturer's recommended values. Where necessary, UL listed lubricants, compatible with the type of insulation involved, may be used to facilitate cable pulling.

3.2 INSTALLATION

- A. Splicing and Tapping: Conductors shall not be spliced between the points of origin and termination. If splices are necessary, their use must be approved in writing by the Engineer before installation. Splices, if allowed, and taps shall be made in boxes or gutters.
- B. Transformers with pigtails shall be terminated as specified for splices, for the size of conductor involved.

- C. Vertical Supports: Conductors in vertical raceways shall be supported at intervals as required by Code. Provide additional supports if so indicated on the Drawings or recommended by the cable manufacturer. Supports shall be of the two-piece insulating type and shall be installed in suitable boxes with covers. Insulated supports shall properly secure the conductors and shall have the strength to carry the weight of the conductors attached thereto. Obtain documentation from cable manufacturers stating acceptance of support manufacture type and spacing utilized.
- D. Circuits and feeder conductors of different voltage levels or those of same voltage level originating from different switchboards or systems shall be isolated in pull boxes and junction boxes with suitable metal barriers. At a minimum, the following systems shall be separated from one another by barriers:
 - 1. Different voltage levels.
 - 2. Different service switchboards.
 - 3. Metered and unmetered.
 - 4. Optional standby/normal.
 - 5. UPS and non-UPS.
 - 6. Emergency circuits (NEC Article 700) shall be in separate pull boxes, junction boxes or cable support boxes from any and all other systems, including, but not limited to, the optional standby system.
- E. Where cable sizes exceed that allowed by the equipment for termination, provide additional bus detail, as required, as part of the equipment for proper installation of oversized conductors.
- F. For homeruns feeding lighting or receptacle branch circuits, no more than six (6) circuits shall occupy the same raceway. Increase conductor size as required to meet the de-rating requirements of the Electrical Code.
- G. Branch circuits feeding a single piece of equipment shall not share a raceway with any other circuits.
- H. Type RHH/RHW Emergency Power Cable (EPC)
 - 1. All couplings shall be stainless steel.
 - 2. All supports, Kindorf, rods, couplings, elbows, etc., shall be subject to the fire rating equivalent to the cable.
- I. Mineral Insulated Cables (MI)
 - 1. Cable Installation for 2-Hour Fire-Rated Application
 - a. Project Specifications shall govern the method of installation for any particular application, but must also comply with the manufacturer's specifications.

- b. Cable can be installed exposed with trapeze supports on intervals as required by the Code and manufacturer.
 2. Exposed or Surface Installations
 - a. Cable shall be clipped directly to walls, beams or ceilings using clips or straps available from the manufacturer attached to Kindorf supports with approved tie-backs having a fire rating equal to the cable.
 - b. The cable shall be supported at a maximum of every thirty-six (36) inches or center horizontally and every seventy-two (72) inches on center vertically to a two-hour rated surface using steel anchors.
 - c. Exposed runs of cables shall be installed paralleled to building lines to present a neat appearance.
 - d. When subject to potentially damaging abuse, cables shall be protected by metal, channel or cable tray. Where cable tray or metal channel is used, it shall maintain a fire rating equal to the cable.
 - e. Cable tray, when used to support cable in fire-rated applications, shall be of construction that the tray system shall function at a temperature up to and including 1850°F for a period of two (2) hours (no aluminum).
 3. Embedded Installation
 - a. Cables imbedded in concrete shall be protected by means acceptable to the Engineer against puncture damage from the medium itself or the pouring equipment and have an overall protection of a PVC jacket.
 - b. Where cables emerge from the slab, protection against shear damage shall be provided by means of a short metal plate or angle, at the point of egress. This protection must extend from 18 inches below finish grade to 8 feet above finish grade.
 4. Bending: The cable can be bent to a minimum radius of five times the cable diameter of the cable up to 250 kcmil and ten times the cable diameter for 350 kcmil or larger.
 5. Pulling
 - a. Non-stretch pulling rope should be used with swivels between cable and pulling rope.
 - b. Use 10 inch sheaves or larger for cables 215/1 through 496/1, 18 inch sheaves or larger for cables 496/1 through 746/1, 24 inch sheaves or larger for cables 834/1 through 1000/1.
 - c. For 350 kcmil or larger cables, do not pull over 360 degrees.
 6. Single Conductor Cables

- a. When single conductor cables are installed, they shall be run in a tri-foil configuration with the sheaths of each cable touching the entire length of the run except when entering the enclosure.
 - b. Where parallel runs are required, each bundle shall contain a conductor from each phase, plus a neutral if required. Each bundle shall be spaced two (2) cable diameters apart and shall be installed in accordance with Code.
 - c. When single conductor cables enter a ferrous metal enclosure, protection must be provided to prevent heating by induction. This may be done by removing a section of the box and replacing it with a brass plate or slotting at least two (2) saw blades wide between holes. Non-ferrous locknuts must be used when using the slotting method.
7. Splicing Cables: When the circuit length exceeds the nominal coil length of a particular reference, two (2) cable splicing options are available:
- a. Factory installed fire-rated joints.
 - b. Field installed fire-rated joints installed by a manufacturer's field technician.
8. Wall or Floor Penetrations: When cable penetrates a wall or floor, a sleeve shall be placed in the opening to protect the cable during pulling. Once the cable is in place, the opening shall be firestopped using an approved firestop system. A list of Underwriters Laboratories approved systems appears in the "Through-Penetration Firestop Systems" in the UL Fire Resistance directory, Guide XHEZ.
9. Lug Connections: When connecting cable to switchboards, panelboards, motor control, circuit breakers, etc., ILSCO lugs, approved for solid conductors, shall be used as follows:

<u>Conductor Size</u>	<u>ILSCO Catalogue Number</u>
No. 1-250 kcmil	Lo-250
350	CRA-300
500	CRA-400

10. Cable Terminations: Cable must be terminated with an approved termination kit in a manner consistent with manufacturer's installation sheets.
11. Connections to Ferrous Enclosures: Brass plates are to be used when using a single conductor cables carrying currents in excess of 200 amperes. Heating by induction and hysteresis will occur if precautions are not taken.
12. Workmanship: Following the recommendations of the manufacturer will consistently produce satisfactory installations. The installer shall avail himself of the services of the Manufacturers Field Technician who will offer the instruction of proper installation techniques.

J. 600 Volt Cable Pull Tension

1. All 600 volt or less feeders in excess of 200 feet or requiring more than 180° of bend where conductors are sized 4/0 AWG or larger shall be measured for pulling tension when installing the feeder.
2. The Contractor shall tabulate the reading observed for each feeder section or pull and provide the manufacturer's recommended maximum pull tension for the cable used. The test shall identify each conductor tested, date and time of the test, and manufacturer's recommended values. The test reports shall be submitted to the Engineer for review. Any pull exceeding the maximum allowable tension shall be removed and replaced, and additional tests shall be performed.

3.3 COLOR CODING

- A. All branch or distribution circuit conductors No. 8 AWG and smaller shall have continuously color-coded insulation as follows or as required by the local Authorities having jurisdiction.
 1. 208Y/120 Volt System
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Ground: Green.
 2. 480Y/277 Volt System
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray.
 - e. Ground: Green.
- B. All conductors larger than No. 8 AWG shall have color-coded tape 50 percent overlapped for a minimum length of 6 in., installed on conductors at all equipment terminations and where conductor passes through pull boxes, unless continuous color-coded insulation is utilized.

3.4 FACTORY TESTING

- A. All electrical conductors shall be tested in accordance with the latest applicable industry standards and governing Code requirements.

3.5 FIELD TESTING

- A. Conductor Test (600 Volt)
 1. All cables shall be megger tested. Each cable shall be megger tested on an individual basis and the test report submitted for review.
 2. Grouping of phase conductors for a group measurement shall not be permitted.

3. Insulation resistance of all conductors shall be tested. Each conductor shall have its insulation resistance tested after the installation is completed and all splices, taps, and connections are made except connection to or into its source and point (or points) of termination.
4. Insulation resistance of conductors which are to operate at 600 volts or less shall be tested by using Biddle (or approved equal) Megger with an output of not less than 1000 volts DC. Conductors shall be tested between phase conductors, between each phase conductor and neutral and ground, and between neutral and ground. Reading shall be observed after 15 seconds of operation of the Megger. Insulation resistance of conductors rated at 600 volts shall be not less than one (1) megohm (1,000,000 ohms), the latest NEMA (IPCEA) Standard requirement for the conductor type or governing Code, whichever is more stringent.
5. Conductors that do not exceed insulation resistance values listed above shall be removed and replaced and test repeated. The Contractor shall furnish all instruments and personnel required for tests.
6. For all conductors, the Contractor shall tabulate readings observed and shall forward four copies of test readings to the Engineer for review. These test reports shall identify each conductor tested, date and time of test, weather conditions, temperature, and relative humidity. Each test shall be signed by party making the test. Any conductor or splice which is found defective shall be promptly removed and replaced, and additional tests shall be performed.
7. All feeders which can be paralleled shall be tested for proper phasing using hot phasing or other approved techniques.

B. Refer to Section 26 08 00 for additional testing requirements for electrical conductors.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all electrical grounding systems as specified herein, and as required for the grounding of systems throughout the project as indicated on and in accordance with the requirements of the Contract Documents.
- B. Section includes:
 - 1. Grounding Conductors.
 - 2. Ground Rods.
 - 3. Ground Plates.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 06 - Electrical Service.
 - 3. Section 26 05 07 - Access Doors and Color Coded Identification in General Construction.
 - 4. Section 26 05 10 - Electrical General.
 - 5. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 6. Section 26 05 20 - Heating Cable.
 - 7. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 8. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 9. Section 26 05 53 - Identification for Electrical Systems.
 - 10. Section 26 09 23 - Lighting Control Devices.
 - 11. Section 26 22 13 - Low-Voltage Distribution Transformers.
 - 12. Section 26 24 13 - Switchboards.
 - 13. Section 26 24 16 - Panelboards.
 - 14. Section 26 27 26 - Wiring Devices.
 - 15. Section 26 28 13 - Fuses.
 - 16. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 - 17. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
 - 18. Section 26 43 00 - Surge Protective Device System
 - 19. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. All grounding system components shall be designed, manufactured, and tested in accordance with the latest applicable codes and reference standards including the following:

B. Codes:

1. IBCNJ - International Building Code New Jersey Edition.
2. NEC - National Electrical Code New Jersey Amendments.

C. Reference Standards;

1. J-STD-607-A - Commercial Building Grounding and Bonding Requirements for Telecommunications.
2. UL Standard 467 - Grounding and Bonding Equipment.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:

1. Grounding system tests, including report forms.
2. Grounding electrodes.
3. Ground enhancement material.
4. Grounding site plans and risers.
5. Ground clamps, rods, plates, etc.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with the requirements of the Division 01 and Section 26 05 00

1.6 WARRANTY

A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment and materials provided under this Section of the Specifications shall be new, UL listed, and bear the UL label.
- B. All switchboards, panelboards, transformers, busway, etc. shall be provided with a copper equipment ground bar bolted, brazed, or riveted to the associated enclosure or cabinet. Refer to each individual equipment Specification Section for additional grounding requirements.
- C. All receptacles, switches, disconnects, individual motor controllers, etc., shall be provided with a grounding terminal connected to the device frame or enclosure. Refer to each individual equipment Specification Section for additional grounding requirements.
- D. All conduit, cable tray, raceways, junction boxes, pull boxes, etc. shall be made electrically continuous by means of grounding conductors, bonding jumpers, grounding bushings, couplings, fittings, etc., as required by the Code and the authorities having jurisdiction.

2.2 GROUNDING CONDUCTORS

- A. All grounding electrode conductors shall be bare or green insulated copper conductors sized as required by Code or indicated on the Drawings, whichever is larger. Where the authorities having jurisdiction require grounding electrode conductor sizing in excess of that shown on the Drawings or specified herein, the larger size conductor shall be installed.
- B. All equipment grounding conductors shall be green insulated copper conductors sized as indicated on the Drawings. Where the authorities having jurisdiction requires equipment grounding conductor sizing in excess of that shown on the Drawings or specified herein, the larger size conductor shall be installed.
- C. All bonding conductors shall be flexible copper bonding jumpers sized in accordance with the Code for grounding electrode conductors.
- D. All conductors shall be run in conduit unless otherwise noted.
- E. Where cable is used for the equipment grounding conductor, all grounding conductors shall be sized in accordance with Article 250 of the NEC. Where feeders are oversized for voltage drop or other considerations, this Contractor shall increase the size of the equipment grounding conductor as required by the Code to a maximum size equal to that of the phase conductor. This increased size may or may not be indicated on the drawings. The responsibility for proper sizing and Code compliance resides with this Contractor.

2.3 GROUND RODS

- A. All ground rods shall be a minimum of 3/4 in. x 10 ft. 0 in. copper-clad steel, unless required to be larger based on Code, site conditions, or in order to obtain resistance to ground as specified herein.

2.4 GROUND PLATES

- A. All ground plates shall be a minimum of 2 ft. x 2 ft. and 0.06 in. thick copper, unless required to be larger based on Code, site conditions, or in order to obtain resistance to ground as specified herein.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The system neutral shall be grounded at the service entrance. The system neutral on interior wiring shall be kept isolated from grounding systems throughout the building and shall be grounded only to the grounding electrode conductor.
- B. Each system of electrically continuous metallic piping and ductwork shall be electrically grounded in accordance with the requirements of the Code for "bonding" as they apply to the "bonding of piping systems". Isolated metallic piping and duct systems shall be bonded to the building equipment grounding system.

- C. Bonding and grounding conductors shall be sized, shall be run in conduit, and shall be connected to various services in accordance with the requirements of the authorities having jurisdiction and the NEC, Article 250.
- D. Grounding shall be done in accordance with the requirements of, and subject to the approval of the Architect, Engineer, and local inspection authorities. Approved materials, devices, and workmanship shall be utilized. All conductor terminations shall be in accordance with Section 26 05 19.
- E. All ground conductors, including the grounding electrode conductor, when run independent from its phase conductors shall be protected from mechanical injury by rigid conduit to which the conductor shall be bonded at each end.
- F. All ground plates and ground rods shall utilize ground enhancement material to ensure connectivity with earth.
- G. Grounding Electrode System
 - 1. All Code qualifying individual grounding electrodes shall be bonded together to form the main grounding electrode system.
 - 2. The grounding electrode conductor shall be bonded together with the incoming domestic water metallic piping system to the building (where galvanized piping is used in direct contact with the earth) on the inlet side of the main shut-off valve, the metal frame of the building, the concrete encased steel reinforcing bars in the building footings and a ground ring encircling the building. This bonding shall serve as the grounding electrode system in accordance with the requirements of the Code. This Contractor shall only connect in one location to the water piping system.
 - 3. The grounding electrode conductor shall be installed in a separate conduit from the point of connection at the grounding electrode system to the system neutral in the service equipment. The grounding electrode conductor shall be insulated stranded copper, sized as required, and shall be without joints or splices over its entire length.
 - 4. Where more than one service entrance is provided, the ground bus of each service entrance shall be brought to a ground bus assembly in the Switchboard Room. The ground bus assembly shall consist of one 5 inch wide by 1/4 inch thick by 10 foot long copper bar, mounted on standoff insulators and tapped for the required number and size of two-bolt-hole lugs, plus five spare 500 kcmil connections. The Switchboard Room ground bus assembly shall be the ground reference point for the services and shall be used for connection of the grounding electrode conductors.
 - 5. A grounding electrode conductor shall be provided, without splice or joints between the service entrance ground reference point and the grounding electrode(s). The grounding electrode conductor shall be 500 kcmil bare stranded copper, or if insulated the color of the insulation shall be green for the conductor's entire length. The grounding electrode conductor shall be attached to the ground reference point and the grounding electrode by means of an exothermic welding process, except that an approved grounding clamp may be used at the cold water service.

6. The grounding electrode conductor shall be connected to the line side of the service switch terminal bar of the identified and/or neutral conductor via the switchboard room ground bus assembly where provided.
7. A bonding connection shall be provided from the line side of the terminal bar or neutral bus to the switchboard enclosure or ground bus.
8. The grounding system shall include resistance to ground testing means for all grounding electrodes. Where building steel is utilized as the ground reference point, this Contractor shall verify the ground integrity and electrical continuity of all structural members used and, if necessary, provide ground jumpers to ensure this condition. At the connection point, the Contractor shall provide a test box to verify the integrity of the grounding electrodes. Provide ground jumpers from the grounding electrode method to each test box. Provide additional jumpers to grounding electrode as required to obtain resistance requirements. The test box shall be located at the base of each column used as a ground reference point by using a Biddle 250-241 earth tester that the maximum resistance to ground does not exceed 5 ohms.
9. All ground rods or plates shall be connected to building steel or grounding electrode system via exothermic weld.

H. Building Equipment Ground

1. All exposed non-current-carrying metal parts of permanently mounted electrical equipment, all terminal devices and the conduit system shall be effectively grounded and securely bonded to the reference ground point of its separately derived service ground. The equipment ground path from conduit, equipment and metal enclosures shall be continuous and permanent, and shall have the capacity to safely conduct any fault currents imposed on it with sufficiently low impedance to facilitate the operation of the circuit protective devices.
2. All conduits, 2 inches and larger, entering motor control centers, service or distribution switchboards, distribution or power panels, transformers, and automatic transfer switches shall be provided with grounding bushings, connected to the respective equipment ground bus by means of bare copper wire.
3. Flexible metal conduit and liquidtight flexible metal conduit or any form of non-metallic conduit, where permitted by other sections of this specification, shall be provided with a separate, copper equipment grounding conductor whether indicated on the drawings or not. The equipment grounding conductor shall be sized in accordance with Code and if insulated the color of the insulation shall be green for the conductor's entire length. The equipment grounding conductor shall be bonded at both ends of the flexible conduit using an approved fitting or bonding screw.
4. Motor frames that are not directly clamped to the supply conduit shall be bonded and grounded to the conduit by means of a suitably sized ground conductor and ground clamp. No soldered connections shall be used in leads. All connections shall be made with an approved solderless connector.
5. A separate insulated (green) equipment grounding conductor shall be installed in all branch circuits under the following conditions:

- a. Where the branch circuit uses AC armored cable as the wiring method.
 - b. Where the branch circuit uses a manufactured wiring system.
 - c. All branch circuits used for electronic computer/data processing or telecommunications equipment.
 - d. All branch circuits serving loads in hazardous locations.
 - e. All branch circuits in outdoor locations.
6. When a separate insulated equipment grounding conductor is provided with a branch circuit, it shall be connected to a ground bus in the panelboard from which it is served. The panelboard ground bus shall be of sufficient size to accommodate all devices served including space for future expansion, as well as lugs of appropriate size for connection of an equipment grounding conductor to the grounding electrode of the derived source.
 7. All conduit which penetrates the walls, floors and/or ceilings (overhead slab) of technology spaces shall be grounded. Grounding straps shall be attached at the equipment at the point of entry into the room and connected to the J-STD-607-A telecommunications grounding bus bar in the room.

I. Flexible Bonds

1. All expansion joints, points of electrical discontinuity, or connections in conduit where firm mechanical bond is not possible shall be bonded with O-Z Gedney Type "BJ" or approved equal bonding jumper.
2. A flexible bonding jumper shall be provided around isolating couplings and isolating nipples and shall be similar and approved equal to O-Z Gedney Type "BJ". All mechanical piping requires isolating couplings or isolating nipples when the piping material is changed.

J. Building Ground Riser System

1. Furnish and install in all electric closets, a complete grounding system utilizing the building steel as the ground reference point. Verify the ground integrity and electrical continuity of all members used for grounding and, if necessary, provide a ground jumper to ensure this condition. Furnish at each electric closet a copper detail of sufficient size to accommodate all device connections plus a minimum of three spare positions for future connections (minimum size shall be 18 in. x 4 in. x 1/4 in.). The copper detail shall be exothermically welded to the building steel. Provide a 500 kcmil copper conductor ground riser to the service entrance grounding electrode.
2. The neutral of each local dry-type transformer shall be bonded to the electric closet ground reference point from the individual transformer external neutral ground lug. All local transformer neutral grounding electrode conductors shall be sized per Code and shall be run in rigid conduit between the transformer and the reference ground point. The ground conductor shall be bonded to the conduit at both ends with a conductor of the same size as the ground conductor contained within and shall be terminated at the reference ground point using an exothermic welding process.

3. The derived neutral of all power conditioning and/or power distribution units shall be bonded to the electric closet ground reference point, the neutral shall be bonded to the electric closet ground reference point. All local transformer neutral grounding electrode conductors shall be sized per Code and shall be run in rigid conduit between the transformer and the reference ground point. In addition, furnish an equipment ground conductor sized per Code between the ground bus of the power conditioning and/or power distribution unit ground bus and its derived service ground reference point.
- K. Emergency Generator System Grounding: The neutral point of the emergency generator system shall be grounded in a manner identical to that previously specified for the service entrance equipment except that the system will require connection to only one of the grounding electrode means noted above. The ground bus in the generator output and control switchboard shall be used as the reference point of the emergency system and shall be grounded to the grounding electrode. Connect the neutral leads from the generator to the reference point using a full size neutral run with the phase conductors, to the switchboard neutral bus, and a bonding jumper between the switchboard neutral and ground bus. Provide a grounding electrode conductor, without splice or joints, of minimum 250 kcmil copper conductor, or as required in NYCEC Article 250, whichever is larger, between the reference ground point and the grounding electrode. Connect the generator frame to the reference ground point using a minimum 250 kcmil copper conductor.

3.2 GROUNDING SYSTEM TESTING

- A. Upon completion of the electrical system, including all grounding, this Contractor shall test the system for stray currents, ground shorts, etc. These tests shall be performed in a manner acceptable to the Engineer. Approved instruments, apparatus, services, and qualified personnel shall be utilized. If stray currents, shorts, etc., are detected, eliminate or correct as required. The test procedure shall be as outlined:
1. Open all main disconnects for the system being tested.
 2. Disconnect the system neutral from the service entrance or step-down transformer neutral connection.
 3. Connect a DC ohmmeter across the system neutral and equipment ground.
 4. An ohmmeter reading in excess of 100 ohms shall indicate that the system neutral and equipment ground are properly isolated.
 5. An ohmmeter reading less than 100 ohms shall indicate that the system contains ground shorts (stray currents) at some point along the system neutral.
 6. Grounded neutrals may be identified by disconnecting individual neutral conductors from the system one at a time while monitoring the ohmmeter.
 7. The systems shall be retested after correction of all ground shorts is complete. Final readings shall be tabulated for review by the Engineer.
- B. The maximum resistance to ground from any point in the electrical system shall be 5 ohms.

C. Refer to Section 26 08 00 for additional requirements for grounding system testing.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install a complete support system as specified herein and as required for proper distribution, protection, and support of all electrical equipment throughout the project as indicated on and in accordance with the requirements of the Contract Documents.
- B. Section includes:
 - 1. Conduit Hangers and Supports.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 06 - Electrical Service.
 - 3. Section 26 05 07 - Access Doors and Color Coded Identification in General Construction.
 - 4. Section 26 05 10 - Electrical General.
 - 5. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 6. Section 26 05 20 - Heating Cable.
 - 7. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 8. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 9. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 10. Section 26 05 53 - Identification for Electrical Systems.
 - 11. Section 26 09 23 - Lighting Control Devices.
 - 12. Section 26 22 13 - Low-Voltage Distribution Transformers.
 - 13. Section 26 24 13 - Switchboards.
 - 14. Section 26 24 16 - Panelboards.
 - 15. Section 26 27 26 - Wiring Devices.
 - 16. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 - 17. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
 - 18. Section 26 43 00 - Surge Protective Device System.
 - 19. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. All hangers and supports and all components shall be designed, manufactured, and tested in accordance with the latest applicable codes and reference standards, including the following:
- B. Codes:

1. IBCNJ - International Building Code New Jersey Edition.
 2. NEC - National Electrical Code New Jersey Amendments.
- C. Reference Standards:

1. UL 1565 - Positioning Devices.
2. UL 2239 - Hardware for the Support of Conduit, Tubing and Cable.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:
1. Hangers and supports complete with physical dimensions, materials, connector details, installation details, etc.
 2. Shop Drawings of the riser support system inside vertical shafts shall be submitted to the Project Structural Engineer for approval, including details of how the riser support structure is to be attached to the building structure.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the Division 01 and Section 26 05 00.

1.6 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution.
- C. If it complies with the Contract Documents, hangers and supports manufactured by one of the following manufacturers will be acceptable:
1. Thomas & Betts/Kindorf.
 2. Thomas & Betts/Superstrut.
 3. Unistrut.

2.2 GENERAL

- A. Horizontal conduit runs may be supported by beam, special brackets or adjustable trapeze hangers with each conduit strapped at each support point. Conduits 3/4 in. in size within hung ceilings may be supported to black iron ceiling structural members with heavy iron tie wire.
- B. Where cable supports, conduits, etc., are routed vertically through shafts, the Contractor shall provide and install all necessary miscellaneous structural members to support the loads imposed by the risers.
- C. Miscellaneous structural support members installed in Switchboard Rooms, electric closets, central plants, Mechanical Rooms, and where exposed to public view shall be galvanized.

2.3 CONDUIT HANGERS AND SUPPORTS

- A. All horizontal conduits throughout the building shall be thoroughly and substantially supported with individually approved expansion ring hangers or supported in groups using channels and suitable hangers. Hanger spacing shall be determined by the NEC and in no case may hangers be spaced more than ten (10) feet apart. Special hangers and supports shall be provided where they may be required because of any peculiarities of construction. Additional hangers shall be provided where required by the manufacturer, Structural Engineer or Authority Having Jurisdiction.
- B. Perforated extension bar hangers will not be accepted in any part of the Work.
- C. All vertical conduits shall be substantially supported at floor lines or cable support boxes to carry the weight of the conduit and cable in a satisfactory manner with allowance for expansion and contraction.
- D. Where exposed to weather, conduit hangers and supports shall be Robroy Industries "Plasti-Bond", or approved equal. Damaged hangers and supports shall be field-coated with Robroy Industries "Plasti-Bond Touch-Up", or approved equal.
- E. Hanger rod sizes shall be as recommended by the hanger manufacturer for the service intended.
- F. Where embedded in concrete, or where plastic coating is not appropriate, hangers, channels, etc., shall be double hot-dipped galvanized.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Where equipment (transformers, bus ducts, conduit racks, etc.) is supported from structure above, the Contractor shall provide all miscellaneous structural members to support the load plus a 250 lb. live load.

3.2 TESTING

- A. Refer to Section 26 08 00 for additional testing requirements for hangers and electrical systems equipment.

END OF SECTION 260529

SECTION 260533 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all conduit, conduit fittings, wall and ceiling outlet boxes, junction boxes, pull boxes, cable support boxes, conduit bodies, elbows, nipples, insulating bushings, grounding bushings, and other such items for proper distribution, support, pulling, installation, connection, termination, and other such needs of all wire, cable, electrical conductors, luminaires, and other equipment throughout the project as required by code, construction constraints, as indicated on and in accordance with the Contract Documents.
- B. Section includes:
 - 1. Conduit.
 - 2. Troughs.
 - 3. Junction and Pull Boxes.
 - 4. Floor Boxes.
 - 5. Ceiling and Wall outlet boxes.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 06 - Electrical Service.
 - 3. Section 26 05 07 - Access Doors and Color-Coded Identification in General Construction.
 - 4. Section 26 05 10 - Electrical General.
 - 5. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 6. Section 26 05 20 - Heating Cable.
 - 7. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 8. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 9. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 10. Section 26 05 53 - Identification for Electrical Systems.
 - 11. Section 26 09 23 - Lighting Control Devices.
 - 12. Section 26 22 13 - Low-Voltage Distribution Transformers.
 - 13. Section 26 24 13 - Switchboards.
 - 14. Section 26 24 16 - Panelboards.
 - 15. Section 26 27 26 - Wiring Devices.
 - 16. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 - 17. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
 - 18. Section 26 41 13 - Lightning Protection for Structures.
 - 19. Section 26 43 00 - Surge Protective Device System.
 - 20. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. All conduit, outlets, boxes and all components shall be designed, manufactured, and tested in accordance with the latest applicable codes and reference standards, including the following:
- B. Codes:
1. IBCNJ - International Building Code New Jersey Edition.
 2. NEC - National Electrical Code New Jersey Amendments.
- C. Reference Standards:
1. ANSI C80.1 - Electric Rigid Steel Conduit.
 2. ANSI C80.3 - Steel Electrical Metallic Tubing.
 3. ANSI C80.5 - Electrical Rigid Aluminum Conduit.
 4. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 5. UL Standard 1 - Flexible Metal Conduit.
 6. UL Standard 6 - Electrical Rigid Metal Conduit - Steel.
 7. UL Standard 6A - Electrical Rigid Metal Conduit - Aluminum, Red Brass and Stainless Steel.
 8. UL Standard 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
 9. UL Standard 50E - Enclosures for Electrical Equipment, Environmental Considerations.
 10. UL Standard 360 - Liquid-Tight Flexible Steel Conduit.
 11. UL Standard 514A - Metallic Outlet Boxes.
 12. UL Standard 514B - Conduit, Tubing and Cable Fittings
 13. UL Standard 651 - Schedule 40 and 80 Rigid PVC Conduit and Fittings.
 14. UL Standard 797 - Electrical Metallic Tubing - Steel.
 15. UL Standard 1242 - Electrical Intermediate Metal Conduit - Steel.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:

1. Conduit, including samples, complete with fittings, materials, connector details, etc.
2. Outlets and boxes complete with physical dimensions, material, connection details, installation details, etc.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the Division 01 and Section 26 05 00.

1.6 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution.
- C. If it complies with the Contract Documents, raceways and boxes manufactured by one of the following manufacturers will be acceptable:
 1. Rigid Steel and Intermediate Metal Conduit
 - a. Allied Tube & Conduit/Tyco.
 - b. Republic Conduit.
 - c. Triangle.
 - d. Western Tube & Conduit Corporation.
 - e. Wheatland Tube Company.
 2. Rigid Steel and Intermediate Metal Conduit Fittings
 - a. AFC.
 - b. Bridgeport.
 - c. Appleton.
 - d. Cooper Crouse-Hinds.
 - e. O-Z/Gedney.
 - f. Raco/Hubbell.
 - g. Steel City/Thomas & Betts.
 - h. Wheatland Tube Company.

3. Rigid Steel Conduit and Fittings (Exposed to the Weather)
 - a. Ocal/Thomas & Betts.
 - b. Occidental Coating Company.
 - c. Perma-Cote.
 - d. Robroy Industries "Plasti-Bond-Red".
 - e. Triangle.
4. Rigid Aluminum Conduit and Fittings
 - a. Allied Tube & Conduit.
 - b. Republic Conduit.
 - c. Wheatland Tube Company.
5. Electrical Metallic Tubing (EMT)
 - a. Allied Tube & Conduit/Tyco.
 - b. Republic Conduit.
 - c. Robroy Industries.
 - d. Triangle.
 - e. Western Tube & Conduit Corporation.
 - f. Wheatland Tube Company.
6. Electrical Metallic Tubing Fittings
 - a. AFC.
 - b. Appleton.
 - c. Bridgeport.
 - d. Cooper Crouse-Hinds.
 - e. O-Z/Gedney.
 - f. Raco/Hubbell.
 - g. Steel City/Thomas & Betts.
7. Flexible Metal Conduit
 - a. AFC.
 - b. American Metal Molding.
 - c. Anaconda.
 - d. Eastern Wire + Conduit.
 - e. Electri-Flex Company.
 - f. International Metal Hose.
 - g. Southwire/Alflex.
8. Flexible Metal Conduit Fittings
 - a. AFC.
 - b. Appleton.
 - c. Bridgeport.
 - d. Cooper Crouse-Hinds.
 - e. O-Z/Gedney.
 - f. Raco/Hubbell.

- g. Steel City/Thomas & Betts.
 - 9. Liquid-tight Flexible Metal Conduit
 - a. AFC.
 - b. Anaconda.
 - c. Eastern Wire + Conduit.
 - d. Electri-Flex Company.
 - e. International Metal Hose.
 - f. Steel City/Thomas & Betts.
 - 10. Liquid-tight Flexible Metal Conduit Fittings
 - a. AFC.
 - b. Appleton.
 - c. Bridgeport.
 - d. Cooper Crouse-Hinds.
 - e. O-Z/Gedney.
 - f. Raco/Hubbell.
 - g. Steel City/Thomas & Betts.
 - 11. Rigid Nonmetallic Electrical Conduit and Fittings
 - a. Allied Tube & Conduit/Tyco.
 - b. Carlon/Thomas & Betts.
 - c. Certainteed.
 - d. FRE.
 - e. Triangle.
 - 12. Outlets and Boxes
 - a. Appleton.
 - b. Cooper Crouse-Hinds.
 - c. O-Z/Gedney.
 - d. Raco/Hubbell.
 - e. Steel City/Thomas & Betts.
- 2.2 CONDUIT
 - A. The minimum size conduit that shall be permitted is 3/4 inch.
 - B. Conduit shall not be embedded in the slabs except specifically where permitted on the drawings. Submit in writing at time of bid any conduit this Contractor intends to run in slab.
 - C. Non-Flexible Conduit
 - 1. Rigid metal conduit (RMC) or RGS shall be as follows:
 - a. RMC shall have a cross-section formed with a sufficient degree of accuracy to permit the cutting of clean, true, full threads.

