

New Jersey Department of Environmental Protection  
 Division of Air Quality  
 Bureau of Technical Services  
 Air Quality Evaluation Section

**UNIT RISK FACTORS FOR INHALATION**  
 August 2009

H A P	CAS No.	Chemical Name	Unit Risk Factor [/(ug/m <sup>3</sup> )]	Benchmark Concentration (ug/m <sup>3</sup> )	Cancer Class.		Reference	Comment	
					USEPA	IARC			
1	**	208968	Acenaphthalene	1.1E-06	9.1E-01			N&L	PAH
2	**	83329	Acenaphthene	1.1E-06	9.1E-01		3	N&L	PAH
3	*	75070	Acetaldehyde	2.2E-06	4.5E-01	B2	2B	IRIS	
4	*	60355	Acetamide	2.0E-05	5.0E-02		2B	Cal 09a	
5	*	53963	Acetylaminofluorene (2-)	1.3E-03	7.7E-04			Cal 09b	
6	*	79061	Acrylamide	1.3E-03	7.7E-04	B2	2A	IRIS	
7	*	107131	Acrylonitrile	6.8E-05	1.5E-02	B1	2B	IRIS	
8		309002	Aldrin	4.9E-03	2.0E-04	B2	3	IRIS	
9	*	107051	Allyl chloride	6.0E-06	1.7E-01	C	3	Cal 09a	
10		117793	Aminoanthraquinone (2-)	9.4E-06	1.1E-01		3	Cal 09a	
11	*	92671	Aminobiphenyl (4-)	6.0E-03	1.7E-04		1	Cal 09b	
12	*	62533	Aniline	1.6E-06	6.3E-01	B2	3	Cal 09a	
13	*	90040	Anisidine (o-)	4.0E-05	2.5E-02		2B	Cal 09b	
14	**	120127	Anthracene	1.1E-05	9.1E-02		3	N&L	PAH
15		140578	Aramite	7.1E-06	1.4E-01	B2	2B	IRIS	
16	*		Arsenic (inorganic)	4.3E-03	2.3E-04	A	1	IRIS	
17	*	1332214	Asbestos	7.7E-03	1.3E-04	A	1	IRIS	See comment 1.
18		103333	Azobenzene	3.1E-05	3.2E-02	B2	3	IRIS	
19	**	56553	Benz(a)anthracene	1.1E-04	9.1E-03	B2	2B	Cal 09a	PAH
20	*	71432	Benzene	7.8E-06	1.3E-01	A	1	IRIS	
21	*	92875	Benzidine	6.7E-02	1.5E-05	A	1	IRIS	
22	**	50328	Benzo(a)pyrene	1.1E-03	9.1E-04	B2	1	Cal 09a	See comment 2.
23	**	205992	Benzo(b)fluoranthene	1.1E-04	9.1E-03	B2	2B	Cal 09a	PAH
24	**	191242	Benzo(g,h,i)perylene	1.1E-05	9.1E-02		3	N&L	PAH
25	**	205823	Benzo(j)fluoranthene	1.1E-04	9.1E-03		2B	Cal 09a	PAH
26	**	207089	Benzo(k)fluoranthene	1.1E-04	9.1E-03	B2	2B	Cal 09a	PAH
27	*	98077	Benzotrichloride	3.7E-03	2.7E-04	B2	2A	IRIS (oral)	Converted oral data
28	*	100447	Benzyl chloride	4.9E-05	2.0E-02	B2	2A	Cal 09a	
29	*		Beryllium	2.4E-03	4.2E-04	B2	1	IRIS	
30		108601	Bis(2-chloroisopropyl)ether	1.0E-05	1.0E-01	C	3	HEAST 97	
31	*	542881	Bis(chloromethyl)ether	6.2E-02	1.6E-05	A	1	IRIS	
32	*	117817	Bis(2-ethylhexyl)phthalate	2.4E-06	4.2E-01	B2	3	Cal 09a	DEHP
33	*	75252	Bromoform	1.1E-06	9.1E-01	B2	3	IRIS	
34	*	106990	Butadiene (1,3-)	3.0E-05	3.3E-02	B2	2A	IRIS	
35	*		Cadmium	4.2E-03	2.4E-04	B1	1	Cal 09a	
36	*	133062	Captan	6.6E-07	1.5E+00	B2	3	Cal 09b	
37	*	56235	Carbon tetrachloride	1.5E-05	6.7E-02	B2	2B	IRIS	
38	*	57749	Chlordane (technical)	1.0E-04	1.0E-02	B2	2B	IRIS	Also CAS 12789036
39		108171262	Chlorinated paraffins	2.0E-05	5.0E-02		2B	Cal 09a	
40	*	510156	Chlorobenzilate	3.1E-05	3.2E-02	B2	3	Cal 09b	Ethyl-4,4'-dichlorobenzilate
41	*	67663	Chloroform	2.3E-05	4.3E-02	B2	2B	IRIS	
42	*	107302	Chloromethyl methyl ether	6.9E-04	1.4E-03	A	1	Cal 09b	
43		95830	Chloro-o-phenylenediamine (4-)	4.6E-06	2.2E-01		2B	Cal 09a	
44		95692	Chloro-o-toluidine (p-)	7.7E-05	1.3E-02		2A	Cal 09a	
45	**		Chromium VI	1.2E-02	8.3E-05	A	1	IRIS	
46	**	218019	Chrysene	1.1E-05	9.1E-02	B2	3	Cal 09a	PAH
47	**		Cobalt	9.0E-03	1.1E-04		2B	USEPA 09	
48	*	8007452	Coke oven emissions	6.2E-04	1.6E-03	A	1	IRIS	
49		120718	Cresidine (p-)	4.3E-05	2.3E-02		2B	Cal 09a	