- b. RMC shall be joined with pipe couplings and shall be secured in cabinets, outlets, etc., with double locknuts. Conduits terminating in cabinets, outlets, etc., shall be provided with Midwest Catalog Number 931 to 942, or approved equal steel insulating grounding bushings.
 - c. All fittings shall be cast iron or galvanized or cadmium-plated and threaded.
 - d. Steel, hot-dipped galvanized inside and out.
 - e. Where exposed to weather, RMC shall be Robroy Industries "Plasti-Bond-Red" complete with UL listed fittings, or approved equal plastic coated non-flexible metal conduit and fittings. Exposed threads, damaged coatings, etc., shall be field-coated with Robroy Industries "Plasti-Bond-Red Touch-Up", or approved equal.
 - f. Full lengths of pipe shall have galvanized or zinc-coated threads on both ends.
 - g. Running threads shall not be used. Where such a device is required, use T&B "Erickson" type union or O-Z/Gedney Type SSP split coupling, or approved equal.
2. Aluminum rigid metal conduit shall be as follows:
 - a. Aluminum couplings and fittings, shall be used and installed as recommended by the Manufacturer using Crouse-Hinds STL-6 compound, or approved equal.
 - b. All elbows shall be hot-dipped or electroplated galvanized steel.
 3. Intermediate metal conduit (IMC) shall be as follows:
 - a. IMC shall be hot-dipped or electroplated galvanized.
 - b. All fittings shall be cast iron or cast iron alloy, galvanized or cadmium-plated.
 4. Electrical Metallic Tubing (EMT) shall be as follows:
 - a. Steel.
 - b. Formed with a sufficient degree of accuracy to permit the use of connectors.
 - c. EMT shall be joined with Midwest Catalog Nos. 460-469 steel couplings, or approved equal.
 - d. EMT and rigid metal conduit shall be joined with Midwest Catalog Nos. 420-422 steel couplings, or approved equal.
 - e. Conduits shall be secured with Midwest Catalog Nos. 1450-1459 or approved equal steel set screw type insulated connectors at panels, junction boxes, outlets, etc. All connectors and couplings, etc., shall be steel and set screw type.
 - f. At the Contractor's option, metallic tubing using "Unicouple" type connectors may be used instead of tubing and individual couplings. Where "Unicouple"

connectors are used in vertical conduit runs, all flared conduit ends shall be oriented downward to prevent moisture from being “funneled” into the conduit.

5. Polyvinyl chloride (PVC) conduit shall be as follows:
 - a. Any rigid non-metallic conduit (RNC) noted on the project shall be PVC unless indicated otherwise.
 - b. Shall have a cross-section formed with a sufficient degree of accuracy to permit the cutting of clean, true, full threads.
 - c. Conduit shall be joined with weatherproof solvent, cement and approved pipe couplings. PVC conduit shall be provided with steel insulating grounding bushings as manufactured by Kraloy, Carlon, or approved equal.
 - d. All PVC shall be Schedule 80 (extra-heavy wall EPC-80).
 - e. All elbows shall be cast iron or galvanized or cadimum-plated and threaded.

D. Flexible Conduit

1. Flexible Metal Conduit (FMC): Flexible metal conduit shall be steel and shall only be used for connections to the following:
 - a. Motors.
 - b. Transformers.
 - c. Control equipment and devices.
 - d. Lighting fixtures not connected by non-flexible metal conduit. See Section 26 05 19 for requirements for the use of type “AC” and “MC” conductor cables.
 - e. Receptacles: See Section 26 05 19 for requirements for the use of type “AC” and “MC” conductor cables.
 - f. Appliances.
 - g. Equipment and devices requiring adjustment or removal for maintenance.
 - h. Busway switches.
 - i. Fan-powered terminal units.
 - j. Capacitors.
 - k. Equipment and devices subject to movement or vibration.
2. Liquid-Tight Flexible Metal Conduit (LFMC)

- a. Shall be same as flexible metal conduit, with heavy-duty, inert, watertight outer jacket. Shall be used for all connections to:
 - 1) Pumps.
 - 2) Outdoor flexible connections.
 - 3) Vibrating equipment in wet locations.

2.3 TROUGHS

- A. Troughs shall be provided where required.
- B. Provide hinged covers and screw closures.
- C. Troughs shall be Code gauge steel painted and fill capacity shall not exceed Code.

2.4 JUNCTION AND PULL BOXES

- A. Furnish and install junction and pull boxes where required by the Code, as indicated on the Drawings, or where required to facilitate pulling and supporting conductors, regardless of whether shown on Drawings or not. All such boxes must be made accessible and built of heavy gauge steel, unless otherwise specified, and shall be built only from approved detail working drawings. The covers of boxes shall be designed for quick removal and shall be built in sections not to exceed 8 square feet in area. When the system is finished, the boxes shall contain no openings, except that into which the conduit passes. Generally, junction boxes and pull boxes shall be installed every 100 feet in a conduit run and shall not be exposed in finished spaces and, where necessary to do so, reroute these conduit or make other arrangements to meet the approval of the State. Pull boxes or junction boxes occurring in finished areas shall have the removable cover plates flush with finished ceiling. All cables within pull boxes shall be properly tagged for identification, using one (1) inch diameter engraved micarta tags or equivalent. Suitable supports shall be provided in all pull boxes to support feeders passing through the boxes so that the conductors will not remain unsupported for a distance greater than required by Code.
- B. 120/208 volt feeders shall not occupy the same box with 277/480 volt feeders unless suitable barriers are provided within boxes to separate these feeders.
- C. Emergency feeders, as defined by Article 700 of the NEC, shall not occupy the same box with normal or optional standby feeders. Barriers shall not be adequate to separate emergency feeders from other feeders.
- D. Feeders originating from different service switchboards shall not occupy the same box unless suitable barriers are provided within boxes to separate these feeders.
- E. Unmetered feeders shall not occupy the same boxes with any other service, unless suitable barriers are provided within the boxes to separate the services. Separate covers with hardware to facilitate PSE&G seals shall be provided for such box section.

2.5 FLOOR BOXES

- A. Furnish and install watertight floor boxes, where indicated on the Drawings, of the type specified on the Drawings. Coordinate penetration location and fire rating with the Architect and Structural Engineer prior to installation.
- B. Floor boxes shall be metallic. Plastic boxes are not acceptable.
- C. Floor boxes shall be UL listed and scrub-resistant where required.

2.6 CEILING AND WALL OUTLET BOXES

- A. Boxes for interior ceiling, pendant, or wall bracket mounted lighting fixtures shall be galvanized or sherardized steel, stamped or welded in 4 in. octagon or square shape by 1-1/2 in. deep with 3 in. deep boxes used in hung ceilings. Wall bracket outlets shall have a 2-3/4 in. round opening and, except for one (1) light receptacle, shall be furnished with a fixture stud.
- B. All boxes in damp or wet locations, where exposed to the weather, or where surface mounted shall be aluminum or cadmium-plated cast metal Type FS or FD as required with threaded hubs and listed for their use.
- C. Where main ceiling outlets for pendant fixtures occur, this Contractor shall furnish and install not less than 1/2 in. fixture studs securely fastened to the backs of the boxes. All such studs shall be in the centers of the boxes.
- D. Boxes shall have only the holes necessary to accommodate the conduit at the points of installation unless otherwise indicated on the Drawings. All boxes shall have lugs or ears inside to secure the covers. All unused holes in boxes shall be plugged or capped with appropriate accessories.
- E. Outlet boxes for switches and plug receptacles in finished walls shall be of proper design to accommodate the switches, receptacles, and conduits required to each location and shall provide ample room for connections.
- F. All switch, plug receptacle, and junction boxes shall be mounted vertically, unless otherwise noted on the Drawings.
- G. Provide small boxes (GEM) only as required for devices in shallow partitions.
- H. Empty outlet boxes used for junction or extension purposes shall be 2-1/2 in. deep minimum with blank covers.

PART 3 - EXECUTION

3.1 GENERAL

- A. All electric conductors shall be installed in non-flexible or flexible metal conduit, except where Type "AC" or "MC" armor or metal clad cable is specifically permitted, where plenum conductor cable is permitted for horizontal branch wiring to individual fire alarm system devices, where surface metal raceway is specifically permitted, and as specified in Section 26 05 19.

3.2 CONDUIT INSTALLATION – WHERE USED

- A. Rigid Metal Conduit - Steel: All raceways shall be steel RMC except where other materials may be allowed herein or where specifically called out in other locations of the Contract Documents.
- B. Rigid Metal Conduit - Aluminum
 - 1. At the option of the Contractor, aluminum rigid metal conduit may be used instead of steel RMC except in the following locations, systems or parameters, where another method approved herein must be used:
 - a. Underground.
 - b. Embedded or encased in concrete.
 - c. Exposed to weather.
 - d. In wet or damp locations.
 - e. Systems operating at over 600 volts, nominal.
 - f. Parking areas.
 - g. Loading docks.
 - h. Where specifically required elsewhere in the Contract Documents or Code.
- C. Intermediate Metal Conduit
 - 1. At the option of the Contractor, intermediate metal conduit may be used instead of steel RMC only in the following locations for systems operating at below 600 volts, nominal.
 - a. Embedded or encased in concrete.
 - b. In wet or damp locations.
- D. Electrical Metallic Tubing
 - 1. At the option of the Contractor, electrical metallic tubing may be used instead of steel RMC except in the following locations, systems or parameters, where another method allowed herein must be used.
 - a. Underground.
 - b. Embedded or encased in concrete.
 - c. Exposed to weather.
 - d. In wet or damp locations.
 - e. Systems operating at over 600 volts, nominal.

- f. Parking areas.
- g. Loading docks.
- h. Exceeding trade size 4.
- i. Where specifically required elsewhere in the Contract Documents or Code.

E. Polyvinyl Chloride

- 1. Polyvinyl chloride conduit shall only be used instead of steel RMC where specifically indicated on the drawings. PVC shall not be allowed in any location, system or parameter except the following, even if indicated elsewhere on the drawings.
 - a. Outside the building.
 - b. Underground.
 - c. Embedded or encased in not less than 2 in. of concrete.
 - d. Systems operating at over 600 volts, nominal, and in compliance with a., b. or c. above.
 - e. Trade size 4 or larger and in compliance with a., b., or c. above.
- 2. For all PVC located within the building, provide minimum 2 in. of concrete encasement whether indicated or not. Coordinate with project Structural Engineer.
- 3. Where PVC exits concrete encasement, it shall transition to another method prior to being exposed.

F. Flexible Metal Conduit: Flexible metal conduit shall only be used where hereinbefore described. FMC shall not be encased in concrete unless listed for the purpose.

G. Liquid-tight Flexible Metal Conduit: Liquid-tight flexible metal conduit shall only be used where hereinbefore described. FMC shall not be encased in concrete unless listed for the purpose.

3.3 CONDUIT INSTALLATION GUIDELINES

A. Conduit - General

- 1. All references to “conduit” shall include “tubing” of types allowed herein.
- 2. Conduit shall be sized in accordance with the percent fill requirements of the Code and as indicated on the Drawings (whichever is larger, in the event of a conflict) and shall be of ample size to permit the ready insertion and withdrawal of conductors without abrasion.
- 3. Conduit shall not be embedded in any structural slabs, unless specifically noted on the Drawings or when permitted by State’s acceptance of the deduct alternate. The specifically noted conduit to be embedded in any structural slab shall be installed strictly

in accordance with the Project Structural Engineer's written instructions. This Contractor shall forward two (2) copies of the Project Structural Engineer's written approval and instructions for installation to the Engineer for his file prior to proceeding with the installation. Conduits embedded in structural slabs shall have watertight joints.

4. Any and all conduit embedded in concrete or run in earth or underground shall be listed for the purpose.
5. Conduit in finished portions of the building, except in mechanical and electrical equipment rooms, or where otherwise indicated on the Drawings, shall be concealed. Concealed conduit shall be run in as direct a manner and with as long a bend as possible. Exposed conduit shall be run parallel to or at right angles with the lines of the building. All bends shall be made with screw-jointed conduit fittings or with standard ells manufactured only in sizes exceeding 1-1/2 inches, or noted elsewhere in the Contract Documents. All bends shall be free from dents or flattening. Not more than the equivalent of four (4) 90° bends shall be used in any run between terminals and cabinets, or between outlets and junction or pull boxes. Specification conformity of field bends shall be demonstrated if so requested by the Architect or Engineer by passing of mandrel of size compatible within inner diameter of conduit through bend.
6. Conduit shall be continuous from outlet to outlet and from outlet to cabinets, junction or pull boxes and shall enter and be secured at all boxes in such a manner that each system shall be electrically continuous throughout.
7. Terminals of all conduits shall be furnished with bushings, locknuts, connectors, etc., as specified herein. All joints shall be cut square, reamed smooth, and drawn-up tight.
8. Insulation bushing or insulating throats shall be installed on all terminations.
9. All rigid conduit larger than 1 inch trade size terminating in cabinets, panel boxes, pull boxes and not containing a separate insulated ground conductor shall be provided with insulated throat ground bushings.
10. So far as is practicable, all exposed conduit shall be run without traps. Where traps or dips are unavoidable, a junction or pull box shall be placed at each low point.
11. Conduit hangers and fasteners shall be of the type appropriate in design and in dimensions for the particular applications and shall be securely fastened in place as specified herein at Code minimum spacings and at each elbow.
12. Each entire conduit system shall be installed complete before any conductors are drawn in. To guard against obstructions and omissions, each run of conduit shall be finished before gypsum board is installed. All conduit shall be swabbed after plaster is finished and dry.
13. As soon as the conduit system has been permanently installed in place, conduit ends shall be capped or plugged with standard accessories.
14. Conduit for low-voltage systems shall be provided with pull boxes of approved sizes after two right angle bends and at intervals not exceeding 100 feet. Boxes shall be in accessible locations.

15. A 1/8 in. braided polypropylene rope or No. 14 galvanized iron fish wire shall be left in all empty conduit systems. At least 12 in. of properly secured rope or wire shall be folded back into each end of the empty conduits.
16. Where conduit enters the building through a concrete foundation wall below grade level, a watertight entrance seal shall be used. The seal shall be Link-Seal or as approved.
17. In areas designated as Class I, Division 2 hazardous areas, rigid metal conduit (or liquid-tight flexible metal conduit for motor terminations) with approved terminations and fittings shall be used. The Class I, Division 2 hazardous areas shall be as defined by the Authority having jurisdiction for the project.
18. The power leads to all motors shall be in conduit. Where motors have conduit terminal boxes, the feeder conduit shall not be connected directly into same. Provide a flexible conduit for final connection to motor terminal box. Flexible conduit shall be long enough (but in no case less than 36 inches long) and of suitable arrangement to achieve a true flexible connection between motor and rigid conduit. Under no circumstances shall rigid conduit terminate in or be fastened to motor foundation. Liquid-tight flexible metal conduit shall be installed to all motors.

B. Non-Flexible Conduit

1. Furnish and install O-Z/Gedney Company expansion fittings, type DX for rigid metal conduit, type EX for rigid metal conduit exposed to the weather and type TX for electrical metallic tubing (EMT), or equivalent manufactured by Appleton, Crouse - Hinds, or Spring City, where non-flexible metal conduits cross building expansion joints. See Section 26 05 26.
2. Conduit installed in the ground shall have water-tight joints and shall be painted the entire length with two coats of protective finish such as asphaltum or factory-coated with a phenolic resin epoxy material. All coating shall be applied in accordance with the manufacturer's recommendations. The entire length of non-flexible metal conduit, including fittings, in contact with the ground, to a point 6 in. above the ground (or concrete slab), shall be completely coated, subject to the Engineer's approval.
3. Prior to the installation of any plastic coated conduit, the Contractor shall submit a 12 in. sample of the proposed conduit, fittings and miscellaneous materials for review by the Engineer.

C. Flexible Conduit

1. Continuity of the equipment ground across flexible metal conduit connections shall be maintained for all systems that are over 150 volts to ground. The continuity shall be maintained by installing a grounding conductor sized in accordance with the Code. The grounding conductor shall be inside the flexible conduit and shall be connected on one end of the flexible metal conduit by a suitable binding post and similarly connected on the opposite end with another suitable binding post. All grounding conductors shall be solid copper conductors.
2. Liquid-tight flexible metal conduits shall not be installed in lengths exceeding 6 ft.

3. Flexible metal conduit shall be secured with Midwest Catalog Nos. 1708-1715 or approved equal insulated throat clamps. Liquid-tight flexible metal conduit shall be secured with Midwest Catalog Nos. LTB-38 through LTB-300 or approved equal insulated throat watertight fittings and shall be used where subject to weather or moisture conditions. Connectors shall be steel type. Die cast connectors will not be acceptable.

3.4 OUTLETS AND BOXES

- A. The approval of the Architect shall be obtained for any outlet location in question. Outlets placed without specific approval in locations not suitable to the finished room or area shall be removed and relocated without additional cost to the State when so directed by the Architect. This shall include the cutting and patching of Work of others as may be necessary. Refer to Section 26 05 00 for additional requirements.
- B. All boxes shall be rigidly secured in position to building structure. Boxes larger than 4 in. shall be secured at two points. All boxes, except for recessed lighting fixtures and except on unfinished ceilings and walls, shall be so set that the front of each box or cover shall be flush with the finished wall or ceiling line, or not more than 1/4 in. back of same. Boxes for recessed lighting fixtures shall be located at a minimum elevation of 8-1/2 in. above the bottom of the finished ceiling and shall be secured to the structure or structural black iron ceiling supports as permitted by governing Codes. Boxes in hung plaster ceilings shall be provided with two hanger bars and two hanger clips for each bar. Lighting and telephone grid box elevations and locations shall be coordinated in the ceiling space with the mechanical installations. No box for any conduit system shall be secured to the ceiling suspension system, air conditioning ducts, mechanical piping, cable tray, or low-voltage systems and their support systems. Wall boxes shall not be mounted back-to-back, but shall be separated by a wall stud.
- C. Mounting Heights
 1. Unless otherwise shown, specified, or directed, wall outlet boxes shall be located with their center lines at the following elevations above the finished floor line. Refer to architectural drawings for additional details.
 - a. Wall switches: 3 ft. 6 in.
 - b. Wall receptacles (duplex type): 1 ft. 6 in.
 - c. Receptacles above counters (duplex type): Refer to Drawings.
 - d. Clock hanger outlets: 8 ft. 0 in.
 2. Other special outlets shall be installed as shown or specified on the plans, details, or in the symbol list on the Drawings.

3.5 INSTALLATION GUIDELINES FOR PULL AND SPLICE BOXES

A. General

1. Purpose
 - a. Pull boxes shall be used for the following purposes:

- 1) Fishing the conduit run.
 - 2) Installing a pull string or cable.
 - 3) Pulling the cable to the box and then looping the cable to be pulled into the next length of conduit.
- b. Pull boxes shall not be used for splicing cable.
 - c. Splice boxes are intended to be used for splicing in addition to pulling cable.
2. Pull or splice boxes shall be readily accessible. Pull or splice boxes shall not be placed in a fixed false ceiling space unless immediately above a suitably marked access panel.
 3. A pull or splice box shall be placed in a conduit run where:
 - a. the length is over 30 m. (100 ft.);
 - b. there are more than four (4) 90° bends, or equivalent; or,
 - c. if there is a reverse (U-shaped) bend in the run.
 4. Pull and splice boxes should be placed in a straight section of conduit and not used in lieu of a bend. The corresponding conduit ends should be aligned with each other.
 5. Conduit fittings/bodies shall not be used in place of pull or splice boxes unless specifically approved in writing by the Engineer.
 6. Pull and splice boxes shall be labeled on the exposed exterior.

3.6 FIELD TESTING

- A. Refer to Section 26 08 00 for additional testing requirements for outlets, boxes and conduit system.

3.7 "AS-BUILTS"

- A. Provide "as-built" drawings (1/8 in. = 1 ft. 0 in. scale) at the completion of the work to document the location of all buried conduit, boxes, cable, etc. Drawings shall clearly identify locations, quantities, sizes, etc., for coordination with future construction.

END OF SECTION 260533

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all foundation vibration isolation, and associated equipment for conduit, transformers, rotating equipment, etc., and seismic restrains on all systems and equipment, conduit, luminaires, etc., in accordance with Code, as indicated on and in accordance with the requirements of the Contract Documents.
- B. Section includes:
 - 1. Floor Mounting of Transformers 112.5 kVA and Greater.
 - 2. Mounting of Transformers Less Than 112.5 kVA.
 - 3. Seismic Restraints.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 06 - Electrical Service.
 - 3. Section 26 05 07 - Access Doors and Color-Coded Identification in General Construction.
 - 4. Section 26 05 10 - Electrical General.
 - 5. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 6. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 7. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 8. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 9. Section 26 09 23 - Lighting Control Devices.
 - 10. Section 26 22 13 - Low-Voltage Distribution Transformers.
 - 11. Section 26 24 13 - Switchboards.
 - 12. Section 26 24 16 - Panelboards.
 - 13. Section 26 27 26 - Wiring Devices.
 - 14. Section 26 28 13 - Fuses.
 - 15. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 - 16. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
 - 17. Section 26 41 13 - Lightning Protection for Structures.
 - 18. Section 26 43 00 - Surge Protective Device System.
 - 19. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. All vibration isolation devices and all components shall be designed, manufactured, and tested in accordance with the latest applicable codes and reference standards, including the following:

B. Codes:

1. IBCNJ - International Building Code New Jersey Edition.
2. NEC - National Electrical Code New Jersey Amendments.

C. Reference Standards:

1. ANSI R211.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:

1. Vibration Isolation Equipment, including calculations, drawings, etc., bearing the certification stamp of a Structural Engineer registered in the State of New Jersey. Submittal data shall include size, type, load, and deflection of each isolator selected, and shall clearly outline procedures for setting and adjusting all isolation devices.
2. Conduit Riser Anchors and Guides, including riser diagrams and loads imposed upon the structure at support points.
3. Submit isolation Shop Drawings for all horizontal and vertical conduits, equipment inertia bases, and electrical equipment to the Structural Engineer, Architect, and Engineer prior to fabrication and installation of any of the isolation and restraint equipment or systems. Submittal data shall include certification by the vibration isolation manufacturer that all vibration isolation and the equipment and conduit utilizing the isolation (horizontal and vertical) have been examined for excessive stresses and that none will exist in the design proposed. Shop Drawings shall indicate the anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes, construction loading, normal operating condition loading, and the structural loading which will occur during expansion and contraction. All calculations shall be included with the Shop Drawings and shall be of a similar format to facilitate review. Each device shall have a permanently attached identification tag which is cross-referenced to the diagrams by location and service (not just serial numbers).
4. Shop Drawings shall be submitted to the Project Structural Engineer for review of loads imposed on the building structure. The Shop Drawing shall be submitted to the Engineer for review after review by the Project Structural Engineer.

B. Provide certified seismic calculations by a Civil or Structural Engineer licensed to practice in the State of New Jersey, for all equipment and systems to be seismically restrained and their attachment to the structure.

C. Shop Drawings shall also be submitted to the Project Acoustical Consultant for review.

1.5 WARRANTY

A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution.
- C. If it complies with the Contract Documents, vibration isolation devices manufactured by one of the following manufacturers will be acceptable:
 - 1. Amber/Booth Company.
 - 2. Mason Industries, Inc.
 - 3. Vibration Eliminator Company.
 - 4. Vibration Mounting and Controls, Inc.

2.2 GENERAL

- A. All equipment, conduit, transformers, etc., shall be mounted on or suspended from approved foundations and supports, all as specified herein, as shown on the drawings, or as required.
- B. It shall be understood that the requirements of this seismic section are complementary to requirements delineated elsewhere for the support and fastening of equipment and mechanical work. Nothing on the drawings or specifications shall be interpreted as a reason to waive the requirements of this seismic section.
- C. As part of this work, the Contractor shall engage the services of a New Jersey State licensed Professional Engineer with experience in the field of equipment support and seismic restraints. He shall select and coordinate the restraints and supports based on the final coordinated drawings showing exact location of piping and equipment and shall coordinate with the Structural Engineer to ascertain that the connections to the structure will resist the seismic forces to which they might be subjected.
- D. All vibration isolators shall be furnished with zinc electro-plated hardware to prevent corrosion and bolt freeze-up and to maintain attractive appearance. To prevent corrosion, steel or cast iron housing shall be treated by phosphating and painting while aluminum housing shall be etched in Chromi-Coat solution and painted.
- E. Provisions are required for the support and restraint of all equipment, conduit, etc., in the event of earthquake so as to comply with the latest edition of the IBCNJ.

- F. Connection details shall be submitted and verified as part of the Contractor's submission for each piece of equipment and certified by a licensed Civil or Structural Engineer retained by this Contractor.
- G. The isolation devices and channel frames shall be products of a single vibration isolation manufacturer. The isolation manufacturer's representative shall maintain an adequate stock of springs and isolators of the type used so that any changes required during construction and checking can be accomplished promptly. Complete installation instructions, including details and sizing of anchor devices or plates required, shall be furnished by the supplier. After installation, the isolation manufacturer's representative shall check the various isolators and certify that they have been installed in accordance with his recommendations.
- H. This Contractor shall coordinate the vibration isolation supports with the manufacturers of the equipment to be isolated. Prior to submitting detailed Shop Drawings to the Engineer for review, the equipment manufacturer shall approve the Shop Drawings in writing. Refer to Section 26 05 00.
- I. Each isolation device shall have a permanently attached identification tag indicating location and service of the isolation device.
- J. Provide suitable and substantial hangers and supports for all horizontal conduit. Hangers and supports shall be of the type, size and spacing specified, or as approved. All conduit shall be carried by conduit hangers supported from building structure. All supports requiring connections to steel-plated building construction shall be welded to the steel plating. Provide drawings indicating loads, including method of suspension and hanger location, and submit them for approval prior to proceeding with installation. Provide all the supplementary steel required to support, guide and anchor piping within shafts, Electrical Service Rooms, electrical closets, Equipment Rooms and all other floors. Method of attachment to and load imposed on building structures by hangers, anchors, supports, guides and supplemental steel shall be submitted for review.
- K. All equipment and systems, whether isolated or not, shall be bolted to structure to allow for forces of acceleration as detailed hereinbelow. Bolt points and diameter of inserts shall be submitted and verified as part of the Contractor's submission for each piece of equipment and certified by a licensed Civil or Structural Engineer.
 - l. Conduits with center bracing or Type II restraining system to comply with the IBCNJ as outlined below:
 - a. Conduits to be braced at 40 foot intervals and at turns of more than 4 feet.

Component or System	Minimum Seismic Force
1) Life Safety Equipment	
a) Emergency power systems (generator, automatic transfer switches and accessories) and all support systems for emergency generators.	1.0 "g"

Component or System	Minimum Seismic Force
b) Fuel oil pumps.	1.0 "g"
c) Fire pumps.	1.0 "g"
d) BATC system (including air compressors, remote and central control panels).	1.0 "g"
e) Smoke exhaust systems.	1.0 "g"
f) Fire alarm system.	1.0 "g"
g) Elevators, elevator controllers.	1.0 "g"
h) Motor controllers serving equipment identified above and installed by Division 26.	1.0 "g"
2) All other systems.	0.5 "g"

- L. Where base anchoring is insufficient to resist seismic forces, supplementary restraining such as Seismic Restraint System Type II shall be used above system's center of gravity to suitably resist "g" force levels. Vertically mounted tanks may require this additional restraint.
- M. For overhead supported equipment, overstress of the building structure must not occur. Connections which depend all or in part on friction for their supporting action (such as C-clamps) are not acceptable. Bracing can occur from:
 - 1. Flanges of structural beams.
 - 2. Upper or lower truss chords in bar joist construction at the panel points.
 - 3. Cast-in-place inserts or drilled and shielded inserts in concrete structures.
- N. All structurally suspended overhead equipment isolated or unisolated shall be four-point independently braced with Type II seismic restraining system.
- O. Install Seismic Restraining System Type II: Taut for overhead suspended unisolated equipment, or conduit, and slack with 1/4 inch cable deflection for isolated systems.
- P. All equipment and conduits within and serving the Generator Room.
- Q. Equipment, and conduits in or above ceilings of public lobbies, stairways, and egress corridors.
- R. All supports requiring connections to steel-plated building construction shall be welded to the steel plating.

- S. All concrete foundations and supports and required reinforcing thereof will be furnished and installed under another Contract. However, this Contractor shall furnish shop drawings showing adequate concrete reinforcing steel details and templates for all concrete foundations and supports, and all required hanger bolts and other appurtenances necessary for the proper installation of his equipment. Although the General Contractor will complete all concrete work, all such work shall be shown in detail on the shop drawings, prepared by this Contractor, which drawings shall be submitted to the Architects showing the complete details of all foundations including necessary concrete and steel work, vibration isolation devices, seismic restraints, etc.
- T. All floor-mounted equipment shall be erected on 3-1/2 inch high (minimum) concrete pads over the complete floor area of the equipment plus a 3 in. margin, unless specified to the contrary herein. Wherever hereinafter vibration eliminating devices and/or concrete inertia blocks are specified, these items shall, in all cases, be in turn mounted upon 3-1/2 inch high (minimum) concrete pads unless specified to the contrary herein. Concrete pads shall be dowelled to structural slab per Structural Engineer's direction.
- U. The vibration isolation systems shall be guaranteed to have the deflection indicated on the schedule on the drawings. Mounting systems and components of the isolation mounting shall not be resonant with any of the forcing frequencies of supported equipment or piping. Mounting sizes shall be determined by the mounting manufacturer, and the sizes shall be installed in accordance with the manufacturer's instructions.
- V. All mounting systems including seismic restraints exposed to weather and other corrosive environments shall be protected with factory-applied corrosion resistance. All metal parts of mountings (except springs and hardware) to be hot dip galvanized. Springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated.
- W. Where supplementary steel is required to support piping, the supplementary steel shall be designed to provide a maximum deflection of 0.08 inch at the midspan under the supported load. The piping shall be rigidly supported from the supplementary steel and the supplementary steel isolated from the building structure by means of isolators.
- X. Where steel spring isolation systems are described in the following specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 0.8 of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel. The spring specified minimum deflection from loaded operating height shall be 50% of the rated deflection. The maximum motion of any resiliently supported equipment at startup or shutdown shall be 1/4 inch. Approved lateral restraints shall be provided as required to limit motions in excess of 1/4 inch.
- Y. Neoprene-in-shear isolation mounting assemblies shall utilize bare neoprene elements with unit-type design molded in oil-resistant neoprene. The neoprene shall be compounded to meet the following:
1. Not greater than 70 durometer.
 2. Minimum tensiles strength of 2000 psi.
 3. Minimum elongation of 300%.
 4. Maximum compression at 25% of original deflection.

- Z. Vibration isolation equipment submittal drawings shall include the following information:
1. Isolation mounting deflections.
 2. Spring diameters, compressed spring heights at rated load; solid spring heights, where steel spring isolation mountings are used.
 3. Equipment operating speed/frequencies.
 4. Calculations showing that the spring surge frequency is not coincided with any forcing frequencies/harmonics of the equipment to be mounted.
 5. Drawings, as required, to show the number and location of seismic restraints for each equipment, specific details of restraints, including anchor bolts for mountings and maximum load (static plus dynamic) expected at each restraint or snubbing device and showing that fastening devices for the seismic restraints are capable of maintaining equipment in a captive position when subjected to external forces as hereinbefore listed.
- AA. During equipment installation, floor-supported spring isolation bases shall be set on 2 inch high spacers between the isolation base and the housekeeping pad. After all connections (conduit) have been made to the equipment and the system filled, the normal operating equipment load shall be removed without change of equipment elevation or transfer of stress to the equipment.
- BB. Mountings incorporating vertical limit stops shall be furnished and installed with 1/4 inch spacers. The mounting shall serve as blocking during installation. Mountings shall be adjusted and spacers removed after equipment achieves normal operating loads.
- CC. Each seismic restraint, snubbing device or isolation mounting incorporating seismic restraint shall be installed and/or adjusted to provide the minimum operating clearance in all directions to permit the operation of the equipment without objectionable noise or vibration to any part of the building structure. The operating clearance for equipment seismic restraints shall not be greater than 1/4 inch.
- DD. Equipment seismic restraints or snubbing devices and vibration isolation systems mounting shall be the product of one manufacturer.

2.3 FLOOR MOUNTING OF TRANSFORMERS 112.5 KVA AND GREATER

- A. Each transformer shall be mounted on an integral one-piece structural base, reinforced as necessary, to prevent flexure of the base. The structural frame shall be drilled and tapped, as necessary, to receive the transformer equipment so that the frame shall act as a template.
- B. The structural steel integral base shall be supported on steel spring mountings with a minimum static deflection of 1.5 in. ($\pm 10\%$). These mountings shall be positioned in accordance with the weight distribution to ensure adequate deflection and vibration isolation. Housing or snubbing devices shall not be used to contain the isolator springs.
- C. Isolator types shall be one of the following, or as approved:
- | | | |
|----------|---|--|
| Type SLF | - | Mason Industries Inc, Hauppauge, NY |
| Type OST | - | Vibration Eliminator Company, Long Island City, NY |

Type AN - Vibration Mountings and Controls, Inc., Butler, NJ

- D. A minimum 0.75 in. thick neoprene-in-shear pad at a maximum loading of 50 psi shall be provided between the spring isolator and the floor.
- E. Mounting system, where applicable, shall incorporate seismic restraint Type I.

2.4 MOUNTING OF TRANSFORMERS LESS THAN 112.5 KVA

- A. All such equipment shall be mounted on neoprene-in-shear isolators.
- B. If the equipment to be mounted is not furnished with integral structural frames and external mounting lugs (both of suitable strength and rigidity), approved structural sub-base shall be installed in the field, which shall support the equipment to be hung/floor mounted and which shall be attached to the vibration isolators.
- C. Vibration isolators shall develop 3/8 in. minimum static deflection.
- D. Floor-mounted isolators shall be one of the following, or as approved:

Type ND - Mason Industries Inc., Hauppauge, NY
Type RD - Vibration Mountings and Controls, Inc., Butler, NJ
Type 368SD - Vibration Eliminator Company, Long Island City, NY

Mounting system, where applicable, shall incorporate Seismic Restraint Type I.

- E. Suspended equipment shall be isolated with one of the following, or as approved:

Type HD - Mason Industries Inc., Hauppauge, NY
Type RHD - Vibration Mountings and Controls, Inc., Butler, NJ
Type CD - Vibration Eliminator Company, Long Island City, NY

- F. Seismic Restraints Type II, where applicable, shall be provided to hold captive the equipment.

2.5 SEISMIC RESTRAINTS

- A. All seismic restraints, where provided, shall be capable of safely accepting one-half "g" external forces, other than life safety equipment and systems which shall be capable of safely accepting 1.0 "g" external forces, without failure and shall maintain equipment, piping, and ducts in a captive position. Seismic restraints shall not short circuit isolation systems or transmit objectionable vibration or noise, and shall be provided on all equipment as hereinbefore noted in this Article. Calculations by registered Civil or Structural Engineer shall be submitted to verify capacities for each restraint.
- B. As part of this work, this Contractor shall engage the services of a New Jersey State licensed Professional Engineer with experience in the field of equipment support and seismic restraints. He shall select and coordinate the restraints and supports based on the final coordinated drawings showing exact location of piping and equipment and shall coordinate with the Structural Engineer to ascertain that the connections to the structure will resist the seismic forces to which they might be subjected.

- C. Equipment mounted on springs does not require additional seismic restraints providing that the spring mountings:
1. Comply with general characteristics of spring isolators.
 2. Have vertical limit stops and are capable of supporting equipment at fixed elevation during equipment erection.
 3. Incorporate seismic snubbing restraint in all directions at specified acceleration loadings.
 4. Acceptable seismic spring mountings are:
 - Type SSLR - Mason Industries Inc., Hauppauge, NY
 - Type SAWR - Vibration Mountings and Controls, Inc., Butler, NJ
 - Type BXL - Vibration Eliminator Company, Long Island City, NY

D. Seismic Restraint Types

1. Seismic Restraint Type I
 - a. Each corner or side seismic restraint shall incorporate minimum 5/8 inch thick pad limit stops. Restraints shall be made of plate, structural members or square metal tubing in a welded assembly, incorporating resilient pads. Angle bumpers are not acceptable. System to be field bolted to deck with 0.5/1.0 "g" acceleration capacity.
 - b. Seismic spring mountings as described above are an acceptable alternative providing all seismic loading requirements are met.
 - c. Mason Industries Type Z-1011, Type Z-1225, or as approved.
2. Seismic Restraint Type II: Metal cable type with approved end-fastening devices to equipment and structure. System to be field bolted to deck or overhead structural members or deck with aircraft cable and clamps as per SMACNA guidelines.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assume complete responsibility for the anchoring of all the equipment, conduit systems, lighting fixtures, etc., specified hereinafter to the concrete foundation pads, to the concrete inertia bases, and to the supporting structural steel and concrete beams.
- B. Provide all miscellaneous steel for support of equipment, conduit systems, and lighting systems.
- C. Provide as shown, or as approved, all necessary supports for equipment furnished and/or installed under this Section. To meet the varying conditions in each case, these supports shall consist of steel angle or strap hangers, saddles, brackets, etc., as shown, or as approved. All such supports shall have substantial flanges bolted to floor construction; hangers shall be supported from the framing as described hereinabove. All supports requiring connections to steel-plated building construction shall be welded to the steel plating. Supports shall be

properly located with reference to any supporting pads, legs, etc., of the equipment carried and must be of such number and so distributed as not to bring any undue strains to the equipment. All details shall be as approved.

- D. Provide suitable brackets, stands, piers or other supports for all various components of the electrical system. Also provide suitable supports for all pull boxes, support boxes, etc., securely clamped to steel beams, column or bearing walls. All details of this work shall be as specified herein, or as approved.
- E. Guarantee that the work, as installed under this Section of the Specifications, will not result in the transmission of objectionable noise or vibration to any occupied parts of the building, and take full responsibility for any necessary modifications of this equipment, or of the foundations and supports for the same, necessary to secure this result.
- F. The complete vibration isolation installation shall be in accordance with the manufacturer's recommendations.

3.2 FACTORY TESTING

- A. All vibration isolation devices and components shall be tested in accordance with the latest applicable industry standards.

3.3 FIELD TESTING

- A. After installation, and prior to "Final Review", the isolation manufacturer's factory-trained technician shall check all the various isolators and certify in writing to this Contractor and Construction Manager that they have been installed properly and are in accordance with the manufacturer's recommendations.
- B. Refer to Section 26 08 00 for additional requirements for equipment with vibration isolation.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all nameplates and warning signage, as specified herein, and as required for proper identification of circuits and equipment throughout the project, as indicated on and in accordance with the requirements of the Contract Documents.
- B. Section includes:
 - 1. Nameplates.
 - 2. Mimic buses.
 - 3. Circuit identification.
 - 4. Branch Devices.
 - 5. Arc-Flash Labeling.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 06 - Electrical Service.
 - 3. Section 26 05 07 - Access Doors and Color-Coded Identification in General Construction.
 - 4. Section 26 05 10 - Electrical General.
 - 5. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 6. Section 26 05 20 - Heating Cable.
 - 7. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 8. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 9. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 10. Section 26 09 23 - Lighting Control Devices.
 - 11. Section 26 22 13 - Low-Voltage Distribution Transformers.
 - 12. Section 26 24 13 - Switchboards.
 - 13. Section 26 24 16 - Panelboards.
 - 14. Section 26 27 26 - Wiring Devices.
 - 15. Section 26 28 13 - Fuses.
 - 16. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 - 17. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
 - 18. Section 26 41 13 - Lightning Protection for Structures.
 - 19. Section 26 43 00 - Surge Protective Device System.
 - 20. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. All warning signage and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards, including the following:
- B. Codes:
 - 1. IBCNJ - International Building Code New Jersey Edition.
 - 2. NEC - National Electrical Code New Jersey Amendments.
- C. Reference Standards:
 - 1. IEEE Standard 1585 - Guide for Performing Arc-Flash Hazard Calculations.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:
 - 1. Nameplates complete with samples, physical size, color, installation details, etc.
 - 2. Warning signage, including arc-flash warning sign drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Electrical equipment shall be identified by means of nameplates screw-fastened to the equipment at the point of electrical feed. Nameplates shall be colored surface, white core laminated bakelite with engraved letters. Each line of the nameplate shall be separated by 1/8 in. All major components of the electrical distribution system shall be provided with such identification, including voltage and phase, as well as source of feed or circuit origin and load served. Where devices are sourced from two (2) locations (automatic transfer switches), both normal and alternate identification shall be provided.
- B. Nameplates, mimic buses, labels, etc., shall be colored as follows:
 - 1. Normal Power: Black with white lettering.
 - 2. Emergency Power, Fire Pumps, Fire Alarm and Automatic and Manual Transfer Switches for the Emergency System: Red with white lettering.
 - 3. Optional Standby Systems: Blue with white lettering.
- C. The Engineer reserves the right to request additional nameplates at time of review of shop drawings and upon site observations. These shall be furnished at no additional cost to the State.
- D. Nameplates and tag symbols shall correspond to the identification on the Contract Drawings and on the "Record Drawings."

2.2 NAMEPLATES

A. Provide nameplates for equipment as noted below.

1. Switchboards, Panelboards and Load Centers

<u>Item</u>	<u>Lettering Size</u>	<u>Example</u>
Designation	1/2 in.	LP-5A
Voltage	1/4 in.	208/120 volt
Amperage	1/4 in.	225 amp
Phase and Number of Conductors	1/4 in.	3Ø, 4W
Size of Neutral (if applicable)	1/4 in.	200% N
Source of Supply	1/4 in.	Source: SS-A#3

2. Disconnect Switches, Circuit Breakers, Starters, Variable Frequency Drives and Busway Disconnect Switches

<u>Item</u>	<u>Lettering Size</u>	<u>Example</u>
Device	1/4 in.	Disc. Sw.
Voltage	1/4 in.	460 volt
Amperage	1/4 in.	400 amp
Fuse Amperage (if applicable)	1/4 in.	250 amp
Phase and Number of Conductors	1/4 in.	3Ø, 3W
Size of Neutral (if applicable)	1/4 in.	—
Source of Supply	1/4 in.	Source: PP-A#6/8/10
Equipment Served	1/4 in.	Feeds: EF-10
Fuse Type (if applicable)	3/16 in.	Replace only with fuse: LPS-R-250

3. Automatic or Manual Transfer Switches

<u>Item</u>	<u>Lettering Size</u>	<u>Example</u>
Designation	1/2 in.	ATS-A
Voltage	1/4 in.	460/265 volt
Amperage	1/4 in.	3,000 amp
Phase and Number of Conductors	1/4 in.	3Ø, 4W
Size of Neutral (if applicable)	1/4 in.	100% N
Preferred Source	1/4 in.	Pref. Source: SS-A#7
Alternate Source	1/4 in.	Alt. Source: ESS-A#2
Equipment Served	1/4 in.	Feeds: EDS-A

4. Transformers

<u>Item</u>	<u>Lettering Size</u>	<u>Example</u>
Designation (if applicable)	1/2 in.	T-5
kVA Rating	1/4 in.	30 kVA
K-Rating	1/4 in.	K-13
Input Voltage	1/4 in.	460 volt
Output Voltage	1/4 in.	208/120 volt

<u>Item</u>	<u>Lettering Size</u>	<u>Example</u>
Size of Neutral	1/4 in.	200% N
Source of Supply	1/4 in.	Source: LP-2#38/40/42
Equipment Served	1/4 in.	Feeds: UP-2A, UP-2B, UP-2C

5. Generators (On Control Panel)

<u>Item</u>	<u>Lettering Size</u>	<u>Example</u>
Designation	1/2 in.	Generator No. 1
kW/kVA Rating	1/4 in.	1,200 kW/1,500 kVA
Voltage	1/4 in.	480/277 volt
Amperage	1/4 in.	1,805 amp
Phase and Number of Conductors	1/4 in.	3Ø, 4W
Size of Neutral	1/4 in.	100% N
Equipment Served	1/4 in.	Feeds: ESS-A

6. Lighting Relay Panels and Dimming Panels

<u>Item</u>	<u>Lettering Size</u>	<u>Example</u>
Designation	1/2 in.	RP-12A
Source of Supply (If Dedicated Circuit)	1/4 in.	Source: UP-12A#2
Warning	1/4 in.	Warning: This device may be served from multiple sources

2.3 MIMIC BUSES

- A. Provide, for all switchboards, distribution panelboards and power panelboards, a mimic bus screw fastened to the exterior of the equipment. The bus shall reflect the buswork within the piece of equipment, including general location within the equipment and routing. All incoming and outgoing connections shall be indicated by an arrowhead.
- B. Mimic buses shall be 1/2 in. wide colored Bakelite. Colors shall be as hereinbefore described.

2.4 CIRCUIT IDENTIFICATION

- A. All circuits originating from switchboards or panelboards without doors shall be provided with Bakelite plates similar to nameplates hereinbefore described on the cover of the gutter space next to the circuit overcurrent device. The circuit identification shall be as follows:

<u>Item</u>	<u>Lettering Size</u>	<u>Example</u>
Circuit Number	3/16 in.	DP-2#6
Switch or Frame Amperage	3/16 in.	400 amp frame
Fuse or Trip Amperage	3/16 in.	300 amp trip

<u>Item</u>	<u>Lettering Size</u>	<u>Example</u>
Equipment Served	3/16 in.	PP-5
Conductor and Conduit Size and Type	3/16 in.	3#350 kcmil Ø, 2#350 kcmil N, 1#4G in 3 in. c.cu

- B. Cardholders and directory cards shall be provided for circuit identification in panelboards, lighting relay panels and dimming panels. Cardholder shall be located and permanently attached on the inside of panel door and shall be plastic frame with clear Lexan front. Directory cards shall be typewritten. Circuit descriptions shall include specific floor and unit designations as indicated on floor plans, schedules for all equipment served, and conductor sizes.
- C. Circuits and pull wires in empty conduits shall have flameproof tags attached to wiring at points where runs are interrupted at troughs, junction boxes or terminated in panels, boxes, etc., secured with flameproof nonmetallic cord. Feeder or branch circuit numbers shall be indicated. Tags shall be made of pressure sensitive tape or embossed self-attached ribbon. All cables No. 3 and larger shall be identified with engraved cable markers indicating circuit reference at all pull boxes, support boxes and terminal devices.
- D. Equipment connected to emergency power shall be identified with permanent cemented grey discs affixed to lighting fixture trims and distinctively colored receptacles with emergency engraved cover plates.
- E. Multi-outlet Assemblies: Furnish and install an engraved nameplate for all multi-outlet assemblies. Engraving must indicate source(s) of supply.

2.5 BRANCH DEVICES

- A. Remote Smoke Detector Lamps and Test Stations: Furnish and install a nameplate for each remote smoke detector lamp and/or test station. Engraving must indicate the location of the device to which the lamp is connected as approved by the Engineer.
- B. Switches: Furnish and install an engraved nameplate for each switch controlling loads which are not local to the switch (i.e., exterior lighting, loading dock doors, exhaust fans, etc.). Engraving shall be as directed by the Engineer.
- C. Fire Warden Stations: Furnish and install a nameplate on each warden station. Engraving must indicate the floor, identification number and location of the station.
- D. Freeze Protection
 - 1. Install decal-type labels on each pipe which is provided with freeze protection.
 - 2. Labels shall be inscribed "CAUTION – ELECTRIC HEAT TRACING".
 - 3. Affix labels to the thermal insulation not more than 20 ft. on center, but not less than once on every length of pipe.
- E. Fire Alarm Terminal/Control Cabinets
 - 1. Furnish and install on each fire alarm terminal/control cabinet an approved nameplate.

2. Nameplates shall indicate floor, identification number and, where multiple terminal cabinets are installed, a primer designation for each cabinet (e.g., FATC-1A, FATC-1B).
3. Terminal shall be permanently identified in an approved manner.

F. Luminaires: Where connected to other than 120 volt circuit, provide each fluorescent or high intensity discharge fixture with the ballast voltage stenciled on the ballast cover in letters not less than 1/2 in. high.

2.6 ARC-FLASH LABELING

A. Provide all labeling required by NFPA 70E and in accordance with the arc-flash study.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Color-coded Identification: Furnish color-coded buttons or tabs to indicate the location of equipment located above removable type acoustical ceilings where access doors are not required. Provide color-coded dots on access doors to indicate type of service as herein specified.

B. Color Coded Identification

1. Removable ceiling tile and access doors to be marked by small color markings at corner of tile or door in accordance with the following color assignments:
 - a. Electrical - Green.
 - b. Fire Alarm System - Red.
2. Improperly located or sized color-coding identification shall be corrected prior to final review.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all lighting control devices, including relay panels, dimmers, switches, etc., as specified herein, as required by Code, as indicated on the Drawings, and in accordance with the Contract Documents.
- B. Refer to Division 01 for all general requirements for the project.

1.2 RELATED DOCUMENTS

- A. The requirements of the General Conditions, Supplementary Conditions and the following specification sections apply to all Work herein:
 - 1. Section 260500 - Common Work Results for Electrical.
 - 2. Section 260506 - Electrical Service.
 - 3. Section 260507 - Access Doors and Color-Coded Identification in General Construction.
 - 4. Section 260510 - Electrical General.
 - 5. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
 - 6. Section 260526 - Grounding and Bonding for Electrical Systems.
 - 7. Section 260529 - Hangers and Supports for Electrical Systems.
 - 8. Section 260533 - Raceway and Boxes for Electrical Systems.
 - 9. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
 - 10. Section 260553 - Identification for Electrical Systems.
 - 11. Section 262213 - Low-Voltage Distribution Transformers.
 - 12. Section 262416 - Panelboards.
 - 13. Section 262726 - Wiring Devices.
 - 14. Section 262813 - Fuses.
 - 15. Section 263213.13 - Diesel-Engine-Driven Generator Set.
 - 16. Section 264300 - Surge Protective Device System.
 - 17. Section 265100 - Interior Lighting
- B. Refer to Divisions 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.

1.3 REFERENCE STANDARDS

- A. All enclosed switches, circuit breakers, and all components shall be designed, manufactured, and tested in accordance with the latest applicable industry standards and codes, including the following:
 - 1. ANSI/IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code)
 - 2. IEC 60929 - AC-supplied electronic ballasts for tubular fluorescent lamps – Performance requirements
 - 3. IEEE – C62.41 - IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

- 4. UL Standard 20 - General-Use Snap Switches
- 5. UL Standard 489 - Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
- 6. UL Standard 508 - Standard for Industrial Control Equipment
- 7. UL Standard 924 - Standard for Emergency Lighting and Power Equipment.
- 8. UL Standard 1008 - Standard for Transfer Switch Equipment.
- 9. UL Standard 1472 - Solid-State Dimming Controls.
- 10. IBCNJ - International Building Code New Jersey Edition.
- 11. NEC - National Electrical Code New Jersey Amendments.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to Section 260500 and shall include but not be limited to:
 - 1. Control systems, including layouts, equipment, zoning, panel schedules, one-line diagrams, character maps for faceplates, etc.

1.5 WARRANTY

- A. Comply with the requirements of the Contract Documents and Section 260500.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not allow the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of these Specifications.
- B. Any and all substitutions must be included in the Contractor's Base Bid, as a voluntary DEDUCT alternate in the Contractor's Bid Proposal, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be all inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project Specifications/documents will not be revised to reflect the substitution should the substitution be approved.
- C. If it complies with these Specifications, lighting control devices manufactured by one of the following manufacturers will be acceptable:
 - 1. Architectural Dimming Systems
 - a. Crestron.
 - b. Electronic Theater Controls (ETC).
 - c. Lightolier.
 - d. Lutron.
 - 2. Digital Addressable Controls
 - a. Lutron.
 - b. Universal.
 - c. The Watt Stopper
 - 3. Local Controls

- a. Leviton Decora.
- b. Lightolier.
- c. Lutron Nova-T.
4. Network Lighting Control.
 - a. Lutron – Quantum
5. Occupancy and Vacancy Sensors
 - a. Cooper.
 - b. Hubbell.
 - c. Lightolier.
 - d. Lutron
 - e. The Watt Stopper.
6. Momentary Switches
 - a. Hubbell
 - b. Watt Stopper
7. Photo Sensors/Daylight Controls
 - a. Cooper.
 - b. Hubbell.
 - c. Lutron.
 - d. PLC Multipoint.
 - e. The Watt Stopper.
 - f. Universal.
8. Switching/Relay Systems
 - a. Cooper.
 - b. Douglas Controls.
 - c. General Electric – SWS Prosys.
 - d. Lutron.
 - e. The Watt Stopper.
9. Timer Switches
 - a. Cooper
 - b. Hubbell.
 - c. The Watt Stopper
10. Emergency Transfer Relays
 - a. Bodine/Philips – GTD20A
 - b. The Watt Stopper – ELCU-200

2.2 EMERGENCY LIGHTING CONTROL

- A. All fixtures designated with “EM/NL” shall be connected to the emergency generator via electrical panel distribution. See electrical drawings for panel designation. Fixtures shall be uncontrolled and are to remain “on” 24 hours/day, 7 days per week. Provide adequate emergency and nightlight conditions. See electrical drawings or specifications for emergency generator system operation.
- B. Fixtures designated on panels as “EM” shall be connected to the local switch/dimmer under “normal” conditions. In an emergency condition, the “controls” shall be bypassed via “secondary power supply to each fixture” or through a “relay transfer” device. In either condition, all “EM” designated fixtures shall bypass the local controls during emergency conditions, providing full light output. Refer to Emergency Transfer Relay section.

- C. All fixtures as noted on the contract documents as emergency and/or with the designation “EM/BP” shall be equipped with an emergency battery ballast, to provide illumination during emergency operation for a minimum of at least 90 minutes. Battery ballast shall be integral to the fixture, shall be field replaceable and shall use a nickel cadmium source. All battery packs shall have a minimum five year warranty. Fixtures designated shall also be connected to the local switch/dimmer under “normal” conditions. In an emergency condition, the “controls” shall be bypassed via “secondary power supply to each fixture” or through a “relay transfer” device. In either condition, all “EM/BP” designated fixtures shall bypass the local controls during emergency conditions, providing full light output. See electrical drawings for all emergency requirements.
- D. All fixtures as noted on the contract documents as emergency and/or with the designation “EM/NL/BP” shall be equipped with an emergency battery ballast, to provide illumination during emergency operation for a minimum of at least 90 minutes. Battery ballast shall be integral to the fixture, shall be field replaceable and shall use a nickel cadmium source. All battery packs shall have a minimum five year warranty. Fixtures shall be uncontrolled and are to remain “on” 24 hours/day, 7 days per week. Provide adequate emergency and nightlight conditions. See electrical drawings or specifications for emergency generator system operation.
- E. Each fixture outfitted with an emergency battery ballast shall have an integral or remote test switch and charging indicator light (located within the reflector or in an accessible remote location. Provide sufficient wiring where required. Contractor shall provide drawings indicating alternate emergency layout upon substitution of specified manufacturer. See Section 265100 Interior Lighting for ballast specifications.

2.3 LOCAL CONTROLS

- A. See electrical drawings for all controls. Provide a wall box incandescent or fluorescent dimmer suitable for specific lighting loads, in all areas as indicated on drawings. Faceplates to have screwless covers with finish as per Architect.
- B. Wallbox control aesthetic configuration shall be consistent with the entire project (e.g., receptacles, data outlets, switches, wallplates, etc.) and shall match type and style required by the Architect (e.g., toggle, paddle type, designer series, etc.).
- C. Location of all dimmers and switches to be coordinated with and dimensioned from architectural drawings. See electrical drawings for all wiring requirements and quantity of controls and presets.
- D. Dimmers shall provide full-range, smooth and continuously variable control of light intensity.
- E. All dimmers shall be designed to minimize effects of changing line frequency.
- F. An actuator, accessible from the front of the unit, with the wallplate attached, shall activate a mechanical air-gap switch disconnecting power from the load during “safety off” condition; no leakage current shall be present at the fixture(s). This front-accessible safety switch (FASS™) shall be separate from the tapswitch and raise/lower rocker. All actuators shall be captured internally to the control.
- G. Dimmers shall be capable of on/off, raise/lower and mechanical air-gap “safety off” from up to nine (9) additional locations using aesthetically coordinated remotes.

- H. Controls shall be capable of operating at the rated capacity; this includes modified capacities for ganging configurations which require the removal of fins. Operation at rated capacity shall be possible across the full ambient temperature range, without shortening design lifetime.
- I. To ensure a precise color match between all plastic parts, color variation of any gloss part shall not exceed a delta E of 1, as defined in ASTM E 308-99.
- J. Visible parts of dimmers, switches, standard receptacles, cable jacks or any wallplate shall exhibit ultraviolet stability when tested as defined in ASTM D4674-89.
- K. Controls shall be tested to withstand voltage surges of up to 4000V and current surges of up to 200A without damage.
- L. Dimmers shall be designed to reduce interference with radio, audio, and video equipment.
- M. Controls shall incorporate power-failure memory. Should power be interrupted and subsequently returned, the lights or fans will come back on to the same levels set prior to the power interruption. Restoration to some other default level is not acceptable.
- N. Controls shall not be susceptible to damage or loss of memory due to static discharge.
- O. Controls shall operate in an ambient temperature range of 0°C (32°F) to 40°C (104°F).
- P. 3-way controls shall be wired using conventional 3-way and 4-way wire runs.
- Q. Multi-location dimmers without neutral shall be capable of operating either 3-way switch location.
- R. Wall controls shall fit a decorator wallplate opening with a flush tapswitch. Dimmers and remotes shall have a small, raised rocker to the right of the tapswitch. Dimmers shall have seven (7) discrete LED's to the left of the tapswitch. Tapswitches shall remain flush in both the "on" and "off" state. Wall controls shall have a gloss finish.
- S. A single tap of the tapswitch shall raise lights from "off" to the preset light level, or fade light to "off". The raise/fade rate shall travel the dimming range in 3 seconds. A rapid double tap of the tapswitch shall raise lights to full-on in 1.5 seconds. Pressing and holding the tapswitch shall activate a delay fade-to-off functions. Lights shall fade to off over 10 seconds.
- T. The LED's on the left side of the tapswitch shall indicate light level when the dimmer is on. When the dimmer is off, the LED's shall glow softly as a night light with the preset level slightly brighter than any of the other LED's.
- U. The rocker on dimmers and remotes shall raise and lower the light level; this new light level becomes the preset. The rocker shall be able to raise the lights from "off" to low-end and up, and shall lower the lights to low-end, not to "off".
- V. Incandescent Dimmers
 - 1. Provide incandescent dimmers for direct control of up to a full 1000 watts.
 - 2. Dimmers shall have a high-end of no less than 90% of line voltage.
 - 3. Where 3-way dimming is used, dimmers shall be capable of operating in either 3-way switch location.

- W. Electronic (Solid-State) Low Voltage (ELV) Transformer Dimmers
 1. Dimmers shall contain circuitry specifically designed to control the input of electronic (solid-state) low voltage transformers. Dimmers using standard phase control shall not be acceptable.
 2. Provide ELV dimmers for direct control of up to 600 watts of electronic low voltage load.
 3. Dimmers shall have a resettable overload protection that automatically shuts off when dimmer capacity is exceeded. Protection methods that are non-resettable or require the device to be removed from the wall to reset shall not be acceptable.
 4. Dimmers shall be designed to withstand a short, per UL 1472 Section 5.10, between load hot and either neutral or ground without damage to the dimmer.
- X. Dimmers shall have a high-end of no less than 90% of line voltage. Magnetic Low Voltage (MLV) Transformer Dimmers
 1. Provide MLV dimmers for direct control of up to 2,000 VA magnetic low voltage load.
 2. Dimmers shall contain circuitry specifically designed to control and provide a symmetrical AC waveform to the input of magnetic low voltage transformers per UL 1472 Section 5.11.
 3. Dimmers shall not cause a magnetic low voltage transformer to operate above the transformer's rated operating current or temperature.
 4. Dimmers shall have a high-end of no less than 90% of line voltage.
- Y. Fluorescent Dimming Ballast Dimmers
 1. Provide fluorescent dimmers for direct control of fluorescent dimming ballasts up to the manufacturer's specified rating.
 2. Dimmers shall be designed to operate the following ballasts.
 - a. Hi-lume® Architectural Dimming Ballasts (1% 3-wire).
 - b. Hi-lume® Compact™ Lamp Dimming Ballasts (5% 3-wire).
 - c. Eco-10™ Lighting Management Dimming Ballasts (10% 3-wire).
 - d. Eco-10™ Lighting Management Dimming Ballasts (10% 0-10VDC).
 - e. Tu-Wire™ High Performance Dimming Ballasts (5% 2-wire).
 3. Dimmers shall be designed to provide full ballast output at high-end.
- Z. 0-10 V Dimmer
 1. Provide 0-10 V dimmers for direct control of 0-10 volt fluorescent dimming ballasts and 0-10 volt LED drivers up to the manufacturer's specified rating.
 2. Provide proper interface device, where required.
 3. Dimmers shall be designed to provide full output at high-end.
- AA. Radio Frequency Controls
 1. General: RF lighting control system shall require no central processor and shall consist of wall-mounted and table lamp dimmers and switches, wall-mounted, multi-zone preset scene dimming modules and interfaces, RF signal repeaters and wall-mounted and/or table top and/or portable master controls and contact closure interfaces.
 2. Quantities and types of equipment shall be per the load and control schedules, as well as per the drawings.
 3. RF lighting control system shall be designed so that in the event that one or more of the radio frequency signal repeaters is not present or is disabled, the following shall be true:
 - a. Any lights which were on prior to the interruption shall remain on at the same intensity.

- b. It shall be possible to turn on or off, or dim (where a dimmer is used) any local dimmer or switch via a manual override on each dimmer and switch.
 - c. All system information (button function assignments, preset scene values, etc.) shall remain intact.
4. RF lighting control system shall use radio frequency to send and receive communications signals between all components. All components shall be addressed after installation. No rotary address or DIP switches shall be required.
5. Wall-mounted and/or Table Lamp Dimmers and Switches: Quantities of wall-mounted and table lamp dimmers and switches shall be provided to control each type of load shown on the load schedule and/or the drawings.
6. A positive air gap shall be employed with each wall-mounted dimmer and switch when a front-accessible service switch is opened to ensure that the load circuits are off, as per UL Standard #1472.
7. Under full-load conditions in a 40°C environment, all semiconductors shall operate at a minimum 20°C safety margin below the component manufacturer's temperature rating.
8. RF dimmers and switches shall meet the UL Standard #1472, limited short circuit test requirement for snap switches.
9. Each RF dimmer or switch shall allow for operation of the lights independently of the other system components. An RF dimmer shall fade on or off over 3 seconds. With the lights already on, holding the on/off button for more than a half second will cause the lights to fade to OFF over 10 seconds.
10. RF dimmers shall incorporate a multi-function LED display to indicate the status and current light level of the associated lighting load, and to indicate the stored preset light level when the dimmer is off. RF switches shall incorporate an LED to indicate the status of the lighting load.
11. RF dimmer and switch LED's shall be dimly illuminated when associated lighting load is off so that device can be easily located within a darkened room.
12. RF dimmers shall operate the following sources/load types with a smooth continuous dimming curve. RF switch shall also be capable of operating these sources on a non-dim basis. Switches shall also be able to control electronic low voltage transformers or fluorescent ballasts on a non-dim basis.
13. Incandescent, Tungsten and Magnetic Low Voltage Transformer
 - a. Dimmer shall contain circuitry specifically designed to control and provide a symmetrical AC waveform to the input of magnetic low voltage transformers.
 - b. Dimmer shall not cause a magnetic low voltage transformer to operate above the transformer's rated operating current and temperature.
 - c. Dimmer shall contain circuitry to control dioded lamps.
14. RF wall-mounted dimmers shall be capable of sending and receiving radio frequency communication signals without a direct connection to neutral.
15. Multi-location RF dimmers shall be capable of providing smooth, continuous dimming from up to nine (9) control locations of the lighting circuit.
16. RF table lamp dimmers and switches shall provide local lamp control without requiring the use of a master control.
17. power boosters/interfaces shall be able to increase certain dimmer capacities. Capacity shall range from 1,000W/VA to 30,000W/VA. Quantities and sizes of each type of power booster shall be provided to control each type of load shown on the load schedule and/or the drawings. Load types include incandescent, magnetic and electronic low voltage transformers, and fluorescent dimming ballasts.RF Master Control: Master control unit shall be capable of operating preset control units. Each master control shall consist of five (5), ten (10) or fifteen (15) buttons with an associated LED, and two (2) buttons without LED's.