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						USEPA	IARC		
50		135206	Cupferron	6.3E-05	1.6E-02			Cal 09a	
51		615054	Diaminoanisole (2,4-)	6.6E-06	1.5E-01		2B	Cal 09a	
52	*	72559	DDE	9.7E-05	1.0E-02	B2		Cal 09b	
53		50293	DDT	9.7E-05	1.0E-02	B2	2B	IRIS	
54	**	226368	Dibenz(a,h)acridene	1.1E-04	9.1E-03		2B	Cal 09a	PAH
55	**	53703	Dibenz(a,h)anthracene	1.2E-03	8.3E-04	B2	2A	Cal 09a	PAH
56	**	224420	Dibenz(a,j)acridene	1.1E-04	9.1E-03		2B	Cal 09a	PAH
57	**	192654	Dibenzo(a,e)pyrene	1.1E-03	9.1E-04		2B	Cal 09a	PAH
58	**	189640	Dibenzo(a,h)pyrene	1.1E-02	9.1E-05		2B	Cal 09a	PAH
59	**	189559	Dibenzo(a,i)pyrene	1.1E-02	9.1E-05		2B	Cal 09a	PAH
60	**	191300	Dibenzo(a,l)pyrene	1.1E-02	9.1E-05		2B	Cal 09a	PAH
61	**	194592	Dibenzo(c,g)carbazole (7H-)	1.1E-03	9.1E-04		2B	Cal 09a	PAH
62	*	96128	Dibromo-3-chloropropane (1,2-)	2.0E-03	5.0E-04	B2	2B	Cal 09a	
63	*	106467	Dichlorobenzene (1,4-)	1.1E-05	9.1E-02	C	2B	Cal 09a	
64	*	91941	Dichlorobenzidine (3,3'-)	3.4E-04	2.9E-03	B2	2B	Cal 09a	
65		764410	Dichloro-2-butene (1,4-)	4.2E-03	2.4E-04	B2		USEPA 09	
66	*	111444	Dichloroethyl ether	3.3E-04	3.0E-03	B2	3	IRIS	Bis(2-chloroethyl)ether
67	*	542756	Dichloropropene (1,3-)	4.0E-06	2.5E-01	B2	2B	IRIS	
68	*	62737	Dichlorvos	8.3E-05	1.2E-02	B2	2B	Cal 09b	
69		60571	Dieldrin	4.6E-03	2.2E-04	B2	3	IRIS	
70			Diesel exhaust particulate	3.0E-04	3.3E-03		2A	Cal 09a	
71	*	60117	Dimethylaminoazobenzene (4-)	1.3E-03	7.7E-04		2B	Cal 09a	
72	**	57976	Dimethylbenzanthracene (7,12-)	7.1E-02	1.4E-05			Cal 09a	PAH
73	*	79447	Dimethylcarbaryl chloride	3.7E-03	2.7E-04		2A	Cal 09b	
74	*	57147	Dimethylhydrazine (1,1-)	1.0E-03	1.0E-03	B2	2B	HEAST 93	
75		540738	Dimethylhydrazine (1,2-)	1.6E-01	6.3E-06	B2	2A	Cal 09b	
76	*	77781	Dimethyl sulfate	4.0E-03	2.5E-04	B2	2A	Cal 93	
77	**	42397648	Dinitropyrene (1,6-)	1.1E-02	9.1E-05		2B	Cal 09a	PAH
78	**	42397659	Dinitropyrene (1,8-)	1.1E-03	9.1E-04		2B	Cal 09a	PAH
79	*	121142	Dinitrotoluene (2,4-)	8.9E-05	1.1E-02	B2	2B	Cal 09a	
80	*	123911	Dioxane (1,4-)	7.7E-06	1.3E-01	B2	2B	Cal 09a	
81	*	122667	Diphenylhydrazine (1,2-)	2.2E-04	4.5E-03	B2		IRIS	
82	*	106898	Epichlorohydrin	1.2E-06	8.3E-01	B2	2A	IRIS	
83	*	140885	Ethyl acrylate	5.0E-07	2.0E+00	B2	2B	USEPA 85	
84	*	100414	Ethylbenzene	2.5E-06	4.0E-01		2B	Cal 09a	
85	*	51796	Ethyl carbamate	2.9E-04	3.4E-03		2B	Cal 09a	Urethane
86	*	106934	Ethylene dibromide	6.0E-04	1.7E-03	B2	2A	IRIS	1,2-Dibromoethane
87	*	107062	Ethylene dichloride	2.6E-05	3.8E-02	B2	2B	IRIS	1,2-Dichloroethane
88	*	151564	Ethyleneimine	1.9E-02	5.3E-05		2B	Cal 09b	Aziridine
89	*	75218	Ethylene oxide	8.8E-05	1.1E-02	B1	1	Cal 09a	
90	*	96457	Ethylene thiourea	1.3E-05	7.7E-02	B2	3	Cal 09a	
91	*	75343	Ethylidene dichloride	1.6E-06	6.3E-01	C		Cal 09a	1,1-Dichloroethane
92	**	206440	Fluoranthene	1.1E-06	9.1E-01		3	N&L	PAH
93	**	86737	Fluorene	1.1E-06	9.1E-01		3	N&L	PAH
94	*	50000	Formaldehyde	1.3E-05	7.7E-02	B1	2A	IRIS	
95			Gasoline vapors	1.0E-06	1.0E+00		2B	NE 89	
96	*	76448	Heptachlor	1.3E-03	7.7E-04	B2	2B	IRIS	
97		1024573	Heptachlor epoxide	2.6E-03	3.8E-04	B2	2B	IRIS	
98	*	118741	Hexachlorobenzene	4.6E-04	2.2E-03	B2	2B	IRIS	
99	*	87683	Hexachlorobutadiene	2.2E-05	4.5E-02	C	3	IRIS	
100	**	608731	Hexachlorocyclohexanes	5.1E-04	2.0E-03	B2	2B	IRIS	Technical grade
101	**	319846	Hexachlorocyclohexane (alpha-)	1.8E-03	5.6E-04	B2	2B	IRIS	
102	**	319857	Hexachlorocyclohexane (beta-)	5.3E-04	1.9E-03	C	2B	IRIS	
103	*	58899	Hexachlorocyclohexane (gamma-)	3.1E-04	3.2E-03		2B	Cal 09a	Lindane
104		19408743	Hexachlorodibenzo-p-dioxin, mixture	1.3E+00	7.7E-07	B2	3	IRIS	
105	*	67721	Hexachloroethane	4.0E-06	2.5E-01	C	2B	IRIS	