18. Each button with associated LED shall operate in toggle mode. If the LED is off, pressing the button will turn the preset control unit on to preset levels; if the LED is on, pressing the button will turn the preset control unit off. One (1) of the buttons without an LED shall function as an "ALL ON" and the other shall function as an "ALL OFF."
19. When no LED's are illuminated during normal use on a master control, all the LED's shall glow at a very dim level so that the master control can be easily located within a darkened room.
20. Each column of LED's and buttons may be configured to provide two (2) different types of visual feedback of the lighting loads as follows:
 - a. Monitor (or Room) Function: The LED shall light if any of the loads assigned to that button are on. LED shall turn off if all loads assigned to that button are turned off both from the master control and from the local lighting controls. Systems without two-way status feedback shall not be acceptable.
 - b. Scene Function: The LED shall light only if all loads associated with that button are on at the preset levels, and the scene was activated from this master control.
21. Master controls shall be UL listed or derive their power from a UL listed Class 2 power transformer.
22. Portable master controls shall be capable of retrieving the current system lighting status of all lights controlled by that master control.
23. RF master controls shall be capable of copying the button programming from one master control to a different master control.
24. RF contact closure interfaces shall be capable of providing five (5) independent scene function buttons for external equipment to control dimmers and switches. Manufacturer shall be able to provide external equipment for RF scene selection from a telephone, automobile, or automatically by astronomic timeclock.
25. RF Receivers: RF receivers shall be capable of receiving communication signals from up to sixteen (16) control transmitters located within a 35 ft. radius sphere. Receivers shall be capable of outputting up to five (5) momentary dry contact closures that can wire directly into the contact closure interface. Receivers shall derive their power from 120 volt, 277 volt or 347 volt at 60 Hz AC line power.
26. RF Tabletop Transmitter(s): Tabletop transmitters shall be capable of activating four (4), eight (8) or twelve (12) preset scenes and "OFF" via contact closure outputs. Transmitters shall derive their power from two (2) AAA batteries. Tabletop transmitters shall mount securely in a security bracket, allowing for future battery placement.
27. RF Interface: Interface shall enable RF control of remote preset stations by master control station.
28. RF Signal Repeaters: Radio frequency signal repeaters shall be able to automatically select and detect a unique system identification code and shall be able to determine if any neighboring radio frequency signal repeaters have the same system identification code.
29. Radio frequency signal repeaters shall be able to assign addresses to local dimming or switching modules as well as to master controls and interfaces.
30. Radio frequency signal repeaters shall be able to receive communication signals from dimmers, switches, interfaces and master controls and re-transmit those signals to ensure reliable operation of the system.
31. Multiple radio frequency signal repeaters shall be able to be used together in a dwelling to increase the distance the radio frequency communication signals can travel.
32. Radio frequency signal repeaters shall provide the ability to verify radio frequency communications exist between all system components by testing the reception from all other system components and the transmission of RF communication signals to all other system components.

33. Radio frequency signal repeaters shall derive their power from a UL Listed Class 2 power transformer.

BB. Remote Dimming Modules for High Power Loads

1. Where lighting loads exceed the full rated capacity of single dimmers, provide a Maestro incandescent dimmer driving high power modules. High power module and dimmer shall be from the same manufacturer to ensure compatibility.
2. High power modules shall be remotely mounted.
3. High power module shall be rated and UL listed for control of incandescent, magnetic low voltage, electronic low voltage, fluorescent, and neon/cold cathode loads in increments of 2,000 watts up to 30,000 watts.

CC. Remotes for Multi-Location Control

1. Remotes shall provide multi-location control and mechanical air-gap switch. All tapswitch and rocker functions shall operate from each remote. Up to nine (9) remotes may be used with a Maestro dimmer.
2. Remotes shall not have any LED's.

DD. Fan-Speed Controls

1. Fan-speed controls shall be UL Listed, CSA and NOM approved, Lutron Maestro style.
2. Quiet fan-speed model shall provide three speed settings with slide-to-off function.
3. Quiet fan-speed control shall provide single-pole control of one paddle fan (1.5A max.).
4. Fully variable model shall provide fully variable fan-speed control with slide-to-off function.
5. Fully variable model shall provide single pole control of multiple paddle fans, ventilation or exhaust fans (12A max.).

2.4 OCCUPANCY AND VACANCY SENSORS

- A. Provide sensors, in types, characteristics, and electrical ratings for applications indicated that are UL listed and which comply with other applicable UL standards.
- B. Unless noted below or otherwise specifically indicated, provide sensors and their associated equipment for local control of lighting branch circuitry as indicated and in accordance with the following:
 1. Sensors shall be utilized to automatically turn off light fixtures when the area is not occupied. Sensors shall have a time delay before turning off, which shall be continuously adjustable from 30 seconds to 30 minutes. Sensors shall have a sensitivity adjustment to modify the field of view.
 2. Sensors shall operate on 120 or 277 volt circuits. Coordinate wattage minimum requirements and loads with electrical drawings.
 3. Sensors shall be suitable for controlling incandescent, quartz halogen, low voltage, neon, cold cathode, fluorescent and inductive lighting loads without de-rating.
 4. All sensors to be factory set for a 20 minute time delay and to have sensitivity set at 50% maximum. Field-adjust the time delay and sensitivity settings of each occupancy sensor after installation, but prior to occupancy, based on direction of Lighting Consultant or State. Adjustments shall be made in the presence of the State's Representative.
- C. Configuration
 1. Wall-Mounted: Red LED will indicate when unit is being triggered plus it will glow when off to facilitate location in an unlit room. Wall-mounted area sensors shall utilize passive

infrared operation or ultrasonic. The sensor shall emit a “beep” warning tone before shutting off. Sensor shall be able to be mounted in a single-gang wall box and be gangable with other designer-style electrical devices and faceplates. Sensor shall be provided with a designer-style screwless faceplate, color as selected by the Architect. Where indicated, sensor shall be equipped with vandal-resistant hard lens. Sensor operation shall be as follows:

- a. Occupancy
 - 1) Manual switch on with manual switch off.
 - 2) Manual switch on with automatic off.
 - 3) Automatic on with automatic off.
 - b. Vacancy
 - 1) Manual switch on with manual switch off
 - 2) Manual switch on with automatic off
2. Ceiling-Mounted: Ceiling-mounted area sensor shall utilize passive infrared operation. If no occupant motion occurs within the adjustable time delay period, the lights shall automatically be turned off. The sensor shall have an LED indicator to provide feedback to the power pack when detecting movement and shall have a sensitivity and timing adjustment. All components to be contained within a 1 inch high by 6 inch long white plastic housing, using four (4) head sensors at fixed angles. Provide three (3) frequency devices for alternate pattern installation. Provide accompanying switchpack with proper head quantity as specified by manufacturer. Unit shall not detect motion through glass and shall be mounted a minimum of six (6) feet from strong air turbulent devices. Contractor to coordinate all installation with manufacturer’s field representative. Sensor operation shall be as follows:
- a. Occupancy
 - 1) When the sensor detects the presence of an occupant, the lights will automatically turn on.
 - b. Vacancy
 - 1) Manual switch on with manual switch off. Refer to momentary switch for manual control.
 - 2) Manual switch on with automatic off. Refer to momentary switch for manual control.
3. Remote Power/Control Module: Where indicated or required, provide remote power supply that interfaces with occupancy sensor. Power module shall accept multiple input voltages and shall contain a transformer to provide low voltage outputs to compatible sensors, and a dry contact relay (normally open) for switching lighting loads. Control module shall be sized to fit inside a standard 4 in. x 4 in. junction box, and shall be fitted with a 1/2 in. EMT threaded male fitting on the line voltage end such that it may be mounted to the outside of a junction box with the line voltage wiring internal to the box and the low voltage wiring external. Module shall be rated for switching 20A of ballast load at 120V and 277V.
4. Low Voltage Momentary Switch: Where indicated provide single pole momentary switch. Switch to be provided with faceplate.
- D. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms that are to be provided with sensors. Contractor is responsible for arranging a pre-installation meeting with the manufacturer’s factory-authorized representative, at the State’s facility, to verify placement of sensors and installation criteria. Contractor is responsible for coordination of the appropriate voltage and maximum/minimum load condition as well as coordinating with other work such as painting, raceways, electrical boxes, etc.

- E. Contractor shall locate and aim the sensor in the correct position required for complete and proper volumetric coverage within the range indicated in the manufacturer's recommendations, to the satisfaction of the State, Architect and Lighting Designer. Rooms shall have 90% to 100% coverage of the specified area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s).
- F. Lenses shall be clean and free of dust. Wall box sensors shall be installed only in electrical boxes that are free from building materials, dirt and debris. Ceiling-mounted sensors shall not be installed until completion of plastering, ceiling tile work, painting, and general cleanup. Sensors shall be carefully handled to avoid scratching or fingerprinting and shall be, at the time of State acceptance, clean.
- G. Contractor shall be responsible for installing field-of-view templates, as required, to mask the viewing lens to prevent false triggering for Auto-On operation if required.
- H. Contractor shall provide, at the State's facility, the training necessary to familiarize the State's personnel with the operation, use, adjustment and problem solving diagnosis of the occupancy sensing devices and systems.

2.5 PHOTOSENSORS/DAYLIGHT CONTROLS

A. Photoconductive Sensor

- 1. The photoelectric device shall be a Class 2, low voltage, ambient light sensor designed to interface directly with the analog input of the compatible controller. The sensor shall supply an analog signal to the controller system proportional to the light measured. The sensor shall be capable of a fully adjustable response in the range between 0 and 3,000 footcandles with a +/-1% accuracy at 70 degrees F (21 deg.C)
- 2. The sensor shall be calibrated using voltage/footcandle calibration curves. The housing shall be constructed from GE Cycloc (R) ABS, shall be flame retardant and meet UL 94 HB standards.
- 3. Sensor types shall be as follows:
 - a. Indoor: Indoor sensors shall have a Fresnel lens, with a 60 degree cone of response. Indoor sensors shall only require a penetration hole in the ceiling of 3/8 in. dia., and the sensor shall mount to the ceiling using adhesive tape. The indoor sensor range shall be between 6 and 50 FC.
 - b. Outdoor: Outdoor models shall have a hood over the aperture to shield the sensor from direct sunlight. The outdoor sensor circuitry shall be completely encased in an optically clear epoxy resin. Outdoor sensors shall mount to a standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. The outdoor sensor shall have two ranges - between 2 and 40 FC or 40 and 500 FC.
 - c. Atrium or Skylight: Atrium or Skylight sensors shall have a translucent dome with a 180 degree field of view. Atrium or Skylight sensors shall mount to standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. Atrium sensor range shall be from 40 to 750 FC. Skylight sensor range shall be between 400 - 3,000 FC.

B. Photodiode Sensor

- 1. The photoelectric device shall be a Class 2, low voltage, ambient light sensor designed to interface directly with the analog input of the controller. The sensor shall supply an analog signal to the controller system proportional to the light measured. The sensor shall be capable of a fully adjustable response in the range between 0 and 10,000 footcandles with a +/-1% accuracy at 70 degrees F (21 deg.C).

2. The sensitivity adjustment shall be remote at the compatible controller. The sensor housing shall be constructed from GE Cyclac (R) ABS, shall be flame retardant and meet UL 94 HB standards.
3. Sensor types shall be as follows:
 - a. Indoor: Indoor sensors shall have a Fresnel lens, with a 60 degree cone of response. Indoor sensors shall only require a penetration hole in the ceiling of 3/8 in. dia., and the sensor shall mount to the ceiling using adhesive tape. The indoor sensor range shall be between 0 and 750 FC.
 - b. Outdoor: Outdoor sensor models shall have a hood over the aperture to shield the sensor from direct sunlight. The outdoor sensor circuitry shall be completely encased in an optically clear epoxy resin. Outdoor sensors shall mount to a standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. The outdoor sensor shall have two ranges: between 0 and 750 fc or 5 fc and 2500 fc
 - c. Atrium or Skylight: The Atrium or Skylight sensors shall have a translucent dome with a 180 degree field of view. Atrium or Skylight sensors shall mount to standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. Atrium sensor range shall be from 2 to 4,000 FC. Skylight sensor range shall be between 10 and 10,000 FC.

C. Photodiode Sensors for Daylight Control

1. The photoelectric device shall be a Class 2, low voltage, ambient light sensor designed to interface directly with the analog input of the Energy Management System. The sensor shall supply an analog signal to the EMS system proportional to the light measured. The sensor output shall provide for zero or offset based signal. The sensor shall be capable of a fully adjustable response in the range between 0 and 10,000 footcandles with a +/-1% accuracy at 70 degrees F (21 deg.C).
2. The sensitivity adjustment shall be at the sensor body, and outside of the sensor's viewing angle. The sensor housing shall be constructed from GE Cyclac (R) ABS, shall be flame retardant and meet UL 94 HB standards.
3. Sensor types shall be as follows:
 - a. Indoor: Indoor sensors shall have a Fresnel lens, with a 60 degree cone of response. Indoor sensors shall only require a penetration hole in the ceiling of 3/8 in. dia., and the sensor shall mount to the ceiling using adhesive tape. The indoor sensor range shall be between 0 and 750 FC.
 - b. Outdoor: Outdoor sensor models shall have a hood over the aperture to shield the sensor from direct sunlight. The outdoor sensor circuitry shall be completely encased in an optically clear epoxy resin. Outdoor sensors shall mount to a standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. The outdoor sensor range shall be between 0 and 750 FC.
 - c. Atrium or Skylight: The Atrium or Skylight sensors shall have a translucent dome with a 180 degree field of view. Atrium or Skylight sensors shall mount to standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. Atrium sensor range shall be from 2 to 2,500 FC. Skylight sensor range shall be between 10 and 7,500 FC.

D. Photosensors for the Control of Dimmable Ballasts

1. The photoelectric device shall be a Class 2, low voltage ambient light sensor designed to interface directly via 18 gauge wire to dimming ballast.
2. The sensor shall automatically dim indoor fluorescent lighting in response to the availability of natural daylight, and the dimming rate shall be selectable at either three or eight seconds. The sensor shall have a range between 0 - 500 footcandles and be adjustable between 7 and 140 FC. The accuracy shall be +/- 1% at 70F.

3. The illuminance maintained on the task shall be adjustable at the sensor head, outside of the sensor viewing angle, and shall automatically control the lamp output to compensate for lamp lumen depreciation.
4. The sensor shall have a flat Fresnel lens with a 60 degree cone of response. The wire penetration through the ceiling shall be no greater than 3/8" diameter, and the sensor shall mount to the ceiling surface via adhesive tape.

2.6 DIGITAL TIMER SWITCHES

- A. Digital timer switches shall be utilized in Mechanical/Electrical Rooms under 500 sq.ft. overall. Switches shall be mounted in the same locations as conventional wall switches (entry doors).
- B. Digital timer switch shall automatically turn lights off at a preset time selected by the user. Operation of time switch shall be pushbutton variety. A twist-style timer shall not be acceptable. Pressing the on/off button shall turn lights on for a duration of anywhere from 5 minutes to 12 hours. Lights can be turned off prior to the time-out setting by pressing the on/off button.
- C. The time switch can be reset at any time by holding down the on/off button for two (2) seconds. This will restart the timer countdown.
- D. Time-out adjustments shall have five (5) minute increments (up to one [1] hour) and fifteen (15) minute increments (from one [1] hour to twelve [12] hours).
- E. All timer switches to be factory set for a 20 minute time delay.
- F. Time-scroll option shall allow user to temporarily override the timeout setting without adjusting the global settings. With time scroll programmed to "UP", lights can be held on longer than the timeout period. With time scroll programmed to "DN", lights can be turned off sooner than the timeout period. Pressing the on/off switch for more than 4 seconds shall cause the timer to scroll in the set direction throughout the possible timeout settings.
- G. Digital time switch shall incorporate a flash (flicker) warning of lighting within the space coupled with an audible alarm (beep warning). The visual warning shall flash lights at five (5) minutes and again at one (1) minute prior to timeout. The audible signal shall beep every five (5) seconds at one (1) minute prior to timeout. Both functions (visual and audible) must be incorporated into the timer device.
- H. An electroluminescent back-lit LCD in the switch shall show the timer countdown.
- I. Timer switch shall be compatible with all electronic fluorescent ballasts and motor loads and shall be UL listed.
- J. Timer switch shall be factory preset for 4-hour timeout and time scroll DN to comply with Energy Code prescription for override switches, as per ASHRAE 90.1 2004.

2.7 EMERGENCY TRANSFER RELAYS

- A. Provide 20 amp emergency transfer relay for the quantity of circuits or zones, as indicated in the electrical drawings.

- B. The relay device shall comprise of normal voltage sensing circuitry and transfer relay to automatically transfer load circuits from the normal to the emergency power feeds when the normal supply fails.
- C. The relay device shall consist of normal voltage sensing circuitry and transfer relay to automatically transfer load circuits from normal to the emergency power feeds when the normal supply fails.
- D. The emergency transfer cabinets shall be designed for use with 120/277 volt 2 wire feed (line/neutral.)
- E. Voltage sensing relays shall cause automatic transfer upon loss of normal power.
- F. On restoration of the normal power supply, load circuits shall be transferred from the emergency feeds to the normal supply automatically.
- G. An integral test switch shall be provided to simulate normal power source failure for periodic verification of system operation. Access inside the test cabinet shall not be necessary.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. It shall be the responsibility of this Contractor to receive and store the necessary materials and equipment for installation of the lighting controls. It is the intent of these specifications and plans to include everything required for proper and complete installation and operation of the system, even though every item may not be specifically mentioned. The Contractor shall deliver on a timely basis to other trades any equipment that must be installed during construction.
- B. The system shall be installed utilizing complete manufacturer's shop drawings and in accordance with these specifications. Dimmers shall not be used to furnish any temporary light or power for construction activities.
- C. Contractor shall provide accurate "as-built" drawings to the State for correct programming and proper maintenance of the lighting control system. The "as-built" drawings shall indicate the load controlled by each relay or dimmer and the relay/dimmer panel number.
- D. Contractor shall install control stations only after "wet" work such as plastering has been completed and the area has been cleaned.
- E. Mount equipment at locations and heights indicated on approved shop drawings or as directed by the State/Architect. Locations indicated on the electrical drawings are general and approximate – clearly verify locations with Architect's plans and elevations prior to installation. Check for adequate of headroom and clearance with other equipment such as ducts, pipes and openings. This Contactor shall bring any conflicts to the State's attention prior to proceeding with the work.
- F. Upon completion of the installation and prior to removal of the bypass jumpers, this Contractor shall completely test all line voltage power and low voltage control wiring for continuity and

accuracy of connections. The jumpers shall remain in place until all loads have been fully tested and found to be free of miswires, short circuits, or other wiring defects.

- G. On completion of the installation, the lighting control equipment shall operate per specifications and be free from defects in condition and finish. Movable parts must operate freely and with uniform friction throughout their range. The Contractor, prior to inspection, must replace any damaged parts.
- H. Provide any additional relays, transformers, power supplies, or other necessary or auxiliary devices not specifically listed in these specifications or shown on the drawings but that are needed to affect the functional requirements of the control systems.
- I. Provide ten percent (10%) minimum spare conductors in all conduits and raceways, control cables, and control cable connectors. Spare conductors shall be indicated and labeled on shop drawings and shall be terminated on barrier terminal strips and in connectors and labeled in the same manner as active conductors.
- J. Field terminations in these systems shall be made to numbered screw terminals on circuit breakers or switches or on numbered barrier terminal blocks. Wire nuts and crimped connectors are not acceptable.
- K. This Contractor shall run separate neutrals for all branch load circuits.
- L. Sensors
 - 1. This Contractor shall be responsible for providing document plans showing sensor locations, devices, and control sequences.
 - 2. This Contractor shall review the installation, perform functional tests and document the results and operating and maintenance information prior to receiving final project approval.
 - 3. On completion of installation, and after circuitry has been energized, Contractor shall demonstrate capability and compliance with system requirements. Where possible, correct any malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units or relocate devices if required, and proceed with retesting. Testing and retesting shall be done at no cost to the State.
- M. Photosensors (Daylight Controls)
 - 1. Prior to commissioning, Contractor shall verify that all photosensors have been properly located, factory-calibrated (proof required) or field-calibrated and set for appropriate set points and threshold light levels. Contractor shall provide documentation of set points, setting and programming for each device.
 - 2. For luminaires that are powered by a separate lighting circuit from non-daylit areas, the Contractor shall demonstrate that only the luminaires in the daylit zone are affected by daylight control. The Contractor shall simulate both bright and dark conditions for the dimming system in order to determine the following:
 - a. Automatic daylight control system reduces (in a bright condition) and increases (in a dark condition) the amount of light delivered to the space uniformly.
 - b. In continuous dimming systems, demonstrate that the dimming control system provides reduced flicker operation over the entire operating range. Additionally, in stepped light level control systems, demonstrate that the minimum time delay between steps is three (3) minutes to prevent short cycling and that the automatic

daylight control system reduces the amount of light delivered to the space per manufacturer's specifications for power level versus light level.

- c. Contractor shall document illuminance measurements in the space, location of measurements and specific device settings, program settings and any other measurements as required.

N. Network Lighting Controls

1. Provide dedicated network between computer and processor panels.

3.2 MANUFACTURER'S SERVICE

- A. Manufacturer shall assemble and test the dimming system at full load for a minimum of five (5) hours before shipment.
- B. Contractor shall ensure that the factory start-up technician makes any calibrations and adjustments necessary for proper operation of the system.
- C. Equipment manufacturer shall provide six (6) bound copies of an Operation and Maintenance Manual to the State's representative. Manual shall contain wiring diagrams, description of all control functions, operation instructions for all applicable components, maintenance and troubleshooting information, parts lists, component specifications, a copy of the warranty and service contract (if applicable), and address and phone contacts for service personnel.
- D. Manufacturer shall offer technical support hotline and shall be capable of providing on-site service support within 24 hours anywhere in the continental USA and within 72 hours anywhere in the world, except where special visas are required.
- E. Manufacturer shall offer an optional renewable service contract on a year-to-year basis that shall include parts and factory labor as well as annual training visits if requested.
- F. Systems Integration for Integrated Building Systems: As part of the systems integration, all software and associated interface hardware shall be confirmed by both the integrated building system manufacturer and the lighting controls manufacturer to be properly installed and operational.

3.3 SYSTEM START-UP (COMMISSIONING)

- A. On completion of the installation, the system shall be commissioned by a factory-trained technician. The commissioning will be performed upon notification by the Electrical Contractor that the system installation is complete and that all loads have been tested live for continuity and freedom from defects and that all control wiring has been connected and checked for continuity.
- B. Contractor shall advise State's representative prior to scheduling start-up so all persons designated by the State and Architect are present for training. Contractor shall provide both the manufacturer and the Architect/Engineer with ten (10) working days notice of the scheduled commissioning date.
- C. On completion of system commissioning, the factory-trained technician shall demonstrate the operation of the system to appropriate State's representative. Provide a five (5) year warranty covering all material and workmanship.

- D. Contractor shall make any necessary adjustments and calibrations necessary prior to a final inspection by the State.

3.4 TRAINING

- A. Factory Engineer shall demonstrate the operation and maintenance of all system components to the State's representative. Factory technician shall schedule, in coordination with the State, a training period for the State's staff or designated appointees. This training period shall be a minimum of three (3) hours. Training shall encompass entire scope for the system, including operation, adjustment, maintenance, and troubleshooting, until completely understood. Manufacturer shall submit names and period of attendance of those instructed.
- B. For Programmable Switching Systems: Provide one (1) full day of on-site start-up and instruction period. Inspection and sign-off to be either one (1) week prior to floor commissioning and Client move-in, or within two (2) weeks of Client occupation of space (to be coordinated with Client).
- C. For Network Control Systems: Provide one (1) full day of on-site start-up and instruction period. Inspection and sign-off to be either one (1) week prior to floor commissioning and Client move-in, or within two (2) weeks of Client occupation of space (to be coordinated with Client).

3.5 FACTORY TESTING

- A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL Standards.

3.6 FIELD TESTING

- A. Switching/Relay Panels/Network Controls
 - 1. Switching/relay panels shall have automatic and manual operational tests performed following the completion of the installation of the panel and override switches (where included).
 - 2. Simulated programming times (i.e., "On", "Off") shall be input by the Contractor for the test, and following the completion of the test, the actual "on/off" times as required by the State shall be input into the system.
- B. Sensors
 - 1. Sensors shall have manual and automatic operational tests performed following the completion of the installation.
 - 2. Sensors shall have their initial settings adjusted by the Contractor according the State's criteria (i.e., sensitivity, time delay, etc.) prior to testing.
- C. Wall-mounted dimmers shall be operationally tested.

END OF SECTION 260923

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all low-voltage distribution transformers as specified herein and as required for proper transformation of power throughout the Project as indicated on and in accordance with the requirements of the Contract Documents.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:

- 1. Section 26 05 00 - Common Work Results for Electrical.
- 2. Section 26 05 06 - Electrical Service.
- 3. Section 26 05 10 - Electrical General.
- 4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- 5. Section 26 05 20 - Heating Cable.
- 6. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- 7. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- 8. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
- 9. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
- 10. Section 26 05 53 - Identification for Electrical Systems.
- 11. Section 26 09 23 - Lighting Control Devices.
- 12. Section 26 24 13 - Switchboards.
- 13. Section 26 24 16 - Panelboards.
- 14. Section 26 28 13 - Fuses.
- 15. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
- 16. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
- 17. Section 26 43 00 - Surge Protective Device System.
- 18. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. All dry-type transformers shall be designed, manufactured, tested, and installed in accordance with the latest applicable codes and reference standards, including the following:
- B. Codes:
 - 1. IBCNJ - International Building Code New Jersey Edition.
 - 2. NEC - National Electrical Code New Jersey Amendments.
 - 3. IECCNJ - International Energy Conservation Code New Jersey Edition.

C. Reference Standards:

1. ANSI C89.2 - Dry-Type Transformers for General Applications.
2. ANSI/IEEE C57.110 - Recommended Practice for Establishing Transformer Capability When Supplying Non-sinusoidal Load Currents.
3. ANSI/IEEE C57.12.01 - General Requirements for Dry-type Distribution and Power Transformers.
4. ANSI/IEEE C57.12.91 - Test Code for Dry-type Distribution and Power Transformers.
5. ANSI/NEMA TP 2 - Standard Test Method for Measuring Energy Consumption of Distribution Transformers.
6. DOE CSL 3 - Department of Energy Proposed Candidate Standard Level 3.
7. EPACT 2005 - United States Energy Policy Act 2005/NEMA TP1 - Guide for Determining Energy Efficiency for Distribution Transformers.
8. NEMA ST 1 - Specialty Transformers.
9. NEMA ST 20 - Dry-Type Transformers for General Applications.
10. NEMA TP 1 - Guide for Determining Energy Efficiency for Distribution Transformers.
11. UL Standard 506 - Specialty Transformers.
12. UL Standard 1561 - Dry-Type General Purpose and Power Transformers.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:
1. Dry-Type Transformers, complete with capacity data, bus data, test, etc.
 2. Shop Drawings shall be submitted for review by the Engineer before installation of transformers. These Shop Drawings shall give construction details and electrical characteristics as well as physical dimensions and weight of transformers. In addition, sufficient information shall be submitted on the vibration isolators for the design to be checked for approval. See Section 26 05 00 for additional requirements.
- B. The Manufacturer shall submit, with the Shop Drawings, NEMA TP2 test reports and non-linear load test reports, including the following dry-type transformer electrical characteristics based on actual laboratory tests of typical transformers for each kVA rating and type specified:
1. Percent impedance.
 2. X/R ratio.
 3. Percent regulation with 80% and 100% power factor load.
 4. Efficiency at 1/6, 1/4, 1/2, 3/4 and full load.
 5. No load (core) losses.

6. Full load winding conductor (coil) loss.
7. Total losses.
8. Noise level rating.
9. K-factor rating (where applicable).
10. Temperature rise.

These reports shall be signed by factory test engineers.

- C. The manufacturer shall have performed the following additional tests on units identical to the design type being supplied to this Specification. Proof of performance of these tests in the form of test data sheets shall be provided with the shop drawings.

1. Sound Levels
2. Temperature Rise Tests
3. Full Load Losses
4. Regulation
5. Impedance

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the Division 01 and Section 26 05 00

1.6 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution.

- C. If it complies with the Contract Documents, dry-type transformers manufactured by one of the following manufacturers will be acceptable:
1. Eaton/Cutler-Hammer.
 2. General Electric.
 3. Hammond Power Solutions.
 4. Jefferson Electric.
 5. Pioneer Transformers.
 6. Powersmith.
 7. Rex.
 8. Schneider/Square "D".
 9. Siemens Industry Inc.
 10. Sola/Hevi-Duty.

2.2 RATINGS

- A. Dry-type transformers shall be located as shown on the Drawings and described in the Contract Documents, and shall have capacities, current characteristics, and ratings indicated.
- B. All transformers shall have a minimum "K" rating of K-13. Provide higher "K" ratings as noted on drawings.
- C. All transformers to have a minimum TPI rating to comply with IECCNJ and energy efficiency shall comply with DOE CSL 3.

2.3 GENERAL

- A. Dry-type transformers shall have full capacity taps as indicated herein.
1. Single Phase
 - a. 0.25 to 3.0 kVA, no taps.
 - b. 5 to 25 kVA, two 5% taps below normal transformer primary.
 - c. 37.5 to 167 kVA, six 2-1/2% taps, two above and four below normal transformer primary.
 2. Three Phase
 - a. 3 to 9 kVA, two 5% taps below normal transformer primary.

- b. 15 to 750 kVA, six 2-1/2% taps, two above and four below normal transformer primary.
- 3. Provide NEMA 3R transformers where required per Code and/or as indicated on the Drawings.
- B. Dry-type transformers shall be suitable for mounting as indicated on the Drawings. Insulation for these transformers shall be 80°C rise with Temperature Class 220°C (or higher) insulation system, at 100% continuous load in a 40°C ambient environment. Transformers shall comply with temperature rise rating through natural ventilation. No mechanical aids shall be permitted. Winding temperature rise limits applicable to the system temperature classification shall be in accordance with UL Specification 506. Core shall be constructed of cold-rolled, oriented, high permeability silicon steel formed as a coil or laminated. K-factor rated transformer core shall be constructed of high grade, grain oriented, silicon steel with flux density sufficiently below the saturation point.
- C. Windings shall be electrical grade copper individual windings terminated by electrically welding (heliarc or similar process) to tin-plated or silver-plated bars. Foil windings shall not be acceptable. K-factor rated transformers shall include a full-length copper electrostatic shield between the primary and secondary windings and shall be equipped with neutral lugs of sufficient capacity to carry 200% of the secondary nameplate amperage at rated voltage. The neutrals shall be brought up to a lug and bolt inside of case with bolt extending outside so neutral can be grounded externally.
- D. Dry-type transformers shall be especially quiet in operation and shall have a certified sound rating in compliance with the table below:

kVA Rating	Maximum Sound Level (dB)
0 – 9	40
10-50	45
51-150	50
151-300	55
301-500	60
501-700	62
701-1000	64

- E. Sound ratings shall be measured per ANSI C89.91. Any transformer that is noisy in the opinion of the Engineer shall be removed and replaced with one of suitable design. Before installation, complete sound data shall be submitted for review by the Engineer.
- F. The secondary winding conductors shall all be individually insulated, as small in size as possible, and transposed where necessary to keep hysteresis and eddy current losses at the harmonic frequencies to an absolute minimum. The secondary neutral shall be twice the ampacity of the secondary phase conductors, and the primary winding conductor shall be of sufficient size to limit the temperature rise to its rated value, even with the circulating 3rd harmonic current.

- G. The core flux density shall be well below the saturation point to prevent core saturation caused by the nonlinear harmonics, even with a 10% primary overvoltage
- H. The transformer shall have temperature rise within the specified rated temperature and a magnetizing current below the knee of the saturation curve, with a 10% high line voltage with a harmonic load and commensurate with the “K” rating of the unit.
- I. All transformers shall comply with the minimum efficiencies listed below as tested and rated in accordance with CSL-3 and NEMA-TP2 at 35% loading.

<u>Three Phase</u>	
<u>kVA</u>	<u>Efficiency</u>
15	97.6%
30	98.1%
45	98.3%
75	98.6%
112.5	98.8%
150	98.9%
225	98.9%
300	99.0%
500	99.1%
750	99.2%

- J. All transformers shall have vibration isolation that isolates the case from the core and the coil assembly. Transformers shall be mounted either on floor, wall or suspended from the ceiling as required. Additional vibration isolators shall be provided between trapeze or universal hangers of suspended transformer and its case and between transformer case and floor for floor-mounted units. Use flexible metallic conduit of 24 inch minimum length, with external grounding jumper for final connection to transformer case.
- K. Isolators shall be neoprene-in-shear type, providing a minimum static deflection of 3/8 inch.
 - 1. Mountings for suspended transformers shall be one of the following:
 - Type HD, Mason Industries, Inc., Jamaica, New York
 - Type CD, Vibration Eliminator Co., Long Island City, New York
 - 2. Mountings for floor supported transformers shall be one of the following:
 - Type ND, Mason Industries, Inc., Jamaica, New York
 - Type 368SD, Vibration Eliminator Co., Long Island City, New York
- L. Dry-type transformer wiring compartments shall provide adequate space to permit line and load side cable terminations in compliance with the requirements listed in Section 26 05 19. Space shall be adequate for compression connectors as required by these Sections. Terminals shall be internally bussed to end wiring chambers that will not exceed conductor insulation temperature needs.
- M. Provide isolated air terminal chambers for cable connections on all transformers 500 kVA and larger.

- N. Dry-type K-factor rated transformers shall be specifically designed for noise isolation protection of sensitive equipment. These transformers shall provide transverse-mode noise attenuation of 30 dB minimum, and common-mode noise attenuation of 120 dB minimum.
- O. The following enclosure requirements shall be in accordance with UL Specification 506:
 - 1. Ventilation Openings.
 - 2. Corrosion Resistance.
 - 3. Cable Bending Space.
 - 4. Grounding Provisions.
 - 5. Surface Temperatures.
 - 6. Wiring Compartment Temperature Rise Terminations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all dry-type transformers per the manufacturer's recommendations and as indicated on the Drawings.

3.2 FACTORY TESTING

- A. Transformers furnished by this Specification shall be subjected to the following production tests:
 - 1. Applied Potential.
 - 2. Induced Potential.
 - 3. No Load Losses.
 - 4. Voltage Ratio.
 - 5. Polarity.
 - 6. Continuity.
- B. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL Standards.
- C. The manufacturer shall provide three (3) certified copies of factory test reports as part of the required submittals.

3.3 FIELD TESTING

- A. 50 percent load shall be provided on all transformers to confirm the secondary voltage. Secondary taps shall be adjusted as required to provide a minimum of 120/208 volts.

- B. Transformers shall be tested on site to ensure efficiencies as listed herein. Provide on-site revenue class accurate efficiency and harmonic measurements of transformers once installed and operating at site. Data shall be collected from primary and secondary sides of the transformer simultaneously on a synchronized cycle-by-cycle basis. The use of two (2) discrete meters that are not synchronized is not acceptable. Sampling shall be of 10% of transformers on the project once installed and operating, as selected by Engineer. Submit a detailed report to the project Engineer.
- C. Phase rotation shall be demonstrated as part of the operational checkout at the site.
- D. Refer to Section 26 08 00 for additional testing requirements for dry-type transformers.

END OF SECTION 262213

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all free-standing, dead-front type 600 volt service and distribution switchboards utilizing group mounted circuit protective devices, including surge protection devices (SPD) as required for the distribution of lighting and power throughout the building as indicated on and in accordance with the requirements of the Contract Documents.
- B. Section includes:
 - 1. Distribution Switchboards.
 - 2. Service Switchboards.
 - 3. Ground Fault Protection System.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 06 - Electrical Service.
 - 3. Section 26 05 10 - Electrical General.
 - 4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 5. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 6. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 7. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 8. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 9. Section 26 05 53 - Identification for Electrical Systems.
 - 10. Section 26 22 13 - Low-Voltage Distribution Transformers.
 - 11. Section 26 24 16 - Panelboards.
 - 12. Section 26 25 00 - Enclosed Bus Assemblies.
 - 13. Section 26 28 13 - Fuses.
 - 14. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 - 15. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
 - 16. Section 26 43 00 - Surge Protective Device System.

1.3 REFERENCES

- A. Switchboards and all components shall be designed, manufactured, and tested in accordance with the latest applicable codes and reference standards, including the following as modified to conform to Bureau of Electric Control Advisory Board requirements:
- B. Codes:

1. IBCNJ - International Building Code New Jersey Edition.
2. NEC - National Electrical Code New Jersey Amendments.

C. Reference Standards:

1. ANSI 37.20, C37.51 - Switchgear Assemblies Including Metal-Enclosed Bus.
2. CSA Listed C22.2.
3. NEMA PB 2 - Deadfront Distribution Switchboards.
4. NEMA SG-5. - Power Switchgear Assemblies.
5. UL Standard 891 - Switchboards.
6. UL Standard 977 - Fused Power - Circuit Devices.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:
 1. Switchboard[s], complete with physical dimensions and weights, elevations, plan views, schematic diagram, buswork details, nameplate data, voltage, current, and short circuit ratings, materials, bus capacity data, circuit schedule, connector details, factory test reports, installation details, etc.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the Division 01 and Section 26 05 00

1.6 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution
- C. If it complies with the Contract Documents, service switch assemblies and distribution switchboards manufactured by one of the following will be acceptable:

1. Eaton/Cutler-Hammer.
 2. General Electric.
 3. Siemens Industry Inc.
 4. Square "D".
- D. If it complies with the Contract Documents, overcurrent protective devices manufactured by one of the following will be acceptable:
1. Boltswitch.
 2. Eaton/Cutler-Hammer.
 3. Federal Pioneer.
 4. General Electric.
 5. Pringle.
 6. Siemens Industry Inc.
 7. Square "D".

2.2 RATINGS

- A. Switchboards shall be fixed-mounted, outdoor switchboard construction, arranged for 480Y/277 volt or 208Y/120 volt, 3 phase, 4 conductor, full-neutral and 25% ground bus, or as indicated on the Drawings, and assembled complete with spares, spaces and circuit protective devices with capacities as indicated on the Drawings.
- B. Switchboards and their overcurrent protective devices shall be listed, and have a minimum short-circuit interrupting rating/withstand rating of 65,000 amperes RMS symmetrical at 480 volts.

2.3 CONSTRUCTION

- A. General Construction
 1. The outdoor enclosure shall meet the applicable requirements of the NEC, and NEMA.
 2. Each section shall be provided with adequate lifting means, and shall be capable of being rolled or moved into installation position and bolted to the housekeeping pad. Individual shipping sections shall be designed for bolting together at the installation site. All necessary hardware required for bolting, including steel channels with shims for leveling, as well as main bus splices, shall be supplied with the switchboard sections.

3. Adequate conduit space shall be provided in the rear compartments if rear-accessible, or side gutters if not rear-accessible, to satisfy the current ratings of the individual devices and feeder sizes within a vertical section. All cable terminations shall be made with two-bolt hole concentric compression type lugs, which shall be supplied with the switchboard section and approved by the Engineer.
4. Provide switchboard and circuit identification in accordance with Section 26 05 53.

2.4 DISTRIBUTION SWITCHBOARDS

- A. Switchboard assemblies shall be arranged in accordance with the details and schedules shown on the drawings. Each assembly shall consist of a completely metal-enclosed, self-supporting metal structure, of required number of formed and welded vertical panel sections, protective devices in one integrated structure. All fastening between vertical panel sections shall be bolted, not welded. All screwed-on front covers shall be flanged on all four sides and shall be not less than code gauge steel. The tops, side and rear enclosing sheet steel shall be removable, not less than code gauge, and shall be furnished with openings for proper natural ventilation.
- B. Protective devices shall be individually mounted where 1200 amp and larger.
- C. Bolted or welded frames and insulating blocks shall be provided to support and brace all main horizontal buses for the stresses due to the maximum available short circuit current from the electrical system, but not less than 65,000 amperes rms symmetrical.
- D. All main horizontal buses and bus connections between main bus and feeder protection devices shall consist of copper of sufficient size to limit temperature rise to 65°C over an average air temperature outside the enclosure of 40°C, but not less than one square inch per 1000 amperes. All bus connections shall be silver plated, after fabrication, and bolted and taped. Provide Belleville washers on all bolted joints, torqued to manufacturer's requirements.
- E. A full capacity copper neutral bus shall be provided, or larger where indicated. Provide separate ground bus 1/4 inch x 3 inches in each switchboard assembly.
- F. Approved barriers shall be placed between adjacent sections of the switchboard and all openings in the barriers for bus bars shall be closed with snug fitting, approved nonhygroscopic arc resisting material. Provide isolation barriers and approved nonhygroscopic fire stops at main buses, between each means of circuit protection and each means of circuit protection and its respective outgoing section, effectively isolating each distribution means of circuit protection.
- G. Provide isolation barrier between the main bus section and the cable termination area. Provide barriers so that all bus connections can be made accessible for thermoscanning without removal of entire barrier.
- H. Provide non-metallic cable supports to allow the cables to be "shaped" and supported.
- I. All buses shall be assembled so as to maintain the minimum UL electrical clearances without the use of insulating material. Load studs shall be equipped with load extension buses, terminating in copper bodied solderless concentric compression type, 2 bolt-hole long-barrel

lugs in the rear cable compartment. Bus extensions shall be silver plated where the lugs are attached.

- J. Meter readouts shall be provided at the input to switchboards and on each distribution device, for the functions listed below. They shall be mounted at a maximum height of 66 inches and a minimum of 48 inches above the finished floor and shall be combination analog/digital, true rms reading meter per ANSI C39.1.
 - 1. AC current for each phase of each distribution device with 4-position selector switch.
- K. If indicated on drawings, or as required, metal pull box of same depth as the switchboard shall be constructed to the required height (minimum of three feet) and mounted atop each switchboard assembly. Pull box is to be so designed that top, sides and end panels are all screw removable. Insulated cable supports shall be provided. The bottom of pull box shall be enclosed by metal completely separating cables in pull box from switchboard sections. All cables entering the pull box at the bottom from switchboard shall be sealed using an O-Z Type "GRK" with Type "BB" insulated bushings, of size and number of holes as required for cables specified.
- L. All sheet and structural steel parts shall be rustproofed prior to painting, and finished with a light gray paint, ANSI 61, over all steel surfaces on both the interior and exterior faces.
- M. Rear doors shall be not more than 36 inches in width with three-point locking hatches.

2.5 SERVICE SWITCHBOARDS

- A. Service switchboard assemblies shall be arranged in accordance with the details and schedules shown on the drawings and as hereinbefore described for distribution switchboards except where in conflict with the requirements described hereinbelow.
- B. Metal-enclosed main service switch assemblies shall consist of incoming service termination, overcurrent protective devices, fuses, etc., metering current transformer section and outgoing sections. Each service switch shall be enclosed in a self-supporting metal cubicle. Provide isolation barriers and approved nonhygroscopic fire stops at main buses entering and leaving the current transformer section and between each service switch and its respective outgoing section.
- C. Where main service switch sections are contiguous with associated distribution switchboard, provide fire barrier comprised of 3/4 inch nonhygroscopic fiber board between metal end closures of service switch and distribution switchboard assembly. All bus openings in barrier shall be closed with snug fitting, approved nonhygroscopic arc-resisting material. A 1 foot minimum separation shall be provided between service switch and distribution section.
- D. Main bus and section buses shall be provided in each switchboard section and shall be copper with either silver or tin plating at all joints. All main bus shall be either welded or bolted to section bus and bolted where main bus extends to adjacent shipping sections. Bolted joints shall consist of silver or tin plated splice plates and high tensile strength steel bolts with nuts and Belleville washers tightened to the proper torque requirements as dictated by the Belleville washers and UL requirements.

- E. Bus bars shall be adequately braced to withstand resulting mechanical forces exerted during short circuit conditions when subjected to short circuit currents but no less than 65,000 amperes rms symmetrical.
- F. All buses shall be assembled so as to maintain the minimum UL electrical clearances without the use of insulating material. Load studs shall be equipped with load extension buses, terminating in copper-bodied solderless concentric compression type 2 bolt-hole long-barrel lugs in the rear cable compartment of each structure. Bus extensions shall be silver or tin plated where outgoing lugs are attached. The rear cable or bus duct section shall be barriered from the main bus section using nonhygroscopic material. Provide barriers in sections so that all bus connections can be made accessible for thermoscanning without removal of the entire barrier. Provide non-metallic cable supports to allow the cables to be “shaped” and supported.
- G. A continuous 1/4 inch x 4 inch copper ground bus, readily accessible upon removal of rear panels, shall be run through and connected to all component parts of the switchboard structure. Provide for connection of 500 kCMIL copper ground connection.
- H. A full capacity neutral bus, fully insulated from frame, shall be provided with suitable disconnect link. Provide separate ground bus in each service switch and distribution switchboard assembly.
- I. Provide floor steel channels with shims for level mounting of assemblies on floor.
- J. Provide utility metering compartment in accordance with all requirements of PSE&G.
- K. Provide for each service switch, three (3) current transformers of suitable ratio, three phase ammeter switch, and 1% accuracy analog switchboard type ammeter.
- L. Provide for each service switchboard, one (1) 1% accuracy switchboard-type analog voltmeter.
- M. Hinged rear doors shall be not more than 36 inch wide door panels with 3-point locking latches.
- N. All sheet and structural steel parts shall be rustproofed prior to painting, finished with a light gray paint, ANSI 61, on interior and exterior over all steel surfaces.
- O. Each service switchboard shall be provided with surge protection devices (SPD).
- P. All free-standing service switches shall be provided in accordance with the service switchboard section.
- Q. Provide space within service switchboard assemblies for all future utility meters where noted on drawings and/or a future service switch is indicated.
- R. Service Switchboard and Distribution
Switchboard Assembly Circuit Protective Devices
 - 1. All overcurrent protective devices shall be UL listed.
 - 2. All service overcurrent protective devices for all separately derived systems, including, but not limited to, utility service, transformer secondary, generators, power conversion

equipment, etc., shall be rated for 100 percent (100%) of their continuous ampere rating and shall comply with all NEC requirements.

3. On all service disconnect devices and on distribution disconnect devices indicated on the Contract Drawings, provide a ground fault monitoring system. Each ground fault detection system shall consist of a current monitor, zero sequence current transformer relay coil and fault indication on the face of the switchboard either on the device cubicle in alarm or centrally located on the switchboard metering compartment if proper identification is provided.
4. All service switches for all separately derived systems, except for fire pumps 1,000 amps or greater, shall be provided with ground fault protection.
5. For circuit breakers 1200 amps and larger, provide two (2) pairs of isolated Form "C" contacts rated 10 amperes, 125 volts, from each ground fault sensor for remote alarm sensing under other Sections. Extend Form "C" contacts to terminal strips in a separate control compartment in each switchboard.
6. For circuit breakers 1200 amps and larger, provide two (2) pairs of isolated Form "C" contacts rated 10 amperes, 125 volts for each switch for remote status indication provided under other Sections. Extend Form "C" contacts to terminal strips in a separate control compartment in the service switchboard.
7. Provide two (2) pairs of isolated Form "C" contacts rated 10 amperes, 125 volts from each distribution device for remote status indication provided under other Sections. Extend Form "C" contacts to terminal strips in a separate control compartment in the switchboard.
8. Circuit Breakers
 - a. Circuit breakers shall be drawout insulated case type for all circuit breakers, complete with solid-state overcurrent and trip devices and electric operators. All circuit breakers, in their enclosures, shall be UL listed for application at 100% of designated frame ratings (ANSI C37.13, C37.16, C37.17 and C37.50, UL-1066, CSA C22.2). Each circuit breaker faceplate shall have visual indicators to indicate contacts' "open" and "close" positions, with a local "charge" pushbutton and an LCD display unit. An individual trip target shall be visible from the face of the device. Local control buttons shall be provided for breaker operation. Provide adjustable solid-state (digital) tripping devices for each circuit breaker, each having a complete range of tripping functions and characteristics built into its solid state module. In addition, each circuit breaker shall be equipped with a Modbus open protocol communication port. Complete system coordination shall be provided by inclusion of following time/current curve shaping adjustments:
 - Ampere setting
 - Long-time pickup
 - Long-time delay
 - Short-time pickup

Short-time delay

Instantaneous pickup

Instantaneous delay

Ground fault trip

- b. Changes in settings shall be made by adjustment at the circuit breaker trip module or by interchangeable switching plugs for precise settings. All settings shall be sealable. This manufacturer shall submit recommended settings for all switchboards protective devices to achieve a completely selective coordinated system from the main protective device (normal and emergency service disconnect devices), through and including the critical load device (branch devices on subfed critical distribution panelboards). Submit for approval final time current curve indicating selectivity. Circuit breakers shall be rated at 65,000A rms symmetrical amperes. All circuit breakers shall be individually field-tested (primary induction testing) for proper calibration and operation by an independent testing company retained by this manufacturer, before site acceptance testing. The independent testing company shall submit a written report of the test after all corrections and adjustments have been made.
- c. All trip units shall have integral meter readings, including 3 phase amps.
- d. Provide one (1) test kit for testing all frame sizes. The test kit shall contain all required appurtenances, including, but not limited to, harnesses, ground fault defeat modules, etc.
- e. Where circuit breakers are utilized, provide an integral breaker lifting device, mounted on self-contained track, supported from the front section of the assembly, for the switchboard lineup. The lifting device shall not interfere with any incoming power or control cable. The hoist shall be capable of being moved the full length of the switchboard assembly without binding when supporting the largest frame size circuit breaker included in the switchboard. The hoist, with the aid of a lifting yoke, shall be capable of lifting from the floor or from the withdrawn breaker cradle the largest frame size circuit breaker included in the switchboard. The lifting mechanism shall be designed for easy hand operation, and shall be so designed that the load will not move up or down when the lift is left unattended with the load in midair. Suitable stops shall be provided at the ends of the lifting device track to prevent its running off the track.

2.6 GROUND FAULT PROTECTION SYSTEM

- A. Where required by Code, provide a ground fault protection (GFP) system for all main service disconnect devices and distribution switches rated 1,000 amps and above. Each GFP system shall consist of a current monitor, and fault indication. All alarms will be displayed on a digital display panel (LED type). The GFP system shall be mounted on the face of the switchboard on the device cubicle in alarm.
 - 1. Ground fault protection shall be provided where indicated on the drawings and on all main service disconnect devices rated 1000 amps or larger (except fire pump).

2. The ground fault protection shall consist of the following:
 - a. Current Monitor: Zero-sequence current transformer enclosing all current carrying conductors, including the neutral conductor, if used, of the circuit being protected.
 - b. Ground Fault Sensor: Senses the output of the current monitor. Should the sensor detect a ground current in excess of the pickup setting for a duration exceeding the time delay, the sensor shall shunt-trip the appropriate device. The sensor shall have an adjustable pickup of 100 to 1200 amperes and an adjustable time delay from 0 to 60 seconds.
 - c. Test Panels: Provide each ground fault sensor with a test panel which shall completely test the ground fault system. The test panel shall indicate that a ground fault was sensed or test the system with or without tripping the feeder switch or breaker. The test panel shall be installed in the front of the switchboard adjacent to the device being protected.
 - d. Shunt-Trip: Each device or switch with ground fault protection, shall be provided with a shunt-trip which shall automatically open the device when signaled by the sensor.
 - e. Provide fuse-protected central power transformer from the switchboard line side for the ground fault systems. Ground fault and shunt-trip device shall be capable of operation at 55% of rated voltage.
3. Settings: The electrical trade shall set each ground fault sensor pickup setting at 25% of the rating of overcurrent device with a 6-cycle time delay unless specifically indicated otherwise in the accepted short circuit and coordination study.
4. Integral, self-powered ground fault protection with mechanical ground fault indicator, test function, current sensors, and adjustable pick-up and delay with inverse and constant time characteristics. The system shall be field adjustable with pick-up settings from 100 amps to 1,200 amps and trip signal time from 0.1 seconds to 0.5 seconds. The ground fault system shall be self-powered and shall only require external control power for test purposes. The ground fault relay shall have an internal memory circuit that sums intermittent arcing ground faults, until the summed ground fault current reaches the trip setting and opens the switch.
5. The ground fault system components shall be mounted and wired onto the circuit protective device during switch assembly, and factory tested by the manufacturer to insure system compatibility.
6. A ground fault protection monitor and test panel shall be provided as an integral part of the switch. The panel shall be visible from the front of the switchboard and shall be equipped with control power indicating light, ground fault trip indicating target, target reset and means of testing the GFP relay and trip circuit — with and without tripping the switch.

PART 3 - EXECUTION

3.1 INSTALLATION

SWITCHBOARDS

- A. The assembled service and distribution switchboard structures shall be securely anchored to continuous 1-1/2 in. x 6 in. channels the full length of the switchboard which shall be embedded in the concrete equipment pad. Bolt studs shall be at least 3/8 in. in diameter and located not more than 30 in. apart center to center for switchboard mounting. The mounting channels shall be continuous one-piece structural channels mounted along the front and rear for each continuous switchboard lineup, leveled and embedded in the concrete equipment pads. The channel and bolt studs shall be furnished and installed by this Contractor.
- B. A minimum of three (3) spare fuses or current limiters of each type and size used in conjunction with circuit protective devices for the switchboards shall be furnished and delivered to the State upon issuance of a "Certificate of Substantial Completion".

3.2 FACTORY TESTING

- A. All switchboards shall be fully assembled and factory tested for full functionality at the manufacturer's factory prior to shipment as specified herein:
 - 1. The switchboard manufacturer shall provide a ground fault monitoring system test for verification of the trip function and alarming of the ground fault sensors at the factory location. The manufacturer shall pass predetermined values of current through the relay sensors and confirm resultant required relay operation. This test shall include a polarity verification of the interconnection of the ground sensor circuits.

3.3 FIELD TESTING

- A. After construction work is complete and prior to energizing of the switchboard, the ground fault monitoring system shall be field tested and reset to the manufacturer's recommended setting for both current and time.
- B. Service Switchboards, Distribution Switchboards and Panelboards (in excess of 800 amperes)
 - 1. Switchboards shall be megger tested.
 - 2. Switches shall be operated to confirm proper mechanical operation.
 - 3. Test the accuracy of all meters under varying load conditions with hand-held True RMS reading multimeters.
 - 4. Ground fault trip/sensing systems shall be tested to verify their settings and proper activation. Polarity verification of the interconnection of the ground sensor circuits shall be performed.
 - 5. Primary and secondary injection testing shall be performed on all breakers.
- C. Refer to Section 26 08 00 for additional testing requirements for switchboards.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all panelboards as specified herein and as required for proper control and distribution for power, lighting, and receptacle loads throughout the Project as indicated on and in accordance with the requirements of the Contract Documents.
- B. Section includes:
 - 1. Distribution and Power Panelboards.
 - 2. Lighting and Utility Panelboards.
 - 3. Ground Fault Circuit Interrupters.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 06 - Electrical Service.
 - 3. Section 26 05 10 - Electrical General.
 - 4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 5. Section 26 05 20 - Heating Cable.
 - 6. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 7. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 8. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 9. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 10. Section 26 05 53 - Identification for Electrical Systems.
 - 11. Section 26 09 23 - Lighting Control Devices.
 - 12. Section 26 22 13 - Low-Voltage Distribution Transformers.
 - 13. Section 26 24 13 - Switchboards.
 - 14. Section 26 27 26 - Wiring Devices.
 - 15. Section 26 28 13 - Fuses.
 - 16. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 - 17. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
 - 18. Section 26 43 00 - Surge Protective Device System.
 - 19. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. All panelboards and all components shall be designed, manufactured, and tested in accordance with the latest applicable codes and reference standards, including the following:

B. Codes:

1. IBCNJ - International Building Code New Jersey Edition.
2. NEC - National Electrical Code New Jersey Amendments.

C. Reference Standards:

1. NEMA FU 1 - Low-Voltage Cartridge Fuses.
2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
3. NEMA PB 1 - Panelboards.
4. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
5. UL Standard 67 - Safety for Panelboards.
6. UL Standard 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
7. UL Standard 943 - Ground Fault Circuit - Interrupter.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:
1. Panelboards, complete with physical dimensions, materials, bus capacity data, circuit schedule, connector details, nameplate data, voltage, current, and short circuit ratings, factory test reports, installation details, location of neutral and ground buses, etc.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the Division 01 and Section 26 05 00

1.6 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.

- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution.
- C. If it complies with the Contract Documents, panelboards manufactured by one of the following will be acceptable:
 - 1. Eaton/Cutler-Hammer.
 - 2. General Electric.
 - 3. Siemens Industry Inc.
 - 4. Square "D".

2.2 RATINGS

- A. Panelboards shall be of indoor or NEMA 3R construction as appropriate for the mounting location, arranged for the voltage and current capacity ratings indicated on the Drawings and in conformance with the Contract Documents, and assembled complete with spares, spaces and circuit protective devices as indicated on the Drawings.
- B. Panelboards shall have a short-circuit interrupting rating which exceeds the available RMS symmetrical fault current values indicated on the Drawings or Coordination Study. All devices, including branch devices, shall be fully rated.

2.3 GENERAL

- A. Enclosure Construction
 - 1. Panelboard cabinets shall be formed from Code gauge galvanized steel with master-keyed flush door locks. Cabinet fronts shall be finished with two (2) coats of ANSI 61 gray enamel over a rust-inhibiting primer coat, or protected by an electro-deposition or powder coat paint process.
 - 2. All unused spaces shall be provided with blank-off plates.
 - 3. The indoor enclosure shall meet the applicable requirements of UL for NEMA 1 type construction. Wet location enclosures shall meet the applicable requirements of UL for NEMA 3R type construction.
 - 4. Panelboards shall be identified in accordance with Section 26 05 53.
 - 5. Cardholders and directory cards shall be provided in accordance with Section 26 05 53. Circuit arrangement shall correspond to the arrangement indicated on the Panel Schedules on the Drawings. Alternate phases shall be used in consecutive circuit

numbering. If arrangement of circuits is modified to achieve load balance on the phases, panel schedules and "as-built" drawings shall be modified accordingly.

6. Cabinets shall be of sufficient size to allow a gutter space of at least four inches on all sides around lighting and utility panels, and six inches for power and distribution panelboards. Conduit entry points shall be coordinated so additional gutter space is allowed for proper cable terminations at mains to avoid short radius bends on cable. Where gutter taps, multiple lugging provisions, installation of metering current transformers or increased feeder size provisions are required, gutter spaces shall be increased accordingly.
7. Doors and trim shall be door-in-door construction, in one piece so designed that doors will close without a rabbet. Doors shall be fastened to cabinet with flush butt concealed hinges. Trims shall be fastened to cabinet by means of captive screws or clamps and flush butt concealed hinge.

B. Bus Construction

1. Panel bus shall be arranged to accommodate copper bodied, compression connectors at the main lug, main overcurrent device and feed-through lug connections for #6 AWG or larger copper conductors. See Section 26 05 19 for conductor and connector specifications. Attach these lugs to the panel bus with two bolts per lug or one bolt with anti-turn device. Use of rough-edged washers will not be acceptable as an anti-turn device. Bolts shall be captive or shall be studs to facilitate re-installation of the lugs with the wire attached
2. Bus bars shall be designed, supported and braced for a minimum short-circuit equal to the short-circuit interrupting rating of the panelboard as described hereinbefore
3. Bus bars shall be sized to limit the temperature rise within the panelboard to 50°C over a 40°C ambient temperature. Bus bars shall be 98% conductivity round edge copper with bolted joint connections. Bolted joint connections shall be readily accessible for inspection and proper maintenance.
4. Ground Bus: Ground bus in each panelboard section, with a minimum of one (1) termination point per pole and additional termination points where additional equipment grounding conductors are required on the drawings or elsewhere.
5. Neutral Bus (Where Required): Neutral bus in each section panelboard section, fully rated unless otherwise noted herein or on the Drawings, with a minimum of one (1) termination point per pole and additional termination points where additional conductors are required on the drawings or elsewhere.
6. For non-linear load applications subject to harmonics, or where fed by a K rated transformer, provide 200 percent rated, solid neutral with a terminations for 200% rated conductors or double conductors where 1/0 and larger.
7. Isolated Ground Bus (Where Indicated on Drawings): Isolated ground bus in each panelboard section mounted on insulating bushings, with a minimum of one (1) termination point per pole and additional termination points where additional equipment grounding conductors are required on the drawings or elsewhere.

8. Bolted joint connection surfaces for copper bus shall be silver-plated.
 9. All two-section panelboards shall be connected with conductors of a capacity equal to or greater than the panelboard main bus amperage capacity. Conductor connections shall be as specified hereinbefore.
- C. All spares and spaces shall be fully bussed, including bus straps for sizes indicated on drawings.
- D. Certain panels shall be equipped with integral mechanically held contactors or remote mounted multiple relays for remote control of sections or circuits. Adequate panel space shall be coordinated to accommodate these devices and their wiring.

2.4 DISTRIBUTION AND POWER PANELBOARDS

- A. 480Y/277 volt or 208Y/120 volt, 3 phase, 4 conductor or 3 phase, 3 conductor as indicated on the Drawings. Panelboards shall conform to standards and bear the label of the Underwriters Laboratories, Inc., and shall be of dead-front construction. Cabinets and fronts shall be constructed as specified hereinbefore and shall be provided with hinged "door-in-door" type doors.
- B. Panelboards shall be assembled complete with bolted-in devices, spares and spaces as indicated on the Drawings.
- C. Overcurrent and Disconnecting Devices:
1. Multi-pole switches and breakers shall operate all poles with a single action.
 2. Multi pole breakers shall have common trip action.
 3. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Furnish interlock to prevent opening front cover with switch in ON position. Handle lockable in ON or OFF position. Fuse Clips: Rejection type, designed to accommodate NEMA FU 1, Class R, J, or L fuses.
 4. Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
 5. Molded Case Circuit Breakers with Current Limiters: NEMA AB 1, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.
 6. Current-Limiting Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current-limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
 7. Where EPO or Ansul systems are used, breakers or switches shall be provided with shunt trip.

8. Devices serving hydraulic elevators shall have additional contacts indicating position and shall be wired to the controller.

2.5 LIGHTING AND UTILITY PANELBOARDS

- A. 208Y/120 volt, 3 phase, 4 conductor service, or 480Y/277 volt, 3 phase, 4 conductor service. All panelboards shall conform with the standards and bear the label of the Underwriters Laboratories.
- B. The panelboards shall be assembled complete with molded case bolted-in circuit breakers, spares and spaces as indicated on the Drawings.
- C. Certain panels shall be provided in a split bus arrangement with the indicated quantity of multipole circuit breakers or fusible switches provided in section one. All devices in section one shall feed transformers or mechanical equipment or act as the main for the branch devices of section two. The ampacity of section one shall be equal to or exceed the ampacity of the distribution device feeding the panel, but in no case be less than 200 amperes. Provide main lugs only on both sections as specified and include either bus or cable connections to subfeed the second section for the protective device provided in section one.
- D. Where two (2) section panelboards are indicated, each section shall be provided with a main circuit breaker.
- E. Overcurrent and Disconnecting Devices:
 1. Multi-pole breakers shall be interchangeable with single-pole breakers, operate all poles with a single action, and have common trip action.
 2. Molded Case Circuit Breakers: UL 489, bolt-on type thermal magnetic trip circuit breakers, operate all poles with a single action, and have common trip action with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HID for lighting other than fluorescent or incandescent, Type HACR for air conditioning equipment circuits, Class A ground fault circuit interrupter breakers as indicated on Drawings. Do not use tandem circuit breakers.
 3. Current-Limiting Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current-limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
 4. EPO or Ansul system: Breakers shall be provided with shunt trip.
 5. Where no schedule is provided, 42 poles shall be assumed.
 6. Devices serving hydraulic elevators shall have additional contacts indicating position and shall be wired to the controller.

2.6 GROUND FAULT INTERRUPTERS

- A. Class "A" ground fault circuit interrupter branch circuit breakers shall be provided for all exterior receptacles, window washing receptacles, pipe trace circuits and slab heating circuits, and/or as indicated on the Drawings. Circuit breakers shall be circuit interrupting which will operate manually for normal switching functions and automatically under overload, short circuit, and 0.005 amp line-to-ground fault conditions in accordance with UL Standard 943. The operation mechanism shall be entirely trip-free so that contact cannot be held close against an abnormal overcurrent, short circuit, or ground fault condition. The device shall be bolt-on type with molded or insulated case construction and shall be interchangeable with standard breakers utilized in the panelboard.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Panelboards shall be installed per the Code, manufacturer's recommendations and as indicated on the Drawings. Where panelboards are shown or required to be free-standing, provide and install angle iron rack suitably braced.
- B. All panelboards in wet locations shall comply with the requirements of the Code.
- C. Where panelboards are mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and be securely attached to the partition studs or framework. At the Subcontractor's option, the mounting screws may pass through the gypsum board and be securely attached to 6 in. square, 18 gauge galvanized metal backplates which are attached to the gypsum board with an approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions will not be acceptable.
- D. Three (3) spare fuses of each type and size used in conjunction with circuit protective devices for the distribution and power panelboards shall be furnished and delivered to the State upon issuance of a "Certificate of Substantial Completion".