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106	*	302012	Hydrazine	4.9E-03	2.0E-04	B2	2B	IRIS	
107		10034932	Hydrazine sulfate	4.9E-03	2.0E-04	B2		IRIS	
108	**	193395	Indeno(1,2,3-c,d)pyrene	1.1E-04	9.1E-03	B2	2B	Cal 09a	PAH
109	*		Lead and lead compounds	1.2E-05	8.3E-02	B2	2B	Cal 09a	
110	*	74873	Methyl chloride	1.8E-06	5.6E-01		3	HEAST 97	Chloromethane
111	**	56495	Methylcholanthrene (3-)	6.3E-03	1.6E-04			Cal 09a	PAH
112	**	3697243	Methylchrysene (5-)	1.1E-03	9.1E-04		2B	Cal 09a	PAH
113	*	101144	Methylene bis(2-chloroaniline) (4,4-)	4.3E-04	2.3E-03	B2	2A	Cal 09a	
114	*	75092	Methylene chloride	4.7E-07	2.1E+00	B2	2A	IRIS	Dichloromethane
115	*	101779	Methylenedianiline (4,4-)	4.6E-04	2.2E-03		2B	Cal 09a	
116	**	91576	Methylnaphthalene (2-)	1.1E-06	9.1E-01			N&L	PAH
117	*	1634044	Methyl tert-butyl ether	2.6E-07	3.8E+00		3	Cal 09a	MTBE
118		90948	Michler's ketone	2.5E-04	4.0E-03			Cal 09a	
119	**	91203	Naphthalene	3.4E-05	2.9E-02	C	2B	Cal 09a	PAH
120	**		Nickel refinery dust	2.4E-04	4.2E-03	A	1	IRIS	
121	**	12035722	Nickel subsulfide	4.8E-04	2.1E-03	A	1	IRIS	
122	**	602879	Nitroacenaphthene (5-)	3.7E-05	2.7E-02		2B	Cal 09a	PAH
123	*	98953	Nitrobenzene	4.0E-05	2.5E-02		2B	IRIS	
124	**	7496028	Nitrochrysene (6-)	1.1E-02	9.1E-05		2B	Cal 09a	PAH
125	**	607578	Nitrofluorene (2-)	1.1E-05	9.1E-02		2B	Cal 09a	PAH
126	*	79469	Nitropropane (2-)	2.7E-03	3.7E-04	B2	2B	HEAST 97	
127	**	5522430	Nitropyrene (1-)	1.1E-04	9.1E-03		2B	Cal 09a	PAH
128	**	57835924	Nitropyrene (4-)	1.1E-04	9.1E-03		2B	Cal 09a	PAH
129		55185	Nitrosodiethylamine (N-)	4.3E-02	2.3E-05	B2	2A	IRIS	
130	*	62759	Nitrosodimethylamine (N-)	1.4E-02	7.1E-05	B2	2A	IRIS	
131		924163	Nitrosodi-n-butylamine (N-)	1.6E-03	6.3E-04	B2	2B	IRIS	
132		621647	Nitrosodi-n-propylamine (N-)	2.0E-03	5.0E-04	B2	2B	Cal 09a	
133		86306	Nitrosodiphenylamine (N-)	2.6E-06	3.8E-01	B2	3	Cal 09a	
134		156105	Nitrosodiphenylamine (p-)	6.3E-06	1.6E-01		3	Cal 09a	
135		10595956	Nitrosomethylethylamine (N-)	6.3E-03	1.6E-04	B2	2B	Cal 09a	
136	*	59892	Nitrosomorpholine (N-)	1.9E-03	5.3E-04		2B	Cal 09a	
137		759739	Nitroso-n-ethylurea (N-)	7.7E-03	1.3E-04		2A	Cal 09b	
138	*	684935	Nitroso-n-methylurea (N-)	3.4E-02	2.9E-05		2A	Cal 09b	
139		100754	Nitrosopiperidine (N-)	2.7E-03	3.7E-04		2B	Cal 09a	
140		930552	Nitrosopyrrolidine (N-)	6.1E-04	1.6E-03	B2	2B	IRIS	
141	*	87865	Pentachlorophenol	5.1E-06	2.0E-01	B2	2B	Cal 09a	
142	**	85018	Phenanthrene	1.1E-06	9.1E-01		3	N&L	PAH
143	*	1336363	Polychlorinated biphenyls	1.0E-04	1.0E-02	B2	2A	IRIS	
144		7758012	Potassium bromate	1.4E-04	7.1E-03		2B	Cal 09a	
145	*	1120714	Propane sultone (1,3-)	6.9E-04	1.4E-03		2B	Cal 09a	
146	*	57578	Propiolactone (beta-)	4.0E-03	2.5E-04		2B	Cal 09b	
147	*	78875	Propylene dichloride	1.0E-05	1.0E-01	B2	3	Cal 09b	1,2-Dichloropropane
148	*	75569	Propylene oxide	3.7E-06	2.7E-01	B2	2B	IRIS	
149	**	129000	Pyrene	1.1E-06	9.1E-01		3	N&L	PAH
150	*	100425	Styrene	5.7E-07	1.8E+00	B2	2B	HEAST 91	
151	*	96093	Styrene oxide	4.6E-05	2.2E-02		2A	Cal 09b	
152	*	1746016	Tetrachlorodibenzo(p)dioxin (2,3,7,8-)	3.8E+01	2.6E-08	B2	1	Cal 09a	Dioxin; see comment 3.
153		630206	Tetrachloroethane (1,1,1,2-)	7.4E-06	1.4E-01	C	3	IRIS	
154	*	79345	Tetrachloroethane (1,1,2,2-)	5.8E-05	1.7E-02	C	3	IRIS	
155	*	127184	Tetrachloroethylene	5.9E-06	1.7E-01	B2	2A	Cal 09a	Perchloroethylene
156		62555	Thioacetamide	1.7E-03	5.9E-04		2B	Cal 09a	
157	*	95807	Toluene-2,4-diamine	1.1E-03	9.1E-04	B2	2B	Cal 09a	2,4-Diaminotoluene
158	*	584849	Toluene diisocyanate (2,4-)	1.1E-05	9.1E-02		2B	Cal 09a	
159		91087	Toluene diisocyanate (2,6-)	1.1E-05	9.1E-02		2B	Cal 09a	
160	*	26471625	Toluene diisocyanate (2,4-/2,6-)	1.1E-05	9.1E-02		2B	Cal 09c	Mixture
161	*	95534	Toluidine (o-)	5.1E-05	2.0E-02		2A	Cal 09b	