3.2 EXISTING WORK

- A. Survey existing space, closets, and panelboards to verify suitability of installation design indicated. Include any and all modifications of existing conditions necessary to comply with the design intent at time of bid. Additional work shall be highlighted in the bid proposal. This assessment shall include evaluating the availability of branch circuits to accommodate the the circuiting on the design drawings. Rerouting of circuits to alternate panels within the same closet shall be included in bid proposal.
- B. Circuit numbers shown on drawings are for reference only. Actual circuits to be determined at shop drawing phase.
- C. Verify the availability of existing circuit breakers after demolition in order to meet the intent of the new work. Report any discrepancies prior commencement of work
- D. Disconnect and remove abandoned panelboards.
- E. Maintain access to existing panelboard and load centers remaining active and requiring access. Modify installation or provide access panel.

- F. Clean and repair existing panelboards and load centers to remain or to be reinstalled.

3.3 FACTORY TESTING

- A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL standards.

3.4 FIELD TESTING

- A. Following the installation of branch circuitry, phase currents shall be verified to ensure the balance of loads. Branch circuitry shall be reconnected to achieve a maximum imbalance of 10%. Relabel pull boxes, loads, etc., as required.
- B. Refer to Section 26 08 00 for additional testing requirements for panelboards.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all wiring devices as specified herein, and as required for complete and operational systems throughout the Project as indicated on and in accordance with the requirements of the Contract Documents.
- B. Section includes:
 - 1. Line Voltage Switches.
 - 2. Plug Receptacles.
 - 3. Flush Wall Plates.
 - 4. Exposed, Exterior, Surface Mounted, Moist Location Coverplates.
 - 5. Floor Boxes and Cover Plates.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 06 - Electrical Service.
 - 3. Section 26 05 07 - Access Doors and Color Coded Identification in General Construction.
 - 4. Section 26 05 10 - Electrical General.
 - 5. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 6. Section 26 05 20 - Heating Cable.
 - 7. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 8. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 9. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 10. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 11. Section 26 05 53 - Identification for Electrical Systems.
 - 12. Section 26 09 23 - Lighting Control Devices.
 - 13. Section 26 24 16 - Panelboards.
 - 14. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 - 15. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
 - 16. Section 26 43 00 - Surge Protective Device System.

1.3 REFERENCES

- A. All wiring devices and all components shall be designed, manufactured, and tested in accordance with the latest applicable codes and reference standards, including the following:
- B. Codes:

1. IBCNJ - International Building Code New Jersey Edition.
 2. NEC - National Electrical Code New Jersey Amendments.
- C. Reference Standards:
1. NEMA WD 1 - General Color Requirements for Wiring Devices.
 2. NEMA WD 6 - Wiring Devices – Dimensional Requirements.
 3. UL Standard 20 - General-Use Snap Switches.
 4. UL Standard 498 - Attachment Plugs and Receptacles.
 5. UL Standard 514D - Coverplates for Flush-Mounted Wiring Devices.
 6. UL Standard 894 - Switches for Use In Hazardous (Classified) Locations.
 7. UL Standard 943 - Ground-Fault Circuit-Interrupters.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:
1. Wiring devices, complete with physical dimensions, materials, connector details, voltage, and current ratings, installation details, etc., including samples of each general-use receptacle, switch, wall plate, and coverplate intended for use on this Project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the Division 01 and Section 26 05 00.

1.6 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution.
- C. If it complies with the Contract Documents, wiring devices manufactured by one of the following manufacturers will be acceptable:
1. Line Voltage Switches, Plug Receptacles, Wall Plates and Coverplates:

- a. Arrow-Hart/Cooper.
 - b. Bryant.
 - c. Hubbell.
 - d. Leviton.
 - e. Lutron.
 - f. Pass & Seymour/LeGrand.

 - g. Russellstoll/Thomas & Betts
2. Weatherproof "While-in-Use" Covers:
- a. Carlon.
 - b. Pass & Seymour/LeGrand.
 - c. Taymac.

 - d. Thomas & Betts
3. Floor boxes and Covers:
- a. FSR.
 - b. Hubbell.
 - c. Thomas & Betts.
 - d. Wiremold/LeGrand.

2.2 GENERAL

- A. The color of all wiring devices, wall plates, and coverplates constructed of plastic shall be black for general utility service, red for emergency service, and of colors as designated by the Architect for all finished areas.
- B. The finish of all metallic wall plates and coverplates shall be as designated by the Architect.

2.3 LINE VOLTAGE SWITCHES

- A. Indoor line voltage switches, unless otherwise specified on the Drawings, shall be flush-mounted, heavy-duty AC quiet-type rocker handle switches, similar and approved equal to the following Pass & Seymour/LeGrand catalog numbers:
 - 1. Load of 20 amps or less, single pole, 120/277 volts: Pass & Seymour/LeGrand 2621 Decorator Series.
 - 2. Load of 20 amps or less, three-way, 120/277 volts: Pass & Seymour/LeGrand 2623 Decorator Series.
 - 3. Load of 20 amps or less, four-way, 120/277 volts: Pass & Seymour/LeGrand 2624 Decorator Series.
- B. Where ganged with wall dimmers, line voltage switches shall be linear slide switch type, one-pole, 120/277 volt Lutron Model No. NT-1PS, or three-way, 120/277 volt Lutron Model No. NT-3PS, or as indicated on the Drawings.

- C. Where located in damp locations, exposed to the weather, or surface-mounted, line voltage, surface-mounted heavy-duty AC quiet-type toggle switches, unless otherwise specified on the Drawings, shall be similar and approved equal to the following Pass & Seymour/Legrand catalog numbers:
 - 1. Load of 20 amps or less, single-pole, 120/277 volts: Pass & Seymour/Legrand 20AC1.
 - 2. Load of 20 amps or less, three-way, 120/277 volts: Pass & Seymour/Legrand 20AC3.
 - 3. Load of 20 amps or less, four-way, 120/277 volts: Pass & Seymour/Legrand 20AC4.
- D. Outdoor, loading dock and parking garage switches shall be surface or recessed mounted in enclosures (with clear cover) suitable for wet locations similar to Carlon, Taymac, or approved equal.

2.4 PLUG RECEPTACLES

- A. Indoor plug receptacles, unless otherwise specified on the Drawings, shall be flush mounted and similar and approved equal to the following Pass & Seymour/Legrand catalog numbers:
 - 1. 20 amps, 125 volts, duplex: Pass & Seymour/Legrand 26342.
 - 2. 20 amps, 125 volts, single: Pass & Seymour/Legrand 26361.
 - 3. 20 amps, 125 volts, duplex with ground fault interrupter: Pass & Seymour/ Legrand 2091-S.
 - 4. Special outlet numbers shall be as noted on the Drawings.
- B. Outdoor, damp location, loading dock and/or parking garage plug receptacles, unless otherwise specified on the Drawings, shall be 125 volts, 20 amps, surface or recessed mounted in enclosures (with clear cover in spaces accessible only to maintenance crews and solid cover where in public view) similar (or approved equal) to Taymac or Carlon, suitable "for use" in wet locations in accordance with governing Codes.
 - 1. Grade or ground level outdoor receptacles shall be lockable.
- C. Indoor surface-mounted plug receptacles, unless otherwise specified on the Drawings, shall be similar and approved equal to the following Pass & Seymour/Legrand catalog numbers:
 - 1. 20 amps, 125 volts, duplex: Pass & Seymour/Legrand 5352.
 - 2. 20 amps, 125 volts, single: Pass & Seymour/Legrand 5351.
 - 3. 20 amps, 125 volts, duplex with ground fault interrupter: Pass & Seymour/ Legrand 2091-S.
 - 4. Special outlet number shall be as noted on the Drawings.

2.5 FLUSH WALL PLATES

- A. Provide matching plastic wall plates for all back-of-house (MER's, EMR's, electrical closets, etc.) indoor wiring devices, including multiple gang common wall plates were required. The color of all wall plate covers shall be as selected by the Architect.
- B. Provide architectural metal finish wall plates (stainless steel, bronze, brass, etc.) for all other wall plates. Coordinate with the Architect.
- C. All wall plates in Mechanical/Electrical Rooms and closets shall have an engraved plate indicating circuit designation.

2.6 EXPOSED, EXTERIOR, SURFACE
MOUNTED, MOIST LOCATION COVERPLATES

- A. Coverplates for surface-mounted boxes shall be of the galvanized type for interior use and cast metal type with gaskets and covers for moist locations and exterior use and shall be designed to fit the boxes to which they are installed.
- B. All exterior wall plates, wall plates in plenums, wall plates in the parking garage, and wall plates for all devices (receptacles and switches) indicated with a "WP" shall be weatherproof "while-in-use".
- C. All "WP" cover plates for exterior receptacles around the site at grade level shall be lockable when no plug is inserted.

2.7 FLOOR BOXES AND COVER PLATES

- A. Provide flush, gasketed, architectural metal finish (brass, bronze, aluminum, etc., as selected by the Architect) cover plates for all flush floor devices in public areas similar to Carlon, Thomas & Betts, etc.
- B. Floor boxes shall be metallic and suitable for the application (embedded in concrete, etc.).
- C. All receptacles in flush floor boxes shall be GFCI type with scrub resistant covers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Where more than one flush switch, receptacle, and/or dimmer occurs in the same location, they shall be set in gangs under one common wall plate. Dimmer cooling fins shall not be removed.
- B. Switches and/or dimmers shall be installed in boxes in a uniform position so that the same direction will open and close the circuits throughout the project.
- C. Switches in general shall be installed directly adjacent to the entrance door on the lock side or on the wall directly past the full open position of the door or as detailed.
- D. All wiring devices shall be installed plumb and aligned in the same plane of the wall, floor, or ceiling in which they are mounted.

- E. Provide barriers between adjacent switches and or dimmers where the voltage between conductors exceeds 300 volts.
- F. Furnish and install line voltage switches where indicated on the Drawings for the control of certain circuits.
- G. Furnish and install plug receptacles where indicated on the Drawings.
- H. All receptacles in elevator pits, elevator machine rooms, outdoor air plenums, loading dock areas, locker rooms, toilet rooms, and janitor's closets shall be GFCI type.

3.2 FACTORY TESTING

- A. All wiring devices shall be tested in accordance with the latest applicable industry standards.

3.3 FIELD TESTING

- A. Receptacles shall be tested for polarity.
- B. Light switches shall be operationally tested.
- C. Window washing distribution shall be tested to ensure proper voltage at the roof mounted outlets. Provide full motor load equivalent to the manufacturer's window washing rig motor(s) and verify that the output voltage at the outlet is at the manufacturer's recommended voltage level.
- D. Refer to Section 26 08 00 for additional testing requirements for wiring devices.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all fuses as specified herein and as required for electrical distribution throughout the Project as indicated on and in accordance with the requirements of code and the Contract Documents.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.

- B. The following specification sections apply to all Work herein:

- 1. Section 26 05 00 - Common Work Results for Electrical.
- 2. Section 26 05 06 - Electrical Service.
- 3. Section 26 05 10 - Electrical General.
- 4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- 5. Section 26 05 20 - Heating Cable.
- 6. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- 7. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- 8. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
- 9. Section 26 05 53 - Identification for Electrical Systems.
- 10. Section 26 09 23 - Lighting Control Devices.
- 11. Section 26 22 13 - Low-Voltage Distribution Transformers.
- 12. Section 26 24 13 - Switchboards.
- 13. Section 26 24 16 - Panelboards.
- 14. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
- 15. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
- 16. Section 26 43 00 - Surge protective Device System.

1.3 REFERENCES

- A. All fuses and all components shall be designed, manufactured, and tested in accordance with the latest applicable codes and reference standards, including the following:

- B. Codes:

- 1. IBCNJ - International Building Code New Jersey Edition.
- 2. NEC - National Electrical Code New Jersey Amendments.

- C. Reference Standards:

- 1. UL Standard 248 - Low-Voltage Fuses.
- 2. UL Standard 4248 - Fuse Holders.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:

1. Fuses, including fuse characteristic curves and spare fuse list.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution.
- C. If it complies with the Contract Documents, fuses manufactured by one of the following manufacturers will be acceptable:
1. Cooper/Bussmann.
 2. Farraz-Shawmut.

2.2 RATINGS

- A. Fuses: All fuses shall be suitable for use at 480 volts and 208 volts, or at other voltages as indicated on the Drawings and selected to reduce the available fault current to a value less than the withstand rating of the equipment served and less than the interrupting capacity of the circuit protective device.

2.3 FUSES

- A. All fuses shall be of the same manufacturer and shall be installed under this Section in all equipment furnished and/or installed under any Section of the Specifications and motor controllers using rejection-type fuse clips.
- B. Fused circuits rated 601 amperes and larger shall be Class L fuses protected by time delay current limiting fuses listed by Underwriters Laboratories to interrupt 200,000 amperes unless noted otherwise on drawings. These fuses must hold 5 times rated current for a minimum of 4 seconds and clear 20 times rated current in .015 second or less.
- C. Fused motor circuits serving individual or groups of motors, shall be Class RK-5, protected by dual-element current limiting fuses listed by Underwriters Laboratories to interrupt 200,000 amperes. These fuses must hold 5 times rated current for a minimum of 10 seconds.
- D. Lighting, utility and distribution feeders shall be protected by Class RK-1 protected by dual element, current limiting, fast-acting fuses listed by Underwriters Laboratories to interrupt 200,000 amperes. These fuses must hold 5 times rated current for a minimum of 1 second. Where series rating with downstream circuit breakers is required, the fuses noted in this paragraph may be Class J dual-element time-delay listed by UL to interrupt 200,000 amperes. Fuses must hold 5 times rated load for 10 seconds.
- E. Current limiting fuses with suitable operating characteristics shall be installed in series with individual or groups of circuit breakers when the available fault current exceeds the rating of the breaker and the combination of the fuse and the circuit breakers is UL rated for series operation.
- F. Spare Fuses: Upon acceptance of the electrical distribution system, provide the State with spare fuses and multiple racks to hold same as follows:
 - 1. In each major Switchboard Room, provide three (3) fuses of each type used in the room.
 - 2. In each major Electrical Room, provide three (3) fuses of each type used for motor circuit and distribution on the floor with associated racks.
- G. Submit selective coordination fuse curves as required by Code and as necessary for comparative analysis of the Coordination Study as described in Section 26 05 73.
- H. The fuse manufacturer shall provide fuse characteristic curves of peak demand let-through current versus short circuit current in symmetrical RMS amperes for each fuse size installed on this Project. These characteristic curves shall be submitted as Shop Drawings for the Engineer's review. See Section 26 05 00 for requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. No fuse shall be installed or purchased until the coordination study has determined the exact fusing requirements.
- B. This Contractor shall install all fuses per the manufacturer's recommendations and as indicated on the Drawings.

- C. Replace any fuse(s) with new, where the fuse(s) has opened or been otherwise compromised as a result of construction activities, start-up, testing, commissioning, etc.

3.2 FACTORY TESTING

- A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL Standards.

3.3 FIELD TESTING

- A. Refer to Section 26 08 00 for additional testing requirements for fuses.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all fused and non-fused switches and/or enclosed circuit breakers as specified herein, as required by Code, as indicated on and in accordance with the Contract Documents.
- B. Section includes:
 - 1. Enclosed Switches.
 - 2. Enclosed Circuit Breakers.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 06 - Electrical Service.
 - 3. Section 26 05 07 - Access Doors and Color Coded Identification in General Construction.
 - 4. Section 26 05 10 - Electrical General.
 - 5. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 6. Section 26 05 20 - Heating Cable.
 - 7. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 8. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 9. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 10. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 11. Section 26 05 53 - Identification for Electrical Systems.
 - 12. Section 26 09 23 - Lighting Control Devices.
 - 13. Section 26 22 13 - Low-Voltage Distribution Transformers.
 - 14. Section 26 24 13 - Switchboards.
 - 15. Section 26 24 16 - Panelboards.
 - 16. Section 26 27 26 - Wiring Devices.
 - 17. Section 26 28 13 - Fuses.
 - 18. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.
 - 19. Section 26 43 00 - Surge Protective Device System.
 - 20. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. All enclosed switches, circuit breakers, and all components shall be designed, manufactured, and tested in accordance with the latest applicable codes and reference standards, including the following:
- B. Codes:
 - 1. IBCNJ - International Building Code New Jersey Edition.
 - 2. NEC - National Electrical Code New Jersey Amendments.
- C. Reference Standards:
 - 1. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 volt maximum).
 - 2. UL Standard 50 - Enclosures for Electrical Equipment, Non Emergency Considerations.
 - 3. UL Standard 98 - Enclosed and Dead-Front Switches.
 - 4. UL Standard 489/NEMA AB1 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
 - 5. UL Standard 512 - Fuse Holders.
 - 6. UL Standard 869A - Reference Standard for Service Equipment.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:
 - 1. Enclosed switches and circuit breakers, including dimensions, knockout sizes and locations, NEMA construction, capacity, voltage, etc.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the Division 01 and Section 26 05 00

1.6 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of these Specifications.
- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the

substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution.

- C. If it complies with the Contract Documents, enclosed switches and circuit breakers manufactured by one of the following manufacturers will be acceptable:
1. Eaton/Cutler-Hammer.
 2. General Electric.
 3. Schneider/Square "D".
 4. Siemens Industry Inc.

2.2 GENERAL

- A. All enclosed switches and circuit breakers shall be Type HD (heavy duty) and shall be suitable for use at 480 volts and 208 volts, or at other voltages as indicated on the Drawings. Switches protecting motor feeders shall be "horsepower" rated.
- B. Devices serving hydraulic elevators shall have additional contacts to indicate position and shall be wired to the elevator controller.

2.3 ENCLOSED SWITCHES

- A. All enclosed switches shall have manufacturers' permanent nameplates mounted on the cover that indicate the switch type and ratings.
- B. All enclosed switches shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "ON" position.
- C. All enclosed switches shall have provisions for padlocking in the "OFF" position.
- D. All enclosed switches exposed to the weather or to water damage shall be NEMA Type 3R with approved conduit hubs installed on top of these switches, unless a more stringent rating is shown on the Drawings. NEMA Type 12 enclosures shall be used in all plenum areas.
- E. Disconnect switches shall be fused where required for overcurrent protection and unfused where disconnecting means only is required.
- F. Where current-limiting fuses are specified, rejection-type fuse clips shall be provided to prevent installation of non-current-limiting type fuses.
- G. Non-fused switches shall not be provided with fuse clips.
- H. Switches shall be rated where required for motor circuits. Where fused switches are specified, they shall be provided with fuse clips and shall be UL listed in combination with fuses for the short circuit duty required.
- I. See Section 26 05 19 for termination requirements and space in the enclosure.

2.4 ENCLOSED CIRCUIT BREAKERS

- A. Circuit breakers shall be molded-case type.

- B. All circuit breakers shall be UL listed for application at 100% of designated frame ratings.
- C. Complete system coordination shall be provided by inclusion of the following time/current curve shaping adjustments:
 - Ampere setting
 - Long-time delay
 - Short-time pickup
 - Short-time delay
 - Instantaneous pickup
- D. Changes in setting shall be made by adjustment at the circuit breaker trip module or by interchangeable switching plugs for precise settings. All settings shall be sealable.
- E. All circuit breakers shall be provided with two (2) sets of Form "A" and "B" contacts, wired to a terminal strip in the enclosure for remote breaker status.
- F. Provide one (1) test kit for testing all frame sizes. The test kit shall contain all required appurtenances, including, but not limited to, harnesses, ground fault defeat modules, etc.
- G. Circuit breakers shall have short circuit rating as required in coordination study. Provide fusing as part of the assembly if required to obtain short circuit rating.
- H. See Section 26 05 19 for termination requirements and space in the enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. This Contractor shall install all enclosed switches per the manufacturer's recommendations and as indicated on the Drawings.
- B. A disconnect means shall be provided at each appliance and motor, and at other equipment as required by Code and/or as indicated on the Drawings.
- C. The use of lockout pushbuttons in control circuits of motors shall not be permitted in lieu of the above-specified disconnect means.
- D. Disconnect switches and enclosed circuit breakers shall not be installed on any surface subject to vibration. Suitable rigid support shall be provided as required.
- E. Enclosed circuit breakers shall be provided where indicated and may be used in lieu of enclosed switches where appropriate with Engineer's approval.

3.2 FACTORY TESTING

- A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL Standards.

3.3 FIELD TESTING

- A. Switches and enclosed circuit breakers shall be operationally tested.
- B. Refer to Section 26 08 00 for additional testing requirements for enclosed switches.

END OF SECTION 262816

SECTION 263213 - DIESEL ENGINE-DRIVEN GENERATOR SET

This section is included for this contract to execute the installation and commissioning of the pre-fabricated fire pump house purchased separately. Parts 1 and 2 are for reference only. Part 3 shall be included in this contract.

PART 1 - GENERAL (FOR REFERENCE)

1.1 SUMMARY

- A. Install a complete prime rated diesel engine generator (DEG) set, including all associated automatic controls, monitoring, load banks, output distribution, captive fuel oil storage, acoustic enclosure, and appurtenances for a complete, operational system as specified herein and required for backup of emergency (E) Legally required (LR) and optional standby (OS) systems throughout the project, as indicated on and in accordance with the requirements of the Contract Documents.

1.2 RELATED DOCUMENTS

- A. Refer to Divisions 01, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 06 - Electrical Service.
 - 3. Section 26 05 07 - Access Doors and Color Coded Identification in General Construction.
 - 4. Section 26 05 10 - Electrical General.
 - 5. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 6. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 7. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 8. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 9. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 10. Section 26 05 53 - Identification for Electrical Systems.
 - 11. Section 26 09 23 - Lighting Control Devices.
 - 12. Section 26 22 13 - Low-Voltage Distribution Transformers.
 - 13. Section 26 24 13 - Switchboards.
 - 14. Section 26 24 16 - Panelboards.
 - 15. Section 26 27 26 - Wiring Devices.
 - 16. Section 26 28 13 - Fuses.
 - 17. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 - 18. Section 26 43 00 - Surge Protective Device System.
 - 19. Section 26 51 00 - Interior Lighting.

1.3 REFERENCES

- A. The diesel engine-driven generator set and all components shall be designed, manufactured, installed and tested in accordance with the latest applicable codes and reference standards, including the following:
- B. Codes:
1. NFPA 101 - Life Safety Code.
 2. NFPA 110 - Standard for Emergency and Standby Power Systems.
 3. IBCNJ - International Building Code New Jersey Edition.
 4. NEC - National Electrical Code New Jersey Amendments.
- C. Reference Standards:
1. ANSI.
 2. EGSA - Electrical Generating Systems Association Standards.
 3. IEEE 446 - Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications.
 4. IEEE 493 - Design of Reliable Industrial and Commercial Power Systems.
 5. NEMA MG 1 - Motors and Generators.
 6. NEMA MG 2 - Safety Standards and Guide for Selection, Installation, and Use of Electric Motors and Generators.
 7. UL Standard 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
 8. UL Standard 1236 - Battery Chargers for Charging Engine-Starter Batteries.
 9. UL Standard 2200 - Stationary Engine-Generator Assemblies.

PART 2 - PRODUCTS (FOR REFERENCE)

2.1 GENERAL

- A. The emergency power system, including the diesel driven generator set and ATSS has been “pre-purchased”. Refer to the pre-purchase specifications for information. This contractor will receive handle and install all materials which have been pre-purchased and provide all required labor, additional parts and materials for a complete and fully operational system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install generator where shown on drawings. Provide all wiring, power wiring, remote monitoring wiring and control wiring to systems and ATS's, etc. Provide all rigging, coordination, etc., in accordance with manufacturer's guidelines.
- B. Installation of the emergency power system shall be in full accordance and under the technical supervision of qualified technicians provided by the manufacturer. The initial meeting shall take place within two weeks of the Contract award and shall be attended by both the factory project engineer and Filed Service Technicians. As a minimum, the agenda shall include a technical review of the Specification, exceptions taken, a review of the submissions required, system operation and acceptance test procedures. Subsequent meetings are intended to provide instruction to the installing Contractor as to the proper handling, installation and wiring of the vendor's equipment, as well as a review of the Contractor's questions and installation methods during the installation of the equipment.

- C. The manufacturer shall furnish a minimum of fifteen (15) working days of technical supervision, on-site, for the purpose of overseeing the installation and to conduct and assist the State with the site acceptance test. Participation by the manufacturer shall include providing a final check of all wiring, terminations, connections, and startup, interpretation and analysis of site acceptance test results, adjustments if required of controls, etc., all to the satisfaction of the State.
- D. The DEG manufacturer shall furnish a minimum of ten (10) working days of technical supervision, on-site, for the purpose of assisting the State with commissioning critical systems and the integration of the EPS with these systems. The man-hours provided in this paragraph are in addition to any other requirements previously specified.

3.2 SITE ACCEPTANCE TEST

- A. The complete generator system shall be tested as hereinafter described under the supervision of a capable service engineers provided by the diesel engine-generator manufacturer and the control system manufacturer. (Submit a detailed chronological test plan with the shop drawings.) Prior to any testing, verify that the plant is complete and ready for testing and that all instrumentation required is connected and ready for startup and test. Tests shall be witnessed by the State and/or his representatives. Provide necessary lube oil, fuel oil, as well as testing and recording equipment to obtain full load conditions, including the required temporary load banks, full load and temporary cable connections to generator output switchboard. Testing shall be repeated at no additional cost to the State if required for total components and system acceptance.
- B. The on-site test program shall cover the following as a minimum:
 - 1. Verify that all components are correctly installed and interconnected. Exercise each circuit breaker and its drawout mechanism and each automatic transfer switch.
 - 2. Test the engine protective device and verify the accuracy of instrumentation set points. Provide coordination study for each overcurrent and ground fault device and calibrate same before any tests are performed. Circuit breaker testing shall be provided by a third party Subcontractor using a Primary Injection Method. Coordination study shall be used for all protective device settings.
 - 3. The diesel engine-generator shall be operated individually under full load conditions for a minimum of six (8) hours. The diesel engine-generator set shall maintain rated voltage ± 5 volts and rated frequency ± 0.5 hertz for the duration of the full load test. Voltage, amperage and frequency measurements, as well as engine gauge and monitor points, shall be recorded at 15 minute intervals. All electrical connections shall be thermoscanned at 1-hour intervals.
 - 4. From a "cold" start, operate the diesel engine-generator from 0 to 100 percent load, starting at no load and increasing in increments of 25 percent. Hold at each incremental load for 10 minutes and check at each load point for stable operation, fuel consumption, engine performance, and generator performance. The generator shall be capable of returning to its rated voltage and frequency as described hereinabove with a maximum voltage drop when incremental loads are added. Demonstrate kVA, kVAR and circulating currents are within acceptable limits at each system load step. Report system tests with generator connected to emergency panelboard.

5. Perform load transient tests verifying that kilowatts, voltage, amperes, and frequency transient characteristics are within acceptable limits. The transient tests provided in the factory shall be repeated during this test, and in addition, transient recordings shall be made to specified load steps as a system. Submit oscillograph tracings of all transient tests.
 6. Operate the entire generator-backed power system under a full load test for a minimum of eight (8) hours. The system shall maintain rated voltage ± 5 volts and rated frequency ± 0.5 hertz for the duration of the full load test. Voltage, amperage, and frequency measurements as well as all individual LICP gauge measurements shall be recorded at 10 minute intervals.
 7. The generator shall be capable of attaining rated voltage and frequency within 10 seconds of the initiation of a start signal.
 8. Operate load shedding and bypass system and components to verify suitable operation of automatic transfer switches, and priority panel.
 9. Submit a detailed chronological test plan with shop drawings.
 10. Acoustical readings, taken on all sides, top and bottom, shall verify acoustical performance.
- C. Provide all labor and materials required for on-site testing with dummy load at unity power factor, including but not limited to, the following:
1. The required resistive dummy load banks to achieve system full load conditions.
 2. Temporary connections, copper cable, from generator output switchboards to dummy load, including grounding conductor.
 3. Overcurrent and short circuit protection devices, contactors, relays, etc., for temporary cables, as required.
 4. All instrumentation and connections required to measure and record test data (switchboard mounted instruments are not acceptable). Provide accurate voltage, current, frequency, and kW meters to accomplish this. For each transient or load change, provide oscillograph trace recordings of voltage frequency and current, showing the initiating disturbances, entire restabilization period for each. Record and log all test data and submit to State in a comprehensive test report. Provide ten (10) copies.
 5. Disconnection and removal of all temporary power and control wiring and equipment. (Deinstallation under other Section.)
 6. Ten (10) sets of certified test reports, submitted within two (2) weeks.
- D. Perform a final integrated system test (“pull-the-plug”) to demonstrate the system as a whole, including safeties, etc., to the satisfaction of the State/Engineer. This test shall not be conducted as an extension of the site acceptance test, but rather as a separate test after substantial completion of all other work associated with this project. (Submit a detailed chronological test plan with the shop drawings.)

1. Operate all other features of the control system, including but not limited to: load demand control, main bus overload protection, etc.
 2. This test shall utilize actual building loads and fifteen (15) temporary portable 100 kW load banks (furnished by this Section) to be distributed throughout the facility and temporarily connected to the electrical power distribution system.
- E. Provide complete, chronological, detailed factory, on-site and pull-the-plug test procedures for approval with shop drawings.
- F. A minimum of ten (10) working days notice shall be provided to the State, Architect and Engineer, in writing, before all factory, on-site and pull-the-plug testing.

END OF SECTION 263213

SECTION 264300 - SURGE PROTECTIVE DEVICE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install a complete Surge Protective Device (SPD) system with multiple levels to protect the electrical distribution against high energy transient voltages, including surge current diversion, high-frequency attenuation, and line voltage stabilization in ANSI/IEEE Category A, B, and C and UL 1449 Third Edition throughout the project as indicated on and in accordance with the requirements of the Contract Documents.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 14, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 06 - Electrical Service.
 - 3. Section 26 05 10 - Electrical General.
 - 4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 5. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 6. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 7. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 8. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 9. Section 26 05 53 - Identification for Electrical Systems.
 - 10. Section 26 24 13 - Switchboards.
 - 11. Section 26 24 16 - Panelboards.
 - 12. Section 26 28 13 - Fuses.
 - 13. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
 - 14. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.

1.3 REFERENCES

- A. The SPD system and all components shall be designed, manufactured, tested, and installed in accordance with the latest applicable codes and reference standards, including the following:
- B. Codes:
 - 1. IBCNJ - International Building Code New Jersey Edition.
 - 2. NEC - National Electrical Code New Jersey Amendments.
- C. Reference Standards:
 - 1. ANSI/IEEE C62-41.1 - IEEE Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits.

2. ANSI/IEEE C62-41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits.
3. ANSI/IEEE C62-45 - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits.
4. NEMA LS 1 - Low Voltage Surge Protection Devices.
5. UL Standard 1283 - Standard for Electromagnetic Interference Filters.
6. UL Standard 1449 - Standard for Surge Protective Devices.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:
 1. SPD, filters, fuses and all equipment.
 2. One-line diagram showing distribution equipment and connections.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the Division 01 and Section 26 05 00.

1.6 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution.
- C. If it complies with the Contract Documents, surge protective devices manufactured by one of the following manufacturers will be acceptable:
 1. Eaton Innovative Technology.
 2. General Electric.
 3. Liebert.

4. Thomas & Betts/ Current Technology.

2.2 GENERAL

- A. The system shall provide a high energy power conditioning system incorporating surge suppression and high performance electronic filtering.
- B. The system shall be suitable for 277/480 volt, 3 phase, 4 wire and 120/208 volt, 3 phase, 4 wire operation, with a maximum continuous operating voltage of not less than 125 percent of the nominal operating voltage. The operating frequency range of the SPD shall be between 47 and 63 hertz.
- C. Each SPD's maximum repetitive surge rating shall be based on the ampacity of the protected equipment in accordance with the chart below:

Equipment Ampacity Rating	Surge Current Rating Per Phase
≤ 225 Amps	80,000 Amps
≤ 800 Amps	160,000 Amps
≤ 4000 Amps	300,000 Amps
> 4000 Amps	400,000 Amps

- D. SPD protection shall be provided in all modes. Wye-configured systems shall provide line-to-neutral, line-to-ground, and neutral-to-ground protection. Delta configured systems shall provide line-to-line protection in ungrounded systems and line-to-line and line-to-ground protection in grounded systems.
- E. The system shall have a clamping voltage as defined in the NEMA LSI-1992 procedures. The manufacturer shall provide certified documentation of applicable location category testing, showing compliance with the NEMA Standard.
- F. Devices installed on the line side of service disconnects shall be Type 1 in accordance with UL 1449. Devices installed on the downstream of the service shall be Type 1 or Type 2 in accordance with UL 1449.
- G. Devices installed on service equipment shall have a nominal discharge current rating of 20 kA.
- H. All SPDs shall use solid-state, high performance transient suppressors, using arrays of fused non-linear voltage-dependent metal oxide varistors.
- I. All Type 2 SPDs shall include a high frequency transient filter having a minimum of 40 dB attenuation for a bandwidth between 100 kHz and 100 MHZ. The filter shall be capable of attenuating low level surges, and waveform distortion associated with fast rise-time transients.
- J. Each unit shall include dual transient counters to totalize transient surges in both normal and common modes. The counter shall be provided with a non-volatile memory or integral battery with a ten (10) year minimum life span to retain data in the event of a power failure. The unit shall also include an audible alarm, mute button, and Form "C" contacts for status monitoring at the BATC system.
- K. SPDs shall provide protection status indicators for each phase and surge event counters for each with time and date stamping, PC downloadable via RS-232.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Each device shall be wall-mounted in an enclosure in accordance with the below:
1. NEMA 4 or 12, dependent upon the installation location. If the device is protecting a switchboard, switchgear, or panelboard, at the Contractor's option, the device may be mounted within the enclosure with appropriate Code-required clearances. It is the Contractor's responsibility to address any spatial issues which may arise regarding room layouts from installing the SPD within the panel enclosure.
 2. Mounted as close as practicably possible to the equipment protected.
 3. A fused disconnect with wiring terminations suitable for a minimum of No. 3 AWG copper conductors minimum. The disconnect shall be configured to allow safe testing and maintenance without affecting the load.
 4. The device controls and a test port shall be mounted on the panel enclosure cover to safely verify the integrity of the system operation without exposing the device.
 5. Provide all wiring, conduit, disconnect and overcurrent protection as required to complete the installation in accordance with Code and manufacturer's guidelines.
- B. SPD units shall be provided for each service switchboard, distribution board, and panelboard, and at the locations required by the Contract Documents.

3.2 FACTORY TESTING

- A. All SPD equipment shall be tested in accordance with the latest applicable industry standards and governing Code requirements.

3.3 FIELD TESTING

- A. Verify the proper operation of all SPDs using the manufacturer's approved diagnostic test kit. Verify 0.5 ohms maximum ground continuity to all units.
- B. Refer to Section 26 08 00 for additional testing requirements for surge protective device system.

END OF SECTION 264300

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all lighting fixtures of the type indicated by letter and number at each specified location throughout the project as indicated on and in accordance with the requirements of the Contract Documents.
- B. Section includes:
 - 1. Luminaires.
 - 2. Fluorescent Lighting Fixtures.
 - 3. Fluorescent Ballasts.
 - 4. Fluorescent Emergency Ballasts.
 - 5. Lamps.
 - 6. Fluorescent Lamps.
 - 7. Incandescent and Tungsten Halogen Lamps.
 - 8. Finishes.
 - 9. Reflectors.
 - 10. Stems.
 - 11. Lenses, Louvers, and Diffusers
 - 12. Poles.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 14, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.
- B. The following specification sections apply to all Work herein:
 - 1. Section 26 05 00 - Common Work Results for Electrical.
 - 2. Section 26 05 07 - Access Doors and Color-Coded Identification in General Construction.
 - 3. Section 26 05 10 - Electrical General.
 - 4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 5. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 6. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 7. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 8. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 9. Section 26 05 53 - Identification for Electrical Systems.
 - 10. Section 26 09 23 - Lighting Control Devices.
 - 11. Section 26 22 13 - Low-Voltage Distribution Transformers.
 - 12. Section 26 24 16 - Panelboards.
 - 13. Section 26 27 26 - Wiring Devices.
 - 14. Section 26 28 13 - Fuses.

15. Section 26 32 13.13 - Diesel-Engine-Driven Generator Set.

1.3 REFERENCES

A. All lighting fixtures, and all components shall be designed, manufactured, tested, and installed in accordance with the latest applicable codes and reference standards, including the following:

B. Codes:

1. IBCNJ - International Building Code New Jersey Edition.
2. NEC - National Electrical Code New Jersey Amendments.
3. IECCNJ - International Energy Conservation Code New Jersey Edition.

C. Reference Standards:

1. ANSI/ANSLG C78.81- American National Standard for Electric Lamps – Double-Capped Fluorescent Lamps – Dimensional and Electrical Characteristics.
2. ANSI C78 - American National Standards for Metal Halide Lamps.
3. ANSI C78.375 - American National Standard for Fluorescent Lamps – Guide for Electrical Measurements.
4. ANSI C81.61 - American National Standards for Electric Lamp Bases.
5. ANSI C82.2 - American National Standard for Lamp Ballasts – Method of Measurement of Fluorescent Lamp Ballasts.
6. ANSI C82.4 - American National Standard for Ballasts for High-Intensity Discharge and Low-Pressure (LPS) Lamps (Multiple-Supply Type).
7. ANSI C82.11 - American National Standard for High-Frequency Fluorescent Lamp Ballasts.
8. EISA - Energy Independence and Security Act.
9. EPA TCLP - Toxicity Characteristic Leaching Procedure and Characteristic Wastes (D-Codes).
10. IEEE C62.41 - IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
11. UL Standard 844 - Standard for Luminaires for Use in Hazardous (Classified) Locations.
12. UL Standard 935 - Standard for Fluorescent Lamp Ballasts.
13. UL Standard 1029 - Standard for High-Intensity-Discharge Lamp Ballasts.
14. UL Standard 1574 - Standard for Track Lighting Systems.
15. UL Standard 1598 - Standard for Safety of Luminaires.
16. UL Standard 1838 - Standard for Low Voltage Landscape Lighting Systems.
17. UL Standard 2108 - Standard for Low Voltage Lighting Systems.
18. UL Standard 8750 - Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Construction Contract, Division 01 and Section 26 05 00 and shall include, but not be limited to:
1. Shop drawings must clearly indicate the Contract Drawing number of fixture details used as reference in the development of the shop drawings and the names of the job, Architect and Lighting Designer. Provide all full-scale shop drawings in reproducible form. Fixture cuts to be provided in legible reproduction or original, no fax materials will be reviewed.
 2. Submit dimensioned drawings of lighting fixtures. Submit fixture shop drawings assembled in order of luminaire "type" designation with proposed fixture and accessories clearly indicated on each sheet. Shop drawings must be submitted for review before fabrication. Fabrication details may vary slightly from those shown on drawings provided those changes do not adversely affect ease of installation, durability, performance, or appearance of fixture.
 3. Shop drawings shall not vary from the general arrangement and detail shown on drawings, unless the change suits a condition on the actual premises. Changes must be shown clearly on drawings to be submitted for approval.
 4. Catalog cuts lacking sufficient detail to indicate compliance with Contract Documents will not be acceptable.
 5. Shop drawings of lighting fixtures must be submitted within sixty (60) days after award of Contract.
 6. "Pre-Approved" specification status does not and shall not exempt the identified manufacturers from full and complete compliance with all criteria identified either in the Specifications or as attributed to "prime specification" equipment with regards to photometric performance, brightness control, size, finishes, etc. Consideration, acceptance or rejection of any proposed submittal at any time shall rest solely upon the joint evaluation of the Engineer and the Architect for those areas within the project scope.
 7. All fixtures, after the initial approval process, that are submitted as substitutes or have been disapproved or approved with comments pending shall be resubmitted within a two-week time period after Contractor receipt of initial submission. If said comments have not been complied with, Contractor shall resubmit original specified manufacturer.
 8. Where indicated on fixture schedule and Contract Drawings, supply complete photometric data for the fixture, including optical performance as measured by an independent testing laboratory according to methods of the Illuminating Engineering Society of North America:
 - a. Coefficients of utilization.
 - b. Visual comfort probability:
 - 1) 80% ceiling.

- 2) 50% walls.
 - 3) 20% floor.
 - c. Zonal lumens stated numerically in 10 degree increments.
 - d. Luminance table with data presented numerically, showing maximum luminance of the fixture at the shielding angles. Readings should be taken both crosswise and lengthwise in the case of fluorescent fixtures or fixtures with asymmetric distribution.
 - e. Candela distribution data, presented graphically and numerically in no more than 5 degree increments (5, 10, 15, etc.). Data developed for up and down quadrants normal, parallel and at 22.5, 167.5 degrees to fixture axis if light output is asymmetric.
 - f. Provide fixture-operating efficiencies.
 - g. Provide spacing criteria.
 9. Provide photometric data from an independent testing laboratory for any fixtures offered as substitutes for a specified fixture.
 10. For all area luminaires, provide isocandela charts and coefficients of utilization.
 11. For each type of fixture, supplying lighting manufacturers shall provide a maintenance manual listing: any tools required, types of cleaners to be used, replacement part listing, final "as-built" shop drawing.
 12. Lamps, complete with base or pin configuration, lumen rating, life expectancy, color temperature, starting characteristics, etc.
 13. Submit catalog number/cut sheet for all lamps for every fixture type.
 14. Submit catalog number/cut sheet for all transformers, ballasts, and power source for every fixture type.
- 1.5 SAMPLES
- A. Samples, if requested, must be complete with lamps, readied with a 6-foot power cord, 120 volt operation as needed for proper evaluation/examination. Complete sample must be actual working unit.
 - B. All samples shall be shipped prepaid to Architect or Engineer, or as otherwise noted.
 - C. None of the samples received are returnable, nor shall they be included in the quantities listed for the project.
 - D. Provide new samples or modifications to samples for on-site mock-ups.
 - E. Submit color finish samples for approval by Architect as requested by Architect.

1.6 EXTRA MATERIALS (SPARES)

- A. Furnish extra materials described below that match products installed and that are packages with protective covering for storage and identified with labels describing contents
1. Lamps: 10 lamps for every 100 (10%) of each type and rating installed. Furnish at least one (1) of each type.
 2. Plastic Diffusers and Lenses: 5 for every 100 (5%) of each type installed. Furnish at least one (1) of each type.
 3. Ballasts: 5 for every 100 (5%) of each type and rating installed. Furnish at least one (1) of each type.
 4. Globes and Guards: 5 for every 100 (5%) of each type installed. Furnish at least one (1) of each type.
 5. Parabolic Louvers and Reflector Cones: 5 for every 100 (5%) of each type installed. Furnish at least one (1) of each type.
 6. Custom Luminaires: If not otherwise clarified in Part 4 of this Specification, provide 5% spare diffusers or lenses (glass, acrylic, fabric panels, or any specialty material) for custom luminaires. If requested, provide complete fixture as attic stock, in quantities as specified by State.
 7. Non-field-serviceable Fixtures: If a specified luminaire has a return-to-factory warranty only, provide 2% spare fixtures as attic stock. Furnish at least one (1) of each type.

1.7 MOCK-UPS

- A. The specific design requirements of certain building conditions will mandate the necessity of full-scale on site mock-ups prior to final authorization (release) to fabricate. The Contractor shall include, as part of his bid, provision for complete mock-ups of the following conditions:
1. Type and quantity of fixtures, to be determined by the Architect.
 2. Participants at mock-up (Architect, Lighting Consultant, State's representative) shall be given a minimum of one (1) week's notice prior to attendance.
- B. Mock-ups are intended as evaluation tools and should not be construed as part of the permanent installation. Contractor shall provide drawings outlining the scope of the mock-up for approval before proceeding with any aspect of procurement or fabrication.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of the Division 01 and Section 26 05 00

1.9 WARRANTY

- A. Comply with the requirements of the Division 01 and Section 22 05 00.

- B. During the warranty period, the Contractor shall guarantee the following in a form satisfactory to the State:
 - 1. The fixtures shall operate without malfunction.
 - 2. All lamps shall be warranted for their full rated life (see "Lamps").
 - 3. All ballasts shall carry a minimum five (5) year warranty for electronic, three (3) year warranty for magnetic or hybrid (see "Ballasts").
 - 4. All lighting fixtures (unless noted otherwise) and accessories shall carry a minimum one (1) year warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents..
- B. All substitutions must be identified in the Base Bid as a voluntary DEDUCT alternate, and must be accompanied by a letter of equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the contract documents will be revised to reflect the substitution.
- C. If it complies with the Contract Documents, lighting fixtures manufactured by one of the manufacturers listed in Part 4 with the appropriate fixture type will be acceptable.
- D. If it complies with the Contract Documents, lighting fixtures accessory equipment manufactured by one of the following manufacturers, or an approved equal, will be acceptable:
 - 1. Electronic Ballasts
 - a. Advance.
 - b. Osram/Sylvania.
 - c. Universal.
 - 2. Fluorescent Dimming Ballasts
 - a. Advance.
 - b. Lutron.
 - c. Universal.

3. Fluorescent Emergency Ballasts –
1 or 2 lamp, 4P, 13 to 42 watt PL-C and PLT
 - a. Bodine (B84CG).
 - b. Emergilite.
 - c. Iota.
4. Fluorescent Emergency Ballasts –
1 or 2 lamp 27 to 50 watt Biax or 2D
 - a. Bodine (B50).
 - b. Emergilite.
 - c. Iota.
5. Fluorescent Emergency Ballasts –
1 or 2 lamp 2 ft. to 4 ft. U-lamp or linear T8
 - a. Bodine (B50).
 - b. Emergilite.
 - c. Iota.
6. Fluorescent Emergency Ballasts – 1 lamp linear T5, T5HO
 - a. Bodine (LP600).
 - b. Emergilite.
 - c. Iota.
7. Incandescent Emergency Remote Batteries
 - a. Bodine (Eli-250-SD).
 - b. Emergilite.
 - c. Iota.
8. Lamps
 - a. Agilent (LED's only).
 - b. Cree (LED's only).
 - c. General Electric.
 - d. LumiLEDS (LED's only).

- e. Nichia (LED's only).
 - f. Osram/Sylvania.
 - g. Phillips.
 - h. Ushio (Low-Voltage only).
 - i. Venture (HID only).
9. Low-Voltage Emergency Remote Batteries
- a. Atlite (LVR).
 - b. Bodine.
 - c. Encore.

2.2 LUMINAIRES

- A. A UL listing shall be provided for each fixture type and labels shall be affixed to each fixture in a position concealing it from normal view. All equipment shall be listed and approved for use in New Jersey.
- B. Lighting fixtures shall be of rigid construction, dimensionally stable, and shall be assembled with secure fastenings. Ferrous parts shall be protected from corrosion by plating or shall be finished with high reflectance enamel with non-yellowing binder and high pigment-to-binder ratio, with matte finish. Ferrous parts shall be prepared for finish by industry-standard finishing process (see "Finishes").
- C. Provide each fixture with lamps as indicated in the lighting fixture schedule. Where or if lamp types, wattages or distributions are not indicated, contact the Architect for clarification.
- D. Hinged door closure frames shall operate smoothly without binding. Fabricate frames to allow lamp installation/removal without tools. Hinge mechanisms shall be so designed as to preclude accidental falling of hinged door closure frames during relamping operations and while secured in operating position.
- E. Recessed lighting fixtures and lighting track systems shall be suspended from structural members or ceiling structure members of minimum 1-1/2 inch channels, by standard bar hangers, or other approved means. Fixture locations shall be coordinated with ceiling patterns. Refer to architectural reflected ceiling plan for exact location of fixtures and architectural room finish schedule for ceiling construction details and mounting heights. Provide structural steel as required to properly support the fixtures.
- F. Fixture wiring shall be suitable for the temperature rating of the fixture; wiring through fluorescent channels shall be done with Type SFF2 wire. Where a junction box is required to change from branch circuit to fixture wiring, use approved feed through pre-wired fixture wiring and install a separate junction box. The junction box shall be fully accessible after installation of covering materials. Where flexible conduit or portable cord is used, a grounding

jumper shall be installed; all fixtures shall be grounded. Housings shall be so constructed that all electrical components are easily accessible and replaceable without removing fixtures from their mountings, or disassembly of adjacent construction.

- G. All recessed, pendant and surface-mounted lighting fixtures, unless otherwise noted or directed, shall be UL listed for through-wiring and shall be furnished complete with all required integral wiring and all required flexible conditions, pigtailed and related accessories necessary for suitable operation and installation.
- H. All recessed fixtures that are to be installed in insulated ceilings shall be provided with UL listed thermocouple protection.
- I. All materials, accessories, and other related fixture parts shall be new and free from defects which in any manner may impair their character, appearance, strength, durability and function, and be effectively protected from any damage or injury from the time of fabrication to the time of delivery and until final acceptance of the work by the State.
- J. Enclosures: Fabricate fixture enclosures with a minimum No. 20 gauge (0.0359 inch) thick cold rolled sheet steel. Enclosures may be constructed of other metals, provided they are equivalent in mechanical strength, durability, compliance with local Codes and acceptable for the purpose.
- K. Sheet Metal Work: All sheet metal work shall be free from tool marks and dents, and shall have accurate angles bent as sharp as compatible with the gauges of the required metal. All intersections and joints shall be formed true of adequate strength and structural rigidity to prevent any distortion after assembly.
- L. Castings: All aluminum, iron or composite castings shall be exact replicas of the approved patterns and shall be free of sand pits, blemishes, scales and rust, and shall be smoothly finished. Tolerance shall be provided for any shrinkage of the metal castings in order that the finished castings will accurately fit in their designated locations.
- M. Mounting Frames and Rings: If ceiling system requires, each recessed and semi-recessed fixture shall be furnished with a mounting frame or ring compatible with the ceiling in which they are to be installed. The frames and rings shall be one piece or constructed with electrically welded butt joints and of sufficient size and strength to sustain the weight of the fixture.
- N. Yokes, brackets and supplementary supporting members needed to mount lighting fixtures to carrier channels, suitable ceiling members or other structure shall be furnished and installed by the Contractor.
- O. For steel and aluminum fixtures all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel fixtures, all hardware shall be stainless steel. For bronze fixtures, all hardware shall be stainless steel or bronze.
- P. Welding shall be in accordance with recommendations of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surfaces will be free of imperfections such as pits, runs, splatter, cracks, warping, dimpling, depressions or other forms

of distortion or discoloration. All welded surfaces shall be free of weld splatter and welding oxides.

- Q. Extruded aluminum frame and trim shall be rigid and manufactured from quality aluminum without blemish or warpage in the installed product. Miter cuts shall be accurate. Joints shall be flush and without burrs. Cuts shall maintain alignment with the light fixture located in its final position.
- R. All extruded aluminum fixtures shall be fabricated of 6063 alloy (min. wall thickness .110 in.) and in all cases shall be provided with heavy gauge internal alignment brackets in order to assure clean level and continuous appearance after installation. Unless otherwise noted, all end plates shall be continuously welded, filled and ground so as to present a clean, seamless and monolithic appearance. Exposed fasteners on end plates shall be absolutely prohibited. Overlap detail end plates shall not be acceptable.
- S. Lampholders shall be suitable to operate the specified lamp as called for within each fixture type. Sockets shall be positioned such that the lamp is optically centered with respect to fixture operating efficiency and control of glare. Lampholders shall be compliant with the requirements of ANSI.
- T. All fixtures shall be equipped with integral power cut-off switch within
- U. Exit Signs: Exit signs to have a power draw of no more than 5 watts per face. All exit signs to be provided with a sticker or certificate showing power draw allowance.
- V. Exit Sign Letter Height: Exit sign letters to be 6 in. high U.O.N. Refer to Architectural Code compliance drawings or egress drawings for paths of egress.
- W. Maximum Wattage Restriction Sticker: All light fixtures that contain a ballast, transformer, or power supply source that is capable of supplying a greater wattage than the specified lamp shall contain a sticker stating that the maximum installed wattage is that of the specified lamp.

2.3 FLUORESCENT LIGHTING FIXTURES

- A. General Construction and Materials: Housing end plates, socket bridges, reflectors, wiring channels and ballast covers shall be die-formed of not less than No. 20 gauge (0.0359 inch thick) cold rolled steel unless specified otherwise. Construct fixtures so that ballast may be serviced or replaced without removal of fixture housing.
- B. Lampholders shall be heavy white thermoset urea plastic with definite locking-in feature and silver-plated contacts for proper lamp operation and life. Outdoor lampholders shall be neoprene gasketed and compression type. Sockets with open circuit voltage over 300 volts shall be safety type and designed to open supply circuit on lamp removal. All fluorescent lamp holders shall be UL listed devices.
- C. Mount lamps on rapid-start and instant-start circuits within one inch of grounded metal, minimum one inch wide, as long as lamp.
- D. Electromagnetic Interference Filters: Provide electromagnetic interference filters in fluorescent fixtures where indicated. Filters shall be integral to the fixture assembly, one (1) filter per ballast, and shall suppress electromagnetic interference as required by MIL-STD-461,

“Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference.”

- E. All fixtures supplied with ballasts that can be service in place shall be equipped with a means of disconnect.

2.4 FLUORESCENT BALLASTS

- A. Provide fixtures labeled and certified by Electrical Testing Laboratories (ETL), unless the lamps are of unusual types for which “certified” ballasts are not available commercially. Ballasts shall be high power factor type, designed to operate on the voltage system to which they are connected. Ballasts shall be Class P with sound ratings “A” unless otherwise noted. Fixtures and ballasts shall be designed and constructed to limit the ballast case temperature to 90°C when installed in an ambient temperature of 40°C.
- B. Ballasts shall be designed for input voltage of circuits to which they are connected. Fluorescent ballasts shall be “P” protected rated by UL. Submit for each type of fixture used in the project certification that the fixture has been tested, equipped and mounted as it is to be finally installed in the project and found to operate satisfactorily and as specified, including complete absence of cyclical operation of the ballast protector for the installation method, mounting, location, and environmental conditions which the fixture is to be used in this project. Maintain the conditions required by the manufacturer for proper operation throughout the construction period. The permanent installation shall conform to the Drawings and Specifications and the conditions required by the fixture manufacturer for proper operation of ballast, fixture and lamp.
- C. Low Temperature Ballasts: Where indicated, provide fluorescent ballasts having a minimum starting temperature of minus 20°F, in fixtures located where ambient temperature may fall below 50°F.
- D. Solid-State Electronic Ballasts: Provide energy-efficient solid-state electronic ballasts. The ballasts shall be designed to operate at an input frequency of 60 Hz and shall invert the low frequency to a high frequency (20 kHz - 60 kHz) and apply this to the lamps, which shall operate without visible flicker. Ballast shall be designed to exclusively operate specific lamp type (i.e., I-32 watt T8 rapid start lamps).
 - 1. Ballasts shall be non-PCB and RFI limited.
 - 2. Ballasts shall have high power factor/minimum 95 percent, UL listed for Class P, sound rated A, Type I outdoor.
 - 3. Ballast shall be high frequency (20 kHz or greater) and operate without visually detectable flicker (stroboscopic effect).
 - 4. Ballast case operating temperature shall not exceed 35°C temperature rise.
 - 5. Ballast shall have a 5-year written warranty from date of installation against mechanical or electrical defects under normal conditions of use.
 - 6. Electronic ballast shall have a crest factor of no more than 1.7 and a minimum ballast factor of .88.

7. Electronic ballast manufacturer shall certify to have been manufacturing ballasts for no less than ten (10) years prior to submission of data and shall along with their bid submit evidence of successful past installations of similar scale and scope.
8. Upon request, the Contractor shall submit for review by the Engineer definitive independent laboratory (ETL or other) "bench" test data regarding performance of ballasts.
9. Efficacy: Ballast shall meet minimum efficacy standards of Public Law No. 100-357 (1988).
10. Harmonic Distortion: Ballast shall not generate total harmonics (THD) in excess of 20%. Test shall demonstrate performance using specified number and type of lamps.
11. Electromagnetic Interference: Ballast shall comply with No. 18, Part "C" of the FCC Federal Commission Rules and Regulations.
12. Ballast shall be short circuit protected.
13. Line Transient Protection: Ballast shall be designed to withstand line transients.
14. All 265 mA T-8 electronic ballasts shall be parallel instant or programmed start.
15. Reduced current ballasts are not acceptable, unless indicated for a specific application.
16. Interrupt Circuit: Ballast for compact fluorescent lamps shall be electronic, have "flicker free" soft start high power factor (HPF), be encased and have an "A" sound rating, unless specified otherwise. All ballasts shall have a relay power interrupt protection for sensing lamp failure where available. Power disconnect shall occur during relamping mode and lamp failure, to ensure proper life of lamp, ballast and socket rating.
17. All remote ballasts shall be mounted in approved NEMA type enclosures and only located in areas deemed to be readily accessible by maintenance personnel.

2.5 FLUORESCENT EMERGENCY BALLASTS

- A. All fixtures as noted and indicated on the Electrical Drawings and with the designation "EM/BP" or "EM/NL/BP" shall be equipped with an emergency battery ballast, to provide illumination during emergency operation for a minimum of at least 90 minutes. Battery ballast shall be integral to the fixture, shall be field replaceable, and use a nickel-cadmium source. All battery packs to have a minimum five-year warranty. Each fixture shall have an integral test switch and charging indicator light (located within the reflector or in an accessible remote location). Provide sufficient wiring if necessary. Manufacturer shall confirm. Contractor shall provide drawing indicating alternate emergency layout upon substitution of specified manufacturer. Alternate layout to provide "double" the quantity of emergency units as originally designed, exact quantity to depend upon architectural layout. Light output shall be as follows:
 1. Single- or double-lamped fluorescent 2 ft. 0 in. through 4 ft. 0 in. U-lamp or linear T8 fixtures:

- a. Minimum of 1100 to 1400 lumens.
 - b. Total emergency lumen output to be distributed over both lamps in a two-lamp fixture.
2. Single- or double-lamped fluorescent 2 ft. 0 in. through 4 ft. 0 in. U-lamp or linear T5 fixtures:
 - a. Minimum of 650 to 1250 lumens.
 - b. Total emergency lumen output to be distributed over one lamp in a two-lamp fixture.
 3. Single- or double-lamped fluorescent 27 through 50 watt Biax or 2D lamped fixtures:
 - a. Minimum of 900 to 1100 lumens.
 - b. Total emergency lumen output to be distributed over both lamps in a two-lamp fixture.
 4. One- or two-lamp, 4-pin, 13 to 42 watt PL-C and PLT fluorescent lamped fixtures:
 - a. Minimum of 700 to 1250 lumens.
 - b. Total emergency lumen output to be distributed over both lamps in a two-lamp fixture.
- B. When located in fully sealed, enclosed and gasketed fixtures, provide equivalent ballast(s) from manufacturer's damp location series, UL listed for use in enclosed luminaries.

2.6 LAMPS

- A. The Contractor shall provide all lamps as called out in the lighting fixture schedule or Specifications, and, upon request, shall provide a schedule of lamps which are being proposed for use on the project.
- B. All linear fluorescent, compact fluorescent, and high intensity discharge lamps shall be in compliance with EPA Toxicity Characteristic Leaching Procedure and Characteristic Wastes (TCLP).

2.7 FLUORESCENT LAMPS

- A. Fluorescent lamps shall be of the specified wattage, voltage and lumen output with a rated average life of not less than 20,000 hours (linear fluorescent) and 10,000 hours (compact fluorescent) as indicated in the fixture schedule. Lumen output at 30% rated life shall not be less than 80% of initial output. Contractor shall replace any lamps failing during the first 200 days of burning after final written acceptance by the State.
- B. Fluorescent: T5, T8 Lamps: Unless otherwise indicated or authorized, all linear fluorescent lamps for use on this project shall be typical 2, 3, 4, or 5 ft. 0 in. medium bi-pin base and contact, 265 mA, 3500 K, triphosphor type (only) suitable for operation at 277 or 120 volts/60

Hz with a minimum CRI of 85 or greater. Lamps shall be operated on solid-state electronic ballast (20 MHz) ballasts with an operating current of 265 MLA as indicated.

C. Fluorescent (Compact)

1. Unless otherwise indicated or authorized, all compact PL (TT5) fluorescent, circular or Biax lamps for use on this project shall be 9 through 55 watt/type bipin or biaxial base, 3500 K with a minimum CRI of 82. Lamps shall be TCLP compliant, low mercury emission. Where "PLT" or "Quad" base configuration lamps are used, lamps are to have a 4-pin base and utilize "cut-out" diode technology.
2. Compact Retrofit Lamps: Exact lamp type shall be decided in field and ballast shall be electronic, meeting all appropriate ballast standards. Each unit shall be theft-resistant with a min. 2 year warranty.

2.8 INCANDESCENT AND TUNGSTEN HALOGEN LAMPS

- A. Incandescent and tungsten halogen lamps shall be of the specified wattage, voltage and lumen output as identified in the fixture schedule with a rated average life minimum of 2000 hours as indicated in the fixture schedule for "PAR" lamps; 4000 hours for "PAR" Q and quartz line lamps.
- B. After final written acceptance by the State, Contractor shall replace any lamps failing during the first sixty (60) days of operation. Lamps to be rated at 120 volt for line voltage, 12 volt for low voltage, unless otherwise indicated.

2.9 FINISHES

- A. Painted surfaces shall be synthetic enamel with acrylic, alkyd, epoxy, polyester or polyurethane base, light-stabilized, baked on at 350°F minimum, catalytically or photochemically polymerized after application.
- B. White Finishes: Minimum 85% reflectance (semi-gloss).
- C. Selection: Unless otherwise noted, external fixture finishes shall be as selected by the Architect.
- D. Undercoat: Except for stainless steel, all ferrous metal surfaces shall be given a five-stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.
- E. Unpainted non-reflecting surfaces shall be satin finished and coated with a baked-on clear lacquer to preserve the finish. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.
- F. Unpainted Aluminum Surfaces: Finish interior aluminum trims with an anodized coating of not less than 7 mg per square inch of a color and surface finish as selected by the Architect. Finish exterior aluminum and aluminum trims with an anodized coating of not less than 35 mg per square inch of a color and surface finish as selected by the Architect.

2.10 REFLECTORS

- A. Reflectors, cones or baffles shall be absolutely free of spinning lines, stains, ripples or any marks or indentations caused by riveting to other assembly techniques. No rivets, springs or other hardware shall be visible after installation.
- B. Downlight reflectors shall provide minimum 45 degree lamp and lamp image cut-off unless otherwise specified.
- C. Cone flanges shall be formed as an integral part of the cone and shall have identical color and finish as the cone, except as shown. The flange's major surface shall be perpendicular to the cone axis.
- D. The reflecting surface of the cone or reflector shall be tested for proper sealing. Test per ASTM B136-63T. If any stain is visible, the specimen shall not be considered to have been properly sealed. Reflector cones shall be free of manufactured defects. The reflector inner surface shall be free of water spotting and shall maintain a reflectivity ratio of not less than 95% satin specular finish, 90% for all "white" finished internal reflectors.
- E. All Alzak parabolic cones shall be guaranteed by the manufacturer against discoloration for a minimum of ten (10) years and in the event of premature discoloration shall be replaced by the manufacturer (including both materials and the cost of labor) at no cost to the State.
- F. Where modification of standard fixtures are specified, fixtures shall be modified as required with lamp sockets positioned to provide desired photometric performance.
- G. Where or if a "specular black Alzak finish" is specified, high-gloss baked black enamel applied to the reflector shall be considered as acceptable alternate.
- H. Specular and semi-specular clear Alzak reflector cones and parabolic louvers specified with the use of compact fluorescent lamps or triphosphor fluorescent shall be provided with clear non-iridescent coating.

2.11 STEMS

- A. Each stem shall have a brass or steel swivel, hang straight, or be provided with other self-aligning device or design/construction, where required.
- B. Stems shall be made of woven aircraft cable, with minimum 18 in. field adjustability.
- C. Wherever a fixture or its hanger canopy is applied to a surface-mounted outlet box, a finishing ring shall be utilized to conceal the box. Maximum canopy depth shall be 1/8 in. See fixture details/specifications for canopy design.
- D. All power feeds shall be via ST rated cord with a silver polyester mesh "jacket".
- E. Cables shall at the completion of installation and all other work be free of clamp marks, scratches and all other visual imperfections.
- F. Unless otherwise indicated, cables shall be provided in order to adequately mount and level each fixture run with proper structural support per manufacturer's recommendations.

- G. Pendant Fixtures: Install pendant lighting fixtures plumb and at a height from the floor as specified on the drawings. In cases where conditions make this impractical, refer to the Architect for direction. Use ball aligners and canopies on pendant fixtures unless otherwise noted.
- H. Pendants shall be equally spaced along every fixture run. If field conditions or fixture construction does not allow for this condition, immediately notify the Architect.