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162	*	8001352	Toxaphene	3.2E-04	3.1E-03	B2	2B	IRIS	
163	*	79005	Trichloroethane (1,1,2-)	1.6E-05	6.3E-02	C	3	IRIS	
164	*	79016	Trichloroethylene	2.0E-06	5.0E-01	B2	2A	Cal 09a	
165	*	88062	Trichlorophenol (2,4,6-)	3.1E-06	3.2E-01	B2	2B	IRIS	
166	*	1582098	Trifluralin	2.2E-06	4.5E-01	C	3	IRIS (oral)	Converted oral data
167	*	593602	Vinyl bromide	3.2E-05	3.1E-02	B2	2A	HEAST 97	Bromoethene
168	*	75014	Vinyl chloride	8.8E-06	1.1E-01	A	1	IRIS	

**Note:**

**HAP** – Asterisk (\*) indicates that this chemical is on the 1990 Clean Air Act Amendments list of hazardous air pollutants (HAPs). Double asterisk (\*\*) indicates that this chemical is part of a group listed in the 1990 Clean Air Act Amendments list of HAPs.

**CAS No.** - Chemical Abstract Service identification number.

**Unit Risk Factor** - The unit risk factor (URF) is the estimated excess probability of contracting cancer as the result of continuous exposure over a 70-year lifetime to an ambient concentration of one microgram of a chemical per cubic meter of air (ug/m<sup>3</sup>).

**Benchmark Concentration** - Air concentration equivalent to a one in a million risk level (to calculate: 1E-6/URF).

**Cancer Classification** - Two sources of carcinogenicity classifications are given here: USEPA and IARC.

**USEPA** classification of carcinogenicity:

- Group A Human carcinogen; sufficient evidence of carcinogenicity in humans.
- Group B1 Probable human carcinogen; limited evidence of carcinogenicity in humans.
- Group B2 Probable human carcinogen; sufficient evidence of carcinogenicity in animals with inadequate evidence in humans.
- Group C Possible human carcinogen; limited evidence of carcinogenicity in animals and inadequate human data.
- Group D Not classifiable as to human carcinogenicity; inadequate or no evidence.

**IARC** (International Agency for Research on Cancer) classification of carcinogenicity ([www.iarc.fr](http://www.iarc.fr))

- Group 1 Carcinogenic to humans.
- Group 2A Probably carcinogenic to humans.
- Group 2B Possibly carcinogenic to humans.
- Group 3 Not classifiable as to carcinogenicity in humans.
- Group 4 Probably not carcinogenic to humans.

**References**

- Cal 93 California Air Pollution Control Officers Association, Air Toxics "Hot Spots" Program Revised 1992 Risk Assessment Guidelines, October 1993.
- Cal 09a California Environmental Protection Agency (CalEPA), Air Toxics Hot Spots Program Risk Assessment Guidelines, Part II – Technical Support Document for Cancer Potency Factors, May 2009 ([www.oehha.ca.gov/air/hot\\_spots/tsd052909.html](http://www.oehha.ca.gov/air/hot_spots/tsd052909.html)).
- Cal 09b CalEPA Toxicity Criteria Database ([www.oehha.ca.gov/risk/ChemicalDB/index.asp](http://www.oehha.ca.gov/risk/ChemicalDB/index.asp), see linked PDF files), updated 6/18/2009.
- Cal 09c CalEPA Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values, February 2009 ([www.arb.ca.gov/toxics/healthval/healthval.htm](http://www.arb.ca.gov/toxics/healthval/healthval.htm)).
- HEAST 91 U.S. Environmental Protection Agency (USEPA), Health Effects Assessment Summary Tables, Annual FY-1991, Jan. 1991.
- HEAST 93 USEPA, Health Effects Assessment Summary Tables, Annual Update 1992, March 1993.
- HEAST 97 USEPA, Health Effects Assessment Summary Tables, FY-1997 Update, July 1997.
- IRIS USEPA Integrated Risk Information System, as of April 29, 2009 ([www.epa.gov/iris](http://www.epa.gov/iris)).
- IRIS (oral) Converted oral cancer slope factor from IRIS using the equation  $ug/m^3 = [/(mg/kg/day)] * (20 m^3/day) * (1/70 kg) * (1 mg/1000 ug)$ , where  $20 m^3/day$  is the inhalation rate, and 70 kg is the average adult body weight.
- N&L Nisbet, I.C.T., and P.K. LaGoy, 1992, Toxic equivalency factors for polycyclic aromatic hydrocarbons, Reg. Toxicol. Pharmacol. 16:290-300. See Table 4, page 296.
- NE 89 NESCAUM Air Toxics Committee, Evaluation of the Health Effects from Exposure to Gasoline and Gasoline Vapors, Aug. 1989.
- USEPA 85 USEPA, The Air Toxics Problem in the United States: An Analysis of Cancer Risks for Selected Pollutants, Office of Air and Radiation, Washington, D.C., 1985, EPA-450/1-85-001. See Attachment A, Summary Table.
- USEPA 09 USEPA Regional Screening Level Table, April 2009 ([www.epa.gov/reg3hwmd/risk/human/index.htm](http://www.epa.gov/reg3hwmd/risk/human/index.htm)).

**Comments**

1. The unit risk factor for asbestos is given in IRIS as 2.3E-1 (fibers/ml)<sup>-1</sup>. It has been converted based on a conversion factor of 30 ug/m<sup>3</sup> = 1 fiber/cm<sup>3</sup> (Table 7-6, Asbestiform Fibers: Nonoccupational Health Risks, National Research Council, National Academy Press, Washington, D.C., 1984).
2. Benzo(a)pyrene may be used to evaluate total PAHs (polycyclic aromatic hydrocarbons) or POM (polycyclic organic matter), or specific PAH/POM compounds may be evaluated individually. Contact NJDEP Air Quality Evaluation (609-633-1108) for more information.
3. Also see separate listing for hexachlorodibenzo-p-dioxin mixture. Total dioxins and furans may all be evaluated as 2,3,7,8-TCDD, or may be separated into congeners. Toxic equivalency factors for dioxins and furans can be found in Technical Manual 1003. Contact NJDEP Air Quality Evaluation (609-633-1108) for more information.