2.12 LENSES, LOUVERS, AND DIFFUSERS

- A. Lenses/Louvers: General: All lenses, diffusers and shielding media shall be properly and securely mounted within fixture assemblies. Lay-in type lenses and louvers shall not be acceptable. All shielding materials shall be tightly fitted with no loose panels or parts and shall show no visible leaks of unintentional or unscheduled light.
- B. Lenses (Plastic)
 - 1. Unless otherwise indicated or otherwise authorized, all plastic shielding, lenses and diffusers shall be white opal clear 100% UV stabilized virgin acrylic or in special cases high impact polycarbonate (lexan). Use of polycarbonate lenses shall be restricted to those areas outlined in the NEC. Use of polystyrene components is absolutely prohibited.
 - 2. Plastic for lenses and diffusers shall be formed of colorless 100% virgin acrylic as manufactured by Rohm & Haas, DuPont, or preapproved equal. The quality of the raw material must meet American Society of Testing Materials (ASTM) standards, as tested by an independent test laboratory. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified and shall remain free of any dimensional instability, discoloration, embrittlement or loss of light transmittance for at least fifteen (15) years.
- C. Lenses (Glass)
 - 1. Unless otherwise indicated or authorized all glass shielding, diffusers or lenses shall be clear tempered borosilicate glass. Soda lime glass material shall not be acceptable. Submit samples of glass elements upon request.
 - 2. Glass used for lenses, refractors and diffusers in incandescent and tungsten halogen lighting fixtures shall be tempered for high impact and heat resistance; the glass shall be crystal clear in quality with a transmittance of not less than 92%. For exterior fixtures, use tempered borosilicate glass, Corning No. 774-0 or equal.
 - 3. Where optical lenses are used, they shall be free from spherical or chromatic aberrations and other imperfections which may hinder the functional performance of the lenses.
 - 4. Mechanical: All lenses, louvers or other light diffusing elements shall be removable but positively held so that hinging or other normal motion will not cause them to drop out.

2.13 POLES

- A. Wind-load strength shall be adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 100 mph with a gust factor of 1.3. For

pole strength analysis, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection.

- B. Luminaire Attachment: Structural supports to comply with luminaire mounting requirements.
- C. Finish: Unless otherwise noted, match finish of pole, base cover and luminaire. Manufacturer's standard finish shall consist of electrostatically applied, thermally cured TGIC (triglycidic isocyanurate) polyester powder coat paint.
- D. Mountings, Fasteners and Appurtenances: Corrosion-resistant items shall be compatible with support components.
 - 1. Materials shall not cause galvanic action at contact points.
 - 2. Orientation of mountings shall correctly position luminaire attachment to provide indicated light distribution.
 - 3. Anchor bolts, leveling nuts, bolt caps and washers shall be hot-dipped galvanized after fabrication unless stainless steel items are indicated. Anchor bolt template shall be provided in either plywood or steel.
- E. Power-installed screw foundations shall be factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M, and shall be hot-dip galvanized according to ASTM A 123/A 123M, and shall have strength, mounting bolt and top-plate dimensions required to support pole, luminaire and accessories.
- F. Aluminum poles shall be seamless extruded structural tube complying with ASTM B 429, 6063-T6 alloy with access hand hole in pole wall. Cast base covers shall be of same material and color as pole. Grounded and bonding lugs shall be welded 1/2 in. threaded, and shall be listed for attaching grounding and bonding conductors of type and size specified, and shall be accessible through hand hole.
- G. Anchor bolt templates shall be keyed to specific poles and certified by pole manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furnish and install lighting fixtures as noted on the drawings. Fixtures shall be completely wired and lamps installed and shall be in perfect operating condition at the time of completion.
- B. Setting and Securing: Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved shop drawings.
- C. Mounting: Mounting heights specified or indicated are to bottom of fixture for suspended and ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before installation is commenced and, where applicable, after coordinating with the type, style, and pattern of the ceiling system being installed.

- D. Coordination: The Installing Contractor shall coordinate with other trades as necessary to properly interface installation of lighting fixtures with other work. All fixture lengths whether straight or curvilinear shall be fabricated based upon the fixture manufacturer's or Contractor's field verified dimensions only. Contractor shall coordinate conduit entry locations with fixture manufacturer.
- E. Grounding: Ground non-current-carrying parts of electrical equipment. Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.
- F. Installation of lighting fixtures shall be in strict accordance with the intent of the Contract Drawings, and approved shop drawings.
- G. Fixture Locations: Do not scale electrical drawings for exact location of the lighting fixtures. In general, the architectural reflected ceiling plans indicate the proper locations of lighting fixtures.
- H. Coves: Where indicated, all uplight or wallwash coves utilizing fluorescent equipment shall be installed so as to produce a continuous and unbroken band of light free of visual imperfections, socket shadows, light gaps, etc., from end to end of cove. The inability to provide this appearance shall be brought immediately to the Architect's attention prior to installation.
- I. Provide hangers, rods, mounting brackets, supports, frames, earthquake clips and other equipment normally required for the proper, safe and distortion-free installation in the various surfaces in which they appear. Determine surface types from the architectural drawings.
- J. Instructions: Each lighting fixture shall be packaged with complete illustration and instructions showing how to install. Install lighting fixtures in strict conformance with manufacturer's recommendations and instructions.
- K. Rigidly align continuous rows of lighting fixtures for true aligned appearance.
- L. Mechanical Rooms: Lighting fixture locations in Mechanical and Electrical Equipment Rooms are approximate. Coordinate mounting height and location of lighting fixtures to clear mechanical, electrical and plumbing equipment and to illuminate adequately meters, gauges and equipment.
- M. Support all lighting fixtures independently of ductwork or piping.
- N. Splices in internal wiring shall be made with approved insulated "wire nut" type mechanical connectors, suitable for the temperature and voltage conditions to which they are subjected.
- O. All wire utilized for connections to or between individual lamp sockets and lamp auxiliaries (i.e., wires which do not constitute "through circuit" wiring) shall be suitable for temperature, current, and voltage conditions to which it is subjected.
- P. Install reflector cones, baffles, aperture plates, light controlling elements for air handling fixtures and decorative elements after completion of ceiling tiles, painting and general cleanup.
- Q. Replace blemished, damaged or unsatisfactory fixtures as directed by the State.

- R. Provide information/description to the General Contractor to coordinate architectural existing ceiling pendent locations with description for existing J-box/canopy conditions.
- S. Protection: Protect installed fixtures from damage during remainder of construction period.
- T. Tests: Upon completion of installation of lighting fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

3.2 AIMING AND ADJUSTMENT

- A. All adjustable lighting units shall be aimed, focused, locked, etc., by the Contractor under the supervision of the Architect or Engineer. The Architect or Engineer shall indicate the number of crews (foreman and apprentice) required. All aiming and adjusting shall be carried out after the entire installation is complete. All ladders, scaffolds, mechanized lifts, etc., required shall be furnished by the Contractor at the direction of the Architect or Engineer. As aiming and adjusting is completed, locking set screw, bolts and nuts shall be tightened securely.
- B. Night Work: Where possible, units shall be focused during the normal working day. However, where daylight interferes with visual acuity, aiming shall be accomplished at night.

3.3 ERECTION OF POLES

- A. Set reinforcement for anchor bolts, nuts, and washers according to anchor-bolt templates furnished by pole manufacturer. For concrete finish, trowel and rub smooth.
- B. Install poles as follows:
 - 1. Use web fabric slings (not chain or cable) to raise and set poles.
 - 2. Mount pole to foundation with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 - 3. Secure poles level, plumb, and square.
 - 4. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 5. Use a short piece of 1/2-inch (13-mm) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- C. Ground metal poles/support structures as follows:
 - 1. Install grounding electrode for each pole.
 - 2. Nonmetallic Poles: Ground metallic components of pole accessories and foundations.
 - 3. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

D. Corrosion Prevention

1. Aluminum: Do not use in contact with earth or concrete. When in direct contact with dissimilar metal, protect aluminum by insulating fittings or treatment.
2. Steel Conduits: In concrete foundations, wrap conduit with 0.010-inch (0.254-mm) thick, pipe-wrapping plastic tape applied with a 50 percent overlap

3.4 CLEANUP

- A. Clean: Clean lighting fixtures of dirt and debris on completion of installation, with materials and by methods recommended by the manufacturer.
- B. Final Acceptance: At the time of final acceptance by the State, all broken parts shall have been replaced, and all lamps shall be operative.

3.5 FACTORY TESTING

- A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL Standards.

3.6 FIELD TESTING

- A. Lighting Fixtures: Lighting fixtures shall be operationally tested.
- B. Lighting Battery Ballasts/Inverters: Battery ballasts/inverters shall have an operational test performed following installation.

END OF SECTION 265100

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SECTION 316299 - MICROPILES

PART 1 - GENERAL

1.1 SUMMARY

- A. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.
- B. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 RELATED WORK

- A. The Work covered by this section, without limiting the generality thereof, consists of furnishing all plant, labor, equipment, appliances and materials and performing all operations in connection with the construction and installation of cement-grouted, micropiles each having an allowable service load and to achieve an ultimate resistance per pile at the locations and to the grades as shown on the Drawings and includes, but is not limited to the following:
 - 1. Submission of shop drawings for review by the ARCHITECT/ENGINEER.
 - 2. Micropiles shall be constructed with one or more permanent steel casings through the overburden soil and uncased in the underlying decomposed bedrock and/or bedrock bearing strata. Each pile shall include a continuous steel core as specified herein.
 - 3. The permanent steel casings shall be constructed of minimum 36 ksi steel and have a diameter and a minimum wall thickness as show on the Drawings. The casing shall include flush threaded joints. The permanent steel casing shall be drilled through the overburden soil and securely seated into the decomposed rock using rotary wash drilling methods.
 - 4. Drilling equipment and methods used by the CONTRACTOR shall permit advancement of the casing, drill rods and drill bits through soils, gravel, cobbles, boulders and bedrock.
 - 5. All drilling shall be completed using duplex drilling techniques with the permanent, outer steel casing advanced simultaneously with an inner drill rod and drill bit to the top of the decomposed rock. The inner drill bit shall not extend below the bottom of the outer casing more than 18 in. at any time. Duplex drilling shall be completed such that all drilling fluid returns to the ground surface inside the outer casing. Drilling fluid shall be directed through hoses to a constructed temporary basin to handle drilling fluids. No drilling fluids shall flow over the ground surface.
 - 6. All water, drilling fluids, grout and other materials shall be contained within the worksite at all times and shall not be allowed to leave the site or enter the river or any surface waterbody. The CONTRACTOR shall conduct the work such that there is no discharge of fluids or materials from the site to off-site locations. The CONTRACTOR shall install, maintain and

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- clean, as necessary, barriers, protection systems and other devices and systems to control all fluids and materials on-site.
7. The piles will be advanced through fill, gravel, sand, silt, clay, glacial till and decomposed bedrock, bedrock, cobbles and boulders with varying densities and embedded to the depth shown on the Drawings. The work under this item shall consist of the removal of man-placed materials encountered at or below the ground surface.
 8. Core steel shall be continuous from bottom to top of pile. Lengths of core steel shall be spliced using in-line splices, installed in accordance with the manufacturer's instructions, which develop 125% of the core steel capacity.
 9. Centralizers shall be installed on core steel at 3 ft from the top and bottom of each pile and at maximum 10 ft spacing along the core steel.
 10. Install a verification test pile at a non-production location as proposed by the CONTRACTOR and approved by the ARCHITECT/ENGINEER and conduct one acceptable static, pile load test on the test pile. The load test shall be loaded to a minimum load of 80 kips in accordance with Procedure A – Quick Test of ASTM D1143, "Standard Test Method for Piles Under Static Axial Compressive Load".
 11. Comply with all rules, regulations, laws and ordinances of the State of New Jersey, City of Jersey City, OSHA and all other authorities having jurisdiction.
 12. Provide survey control, layout of design pile locations and as-built sketches by a registered land surveyor. Forward records to the ARCHITECT/ENGINEER upon completion of each pile.
 13. The CONTRACTOR shall maintain and forward to the ARCHITECT/ENGINEER, upon completion of each pile.

1.3 PROJECT CONDITIONS

A. Geotechnical Report:

1. A Geotechnical Report titled "CRRNJ Terminal Building Interior and MEP Restoration Geotechnical Report" prepared by STV Incorporated for the State of New Jersey, Department of the Treasury, Division of Property Management and Construction, dated October 2014 is available. The CONTRACTOR shall review this report for additional information.

B. Protection of Adjacent Property and Utilities:

1. The CONTRACTOR shall protect adjacent structures (above ground and buried) from damage associated with pile construction and other related operations including existing foundation support piles except where removal of existing foundation is specified.

1.4 DEFINITIONS AND REFERENCE STANDARDS

A. ASTM: Specifications of the American Society for Testing and Materials.

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- B. AWS: Standard Code for Welding in Building Construction, of the American Welding Society.
- C. AISC: Specification of the American Institute of Steel Construction.
- D. ACI: American Concrete Institute.
- E. EPA: U.S. Environmental Protection Agency.
- F. DEP: New Jersey Department of Environmental Protection.
- G. OWNER: State of New Jersey
- H. ARCHITECT/ENGINEER: STV Incorporated.
- I. CONTRACTOR: Person or organization identified in the Agreement as being responsible for the Work under this Section. The term CONTRACTOR shall also refer to an authorized representative(s) of the CONTRACTOR.

1.5 QUALITY ASSURANCE

- A. Comply with all rules, regulations, laws and ordinances of the State of New Jersey, City of Jersey City, and that of all other authorities having jurisdiction. All labor, materials, equipment and services necessary to make the work comply with such requirements shall be provided without additional cost to the STATE.
- B. Field Monitoring and Testing:
 - 1. Full-time field monitoring of the drilled pile installation and pile load test operations will be provided by the ARCHITECT/ENGINEER. No piles shall be installed except in the presence of the ARCHITECT/ENGINEER.
 - 2. The ARCHITECT/ENGINEER and will provide on-site monitoring of cement grout placement. No piles shall be grouted except in the presence of the ARCHITECT/ENGINEER. Cement grout test cylinders shall be taken and tested by the CONTRACTOR, who shall also facilitate storing samples. The CONTRACTOR shall provide a minimum of two (2) seven-day and two (2) twenty-eight day compressive strength tests per grout mix.
 - 3. Certification of the quality of the pile materials to be used in the Work shall be furnished, in a form acceptable to the ARCHITECT/ENGINEER, at the time of delivery of materials to the site. Pile materials shall also be subject to on-site observation for conformance with the specifications.
 - 4. Approvals and acceptance given by the ARCHITECT/ENGINEER shall not relieve the CONTRACTOR of responsibility for performing the Work in accordance with the Contract Documents.
- C. Lines and Grades:

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1. The CONTRACTOR shall be responsible for the correct location of piles and keeping a record of the piles installed.
2. The CONTRACTOR shall establish, maintain and record all locations and elevations required. The CONTRACTOR shall have a minimum of 5 years experience in the work specified in this Contract and shall have successfully completed a minimum of 5 similar projects.

D. Qualifications:

1. The CONTRACTOR shall submit supporting documentation of a minimum of 5 years experience in the work specified in this Section and of successful completion of a minimum of 5 similar projects to the work specified in this Section. Supporting documentation shall include, at a minimum, the following:

Project Name

Project Location

Dates of Construction

Types of Piles Installed

Number and Length of Piles Installed

Value of Pile Contract

Contact information for project THE STATE or ENGINEER.

1.6 SUBMITTALS

A. General:

1. The CONTRACTOR shall submit the information specified herein to the ARCHITECT/ENGINEER for review. Pile installation shall not commence until all required submittals have been reviewed and accepted, and approval to proceed is provided by the ARCHITECT/ENGINEER.
2. Submit qualifications to satisfy the requirements of Article 1.5.D.

B. Design Drawings:

1. Drawings and calculations indicating proposed pile capacities, pile diameter and materials, length in bearing stratum, pile layout, details of the pile including splice details, reinforcing, procedures for placement of grout, and other items pertinent to pile installation. Calculations shall be sealed by a Professional Engineer registered in the State of New Jersey.
2. Details of equipment and procedures for pile installation.

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3. Details of drilling including: materials, techniques, rig sizes, tools, bits, casing, drilling fluid, casing bits (or shoe, J-teeth, etc.) methods and devices for establishing and maintaining pile batter.
4. Shop drawings of the verification test setup including all details of equipment and apparatus to be used for the load tests, a certificate of calibration for both the pressure gage and the hydraulic jack, and design details of the test including load test procedure. The pressure gage and hydraulic jack shall have been calibrated together as a unit within 30 days prior to the load test. Details of load frame and hold-down anchors, if used, or load frame setup to support gravity load and details of gravity loads, if used.
5. Submit a load test report for each test which contains records of test pile installation procedures and as-built data, grout compressive strength results, data collected from test pile instrumentation, interpretation of the load test data including graphical presentation (i.e. load vs. settlement for the various dial gages and telltales and load vs. elevation for the strain gages), a comparison of the results to acceptance criteria, and a presentation of any adjustments to the micropile design or installation, as may be required.

C. Installation:

1. Provide details of the pile including: reinforcing, reinforcement connection methods, procedures for placement of grout, steel core centralizers and other items pertinent to pile installation.
 2. Details of equipment and procedures to be used for pile installation including those to be used to drill through obstructions.
 3. Detailed plan to advance piles through obstructions including: equipment, machines, tools, drill bits, drilling techniques, support equipment and other items proposed by the CONTRACTOR to advance pile through obstructions. A narrative including detailed procedures the CONTRACTOR will employ to advance piles through obstructions.
 4. Planned construction and drilling sequence and platform elevation of drill rig and drill hole.
- D. The cement grout mix design proposed for use. If the Contractor performs on-site cement grout batching, submit quality control test procedures (other than samples for compressive strength testing) to be performed to monitor consistency of batched grout.
- E. Submit proposed reinforcing bar splice detail.
- F. Coordination drawing showing the size and location of equipment relevant to complete pile installation. Included on the drawing shall be shown the areas planned to use for staging, access areas, pile locations, and any other element of the installation.
1. Engineered drawings with plan and elevation views of micropile drill rig set-up showing existing bridge, caps and other site features with rig set-up and other support items the CONTRACTOR proposes to use for drill rig support such as drilling platform, cofferdam, excavation required, backfilling required or other support.

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- G. Details of plans to contain and dispose of drill spoil during the drilling operation.
- H. As-Built Data: CONTRACTOR shall provide the ARCHITECT/ENGINEER written, individual pile installation logs for each micropile indicating the following information:
1. Results of the compressive strength testing performed as required in Section "Quality Assurance.B.2."
 2. Micropile Logs:
 - a. Project Name and Pile Number
 - b. Name of CONTRACTOR;
 - c. Pile location;
 - d. Dates of drilling, installation, and grouting;
 - e. Pile type and size;
 - f. Design pile capacity;
 - g. Type of drill rig used;
 - h. Type of drilling method used;
 - i. Material type, dimensions, and thicknesses of pile components including casing, core steel, spacers, tremie tubes and grout;
 - j. Casing length and type of couplings;
 - k. Reinforcing bar size, batch number, mill certificate, grade, length and splice locations;
 - l. Splice size, type and installation technique;
 - m. Rate of operation of drill rig;
 - n. Pile dimensions;
 - o. Date, time, and volume of grout placed;
 - p. Elevation of tip;
 - q. Elevation of top of decomposed rock;
 - r. Length of rock socket;
 - s. Elevation of butt before and after cut-off;
 - t. Unusual occurrences during pile installation;
 - u. Elevation of top of each pile after installation of the cap plate (measured to the nearest 0.05 ft); and
 - v. Deviation from design plan location (measured to the nearest 0.01 ft.).

1.7 MINIMUM PILE INSTALLATION CRITERIA

- A. General: Installation details of the piles shall be in accordance with previously accepted and approved submittals.
- B. Pile Length:
Minimum pile lengths shall be in accordance with the Drawings and the accepted pile load test.
- C. Pile Diameter:
Minimum pile diameters shall be in accordance with the Drawings and the accepted pile load test.

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D. Permanent Steel Casing:

1. Each pile shall be installed with a permanent steel casing from the top of the pile (pile cut-off El.) downward, through overburden soils and securely seated into decomposed rock and/or bedrock.

E. Steel Reinforcing Bar

Reinforcing steel shall be in accordance with the Drawings and the accepted pile load test.

F. Pile Splices

1. Lengths of reinforcing steel shall be spliced using in-line splices, installed in accordance with the manufacturer's instructions, which develop minimum 125% of the core steel capacity. No splices of the reinforcement shall be installed within 10 ft below the pile design cut-off elevation.. Splices of reinforcement steel and permanent steel casing shall be offset minimum of 2 ft vertically within the pile (i.e., reinforcement steel splices and casing joints shall not be within 2 ft of each other).
2. Lengths of permanent steel casing shall be spliced together using flush threaded joints and the joints shall be sufficient to develop minimum 100% of the steel casing axial capacity. No splices of the permanent steel casing shall be installed within 10 ft below the pile design cutoff elevation. Splices of reinforcement steel and permanent steel casing shall be offset minimum of 2 ft vertically within the pile (i.e., core steel splices and casing joints shall not be within 2 ft of each other).

G. Centralizers

1. Centralizers shall be installed on core steel at 3 ft from the top and bottom of each pile and at maximum 10 ft spacing along the core steel.

H. Grouting

1. Grout shall be Portland cement-water grout mix and minimum compressive strength of 4,000 psi at 28 days. Grout shall be installed in each pile by tremie methods from the bottom of the top of the pile.

PART 2 - PRODUCTS

2.1 MATERIALS

Cement Grout

- A. Cement grout for piles may be prepared at the site or may be batched offsite. If batched offsite, the grout shall conform to ASTM Specification C94 for Ready Mixed Concrete, Third Edition.
- B. The cement grout mixture shall be Portland cement-water mix and have a minimum 28-day compressive strength (f'_c) of 4,000 psi.

Steel Reinforcement

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- A. Steel reinforcement as a minimum shall be standard deformed steel conforming to the requirements of ASTM A615, Grade 80.

Permanent Steel Casing

- A. Permanent steel casing shall have a minimum wall thickness of 0.5 inches. Steel casing shall conform to ASTM A252, Grade 3 or approved equal. The permanent steel casing shall meet the following minimum criteria:

1. Minimum $F_y=45$ ksi; Minimum Elongation = 15%
2. Minimum wall thickness of 0.5 inches
3. Minimum Outside Diameter of 8-5/8 inches
4. Flush threaded splices

- B. Bottom of casing shall be fitted with cutting shoe, bits, J-teeth, or other approved device to enable casing to drill through soil and rock and be securely seated in the decomposed rock and/or bedrock.

Steel Reinforcement Splices

- A. Steel reinforcement splices shall consist of in-line splices capable of developing a minimum of 125% of the reinforcing steel capacity.

Centralizers

- A. Centralizers shall be fabricated from any material, except wood, which is non-detrimental to the pile and can securely position the core steel within 0.5 in. of the center of the pile and maintain the core steel at the pile center until grout has cured. Centralizers shall position the core steel in the pile to within 0.5 inches of the center of the pile. Centralizers shall be spaced at 10-ft intervals as a maximum and at 3 ft from the top and bottom of each pile. Centralizers shall not inhibit the placement of a tremie pipe or the flow of grout.

Plates

- A. Steel Plates for pile top attachment shall be ASTM A572 Grade 36 or 50.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

General

- A. Piles shall be installed to the line and grades specified in the Drawings.

Conduct of Work

- A. The design, materials, equipment and installation procedures developed by the CONTRACTOR shall avoid any detrimental effects to existing structures, unnecessary noise or vibrations, and damage to property.
- B. The CONTRACTOR will be completely and solely responsible for job safety, and security.

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- C. The CONTRACTOR shall have the known utility locations in the vicinity of proposed pile locations marked in the field by utility companies, prior to commencing work. The CONTRACTOR is responsible for all Dig-Safe calls and utility coordination. In addition, the CONTRACTOR shall be responsible for completing pile installation without damage to any utilities or other substructures.
- D. The CONTRACTOR shall provide provisions to control exhaust from equipment, the flow of water/cuttings and disposal of same, and shall keep the premises clean and free of water and debris from the drilling/pile installation work.
- E. The CONTRACTOR shall repair any damage to structures or property caused from performing the Work as described herein.

Method of Installation

- A. The method of pile installation shall be determined by the CONTRACTOR, subject to review by the ARCHITECT/ENGINEER and the following: Pile installation shall be made by non-displacement, low vibration, duplex (internal flush), and rotary wash drilling. Rotary wash drilling methods shall employ sufficient fluid pressure to provide complete removal of the drill cuttings from the hole. Driving of casing is prohibited.
- B. Drilling shall be made in such a manner to prevent loss of ground beyond the specified pile diameter. Drilling shall be by duplex (internal flush) drilling employing the use of an outer, permanent casing through the overburden soils and decomposed rock and/or bedrock. The bottom of the outer permanent casing shall be fitted with a cutting shoe, bits, J-teeth, or other device acceptable to the ARCHITECT/ENGINEER to drill through overburden securely seat the casing into decomposed bedrock and/or bedrock. Drilling mud shall consist of water and drill cuttings, unless alternative drilling mud is authorized in writing by the ARCHITECT/ENGINEER. Drilling mud shall be sufficiently fluid such that it is readily and fully displaced by the cement grout.
- C. All excavation and drilling spoil shall be controlled to minimize disturbances to site conditions and hindrances to pile installation procedures and requirements. All drilling water, spoils and other resulting by-products shall be returned to the top of pile through the casing in duplex drilling techniques. During drilling, the permanent steel casing shall be advanced simultaneously with an inner drill rod and drill bit to the top of bedrock. The inner drill bit shall not extend below the bottom of the outer casing more than 18 in. at any time when drilling through the overburden soils. Duplex drilling shall be completed such that all drilling fluid returns to the ground surface inside the outer casing. Drilling fluid shall be directed through hoses, or other device approved by the ARCHITECT/ENGINEER in writing, to a constructed temporary basin to handle drilling fluids. No drilling fluids shall flow over the ground surface.
- D. All water, drilling fluids, grout and other materials shall be contained within the worksite at all times and shall not be allowed to leave the site or enter the river or any surface waterbody. The CONTRACTOR shall conduct the work such that there is no discharge of fluids or materials from the site to off-site locations. The CONTRACTOR shall install, maintain and clean, as necessary, barriers, protection systems and other devices and systems to control all fluids and materials onsite.
- E. The site is near the Hudson River and no drilling fluid, drill spoils, grout, or other substance shall enter the river at any time.

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- F. All piles shall be installed at locations and batters shown on the Drawings which include field verification to miss existing foundations. Pile location and batter shall be checked during installation and appropriate measures taken as necessary to maintain the correct pile location and batter.
- G. Each pile shall be drilled to achieve foundation support within the decomposed rock and/or bedrock and shall be capable of supporting the specified design load.
- H. Following completion of drilling of the bond length in rock, the piles shall be grouted. Grouting of the piles shall provide complete filling of the pile with a minimum of segregation. Grout shall be placed under a gravity head by means of a tremie pipe and grout pump from the bottom of the pile upward in one continuous operation until the pile is filled and suitable, undiluted cement grout returns at the top of the pile. The cement grout shall not be allowed to fall freely through slurry or water.
- I. Reinforcing steel shall be centered in the hole with approved centralizers. Reinforcing steel shall be placed to within 0.5 inches of the center of each pile. Place reinforcing steel before or immediately after grouting. Core steel lengths shall be minimum 18 ft and installed full height in piles. If multiple lengths of core steel are required, core steel lengths shall be spliced together using in-line splices capable of developing 125% of the core steel capacity. Reinforcing steel splices shall be off-set from joints/splices in the permanent steel casing a minimum of 2 ft vertically. There shall be no splices in the core steel within the top 10 ft of pile. Centralizers shall be installed at 10 ft lengths along the core steel and at 3 ft from the top and bottom of the pile.
- J. The CONTRACTOR shall sequence pile installation such that piles within 8 ft of the pile to be drilled are not grouted within the previous 12 hours (i.e., when a pile is grouted, piles within 8 ft of the grouted pile shall not be drilled for minimum 12 hours, or, allow 12 hours of grout set-up prior to drilling within 8 ft).

Pile Verification Load Testing

A. General:

1. CONTRACTOR shall complete one acceptable static, verification load test on a nonproduction test pile installed at the site.
2. One, non-production micropile shall be installed and load tested to the allowable service load specified on the Drawings multiplied by a factor of safety of 2.0 before installing production micropiles. The acceptance criteria shall be such that:
 - a. The measured slope of the load versus micropile head settlement curve be less than 0.025 in/kip at 2.0 times the allowable service load.
 - b. 50% of the applied load causes a net settlement of the pile of 0.5 inches or less where net settlement is defined as the gross settlement at the test load less the elastic compression.
3. If the pile load test indicates that the micropile did not perform in accordance with the acceptance criteria, the CONTRACTOR shall immediately inform the ARCHITECT/ENGINEER of the results of the test and forward the ARCHITECT/ENGINEER the Load Test Report and proposed design adjustments for the ARCHITECT/ENGINEER'S review.

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4. The CONTRACTOR shall provide all labor, materials and equipment required to set up, conduct and dismantle the load tests. The CONTRACTOR shall design the load frame, set frame, conduct an acceptable pile load test and breakdown and demobilize the material offsite.
5. If hold-down piles are used as a reaction for the pile load test, hold-down piles shall be minimum 8 ft clear from test pile and shall be non-production.
6. The test pile shall be installed by the methods and equipment specified for production piles.
7. The verification load test shall be completed and accepted before production piles are installed.
8. Grout in test piles shall have attained a minimum compressive strength of 4,000 psi prior to load testing. The CONTRACTOR shall provide substantiating compressive strength test data prior to load testing.

B. Pile Instrumentation:

1. The CONTRACTOR will furnish instrumentation and install as necessary to monitor settlement of the verification and proof test pile during the load test in conformance with ASTM D1143.

C. Test Procedures:

1. Load shall be applied to the test pile by means of a hydraulic jack operated by the CONTRACTOR which reacts against a reaction beam. Reaction beam support shall be at least 8 feet away from the test pile.
2. The hydraulic jack shall have a capacity of at least 100 kips and shall be capable of moving the pile a minimum of 6 inches.
3. The top of the test pile shall be level and capped to provide a horizontal bearing surface.
4. Micrometer dials shall be mounted to one or more steel reference beams provided by the CONTRACTOR. The beam(s) shall be rigid and supported by piles extending at least 15 feet below ground surface at a distance of at least 10 feet from the test pile. The reference beams shall be fixed at one end and shall be free to move horizontally at the other end to allow for expansion and contraction of the reference beam without vertical deflection at points where dials are mounted. Wood or other materials subject to variations in moisture content shall not be used in reference beams, crossbeams, shims, or for any other means of dial support.
5. The CONTRACTOR shall protect the entire measuring apparatus against disturbances which may affect the reliability of the settlement observations. The CONTRACTOR shall provide suitable heaters and suitable enclosures to maintain the temperature around the test apparatus at a minimum of 40 ° F, and shall provide temporary lighting as necessary.

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6. Loading and unloading of the verification test pile shall be performed only in the presence of the ARCHITECT/ENGINEER and in accordance with Procedure A – Quick Test of ASTM D1143, "Standard Test Method for Piles Under Static Axial Compressive Load"..

Tolerances and Criteria for Acceptance

- A. Piles shall be installed as close as practicable to the required locations. A maximum lateral deviation from the correct location at cut-off elevation permitted will be 1.5 inches. A maximum deviation from design cut-off elevation equal to one (1) inch will be permitted.
- B. Piles which are believed to have collapsed, based on the grout take volume, or which are otherwise unsatisfactory as specified above and which cannot be removed or repaired, shall be abandoned and filled with cement grout.
- C. Piles that are rejected because of damage, mislocation or misalignment, or failure to meet other installation criteria, shall be cut off below the design cut-off grade and abandoned. Additional pile(s) shall be installed as necessary subject to review by the ARCHITECT/ENGINEER. Whenever, in the judgment of the ARCHITECT/ENGINEER, misalignment or rejection of a pile is caused by the CONTRACTOR's violation of the specifications or other error on the CONTRACTOR's part, and installation of one or more replacement piles is necessitated, the cost of such re-installation shall be borne by the CONTRACTOR.

Disposal of Excavated Material

- A. All excavated material, drill fluid, drill spoils and other material generated during work of this section shall be removed and properly disposed of off-site by the CONTRACTOR.

Test Pile Removal

- A. After completion of successful testing, test pile and temporary piles (hold down piles) for support of the reaction and reference beam systems shall be removed to a depth of at least 3 feet below finished grade.

END OF SECTION

GEOTECHNICAL AND ASBESTOS TEST REPORTS FOR THIS CONTRACT
ARE NOT REPRINTED HERE DUE TO SIZE