

Appendix A

Category I

Algorithm and Tables

APPENDIX A
FIGURE 1
Discussed in Section II.B.1

CATEGORY I CONTAMINANTS:
ALGORITHM USED TO DERIVE HAZARDOUS AMBIENT AIR STANDARD

Goal: Estimate ambient concentration that corresponds to an excess lifetime carcinogenic risk of one in one million

Algorithm:

$$\text{RISK} = 1 - e^{-(\text{CPF} * \text{CONCENTRATION} * \text{DAILY INHALATION RATE} * \text{F} / \text{BODY WEIGHT})}$$

Body Weight - 70 kilograms [kg]

Concentration - Ambient concentration (milligram chemical per cubic meter ambient air [$\mu\text{g}/\text{m}^3$]) (Hazardous Ambient Air Standard)

CPF - Cancer Potency Factor (milligram chemical\kilogram body weight-day) $^{-1}$ [$(\text{mg}/\text{kg}/\text{d})^{-1}$]

Daily Inhalation Rate - 20 cubic meters per day [m^3/day]

F - Absorption Factor of 100 percent (1) employed for all compounds

Risk - Excess lifetime carcinogenic risk

SET RISK EQUAL TO 1×10^{-6} AND SOLVE FOR CONCENTRATION

CONCENTRATION ($\mu\text{g}/\text{m}^3$) =

$$\frac{\ln [1 - (1 \times 10^{-6})] * \text{CF}}{[\text{CPF} (\text{mg}/\text{kg}/\text{d})^{-1} * \text{Inhalation Rate} (\text{m}^3/\text{d}) * \text{F} / \text{Body Weight} (\text{kg})]}$$

CF - Conversion Factor 1000 micrograms per milligram

EQUATION REDUCES TO:

$$\text{HAAS} (\mu\text{g}/\text{m}^3) = .0035 / (\text{CPF} * \text{F})$$

APPENDIX A

TABLE 1

Discussed in Section II.B.2

CATEGORY I CONTAMINANTS: CLASSIFICATION STATUS

Category I Contaminant	CAS Number	US EPA Weight of Evidence	IARC Classification
Acrylamide	79-06-1	B2	2A
Acrylonitrile	107-13-1	B1	2A
Allyl chloride	107-05-1	C	3
Aniline	62-53-3	B2	3
Antimony trioxide	1309-64-4	No Data	2B
Arsenic, total	7440-38-2	A	1
Arsine	7784-42-1	No Data	No Data
Asbestos	1332-21-4	A	1
Benzene	71-43-2	A	1
Benzidine	92-87-5	A	1
Benzo(a)pyrene	50-32-8	B2	2A
Beryllium, total	7440-41-7	B2	1
1,1-Biphenyl	92-52-4	D	No Data
Bromoform	75-25-2	B2	3
1,3-Butadiene	106-99-0	B2	2A
Cadmium, total	7440-43-9	B1	1
Carbon tetrachloride	56-23-5	B2	2B
Chloroform	67-66-3	B2	2B
Chloroprene (a)	126-99-8	No Data	3
Chromium, total (b)	18540-29-9	A	1
Diazomethane	334-88-3	No Data	3
Dichloroethyl ether	111-44-4	B2	No Data
Dimethyl sulfate	77-78-1	B2	2A
2,4-Dinitrotoluene	121-14-2	B2 (c)	2B
Dioxane	123-91-1	B2	2B
Epichlorohydrin	106-89-8	B2	2A
Ehtylene dibromide	106-93-4	B2	2A
Ethylene dichloride	107-06-2	B2	No Data
Ethylene oxide	75-21-8	B1	1
Formaldehyde	50-00-0	B1	2A
Hexachlorobenzene	118-74-1	B2	2B
Hexachlorobutadiene	87-68-3	C	3
Hexachloroethane	67-72-1	C	3
Methyl bromide	74-83-9	D	3
Methyl chloride	74-87-3	C	3
Methylene chloride	75-9-2	B2	No Data
Methyl iodide	74-88-4	No Data	3
Nickel carbonyl	13463-39-3	B2	No Data
Nickel (refinery dust) (d)		A	1
2-Nitropropane	79-46-9	B2	2B
PCDDs/PCDFs (e)	1746-1-6	B2	1
Polychlorinated Biphenyls	1336-36-3	B2	2A
Propylene dichloride	78-87-5	B2	No Data
Propyleneimine	75-55-8	No Data	No Data
Propylene oxide	75-56-9	B2	2B
1,1,2,2-Tetrachloroethane	79-34-5	C	3
Tetrachloroethylene	127-18-4	B2-C (f)	2A
o-Toluidine	95-53-4	No Data	2B
1,1,2-Trichloroethane	79-00-5	C	3
Trichloroethylene	79-1-6	B2-C (g)	2A
2,4,6-Trichlorophenol	88-06-2	B2	No Data
Vinyl chloride	75-01-4	A	1

Notes:

CAS - Chemical Abstracts Service

IARC - International Agency for Research on Cancer

US EPA - United States Environmental Protection Agency

(a) - Included as Category I based on information presented in National Toxicology Program abstract.

(b) - Values cited are for hexavalent chromium (Cr VI).

(c) - Based on evaluation of a mixture of 2,4 and 2,6 dinitrotoluene.

(d) - Nickel refinery dust is a mix of many nickel moieties and it is not certain what the carcinogenic species is in the refinery dust (IRIS, 1997).

(e) Information cited is for 2,3,7,8-tetrachlorodibenzo-p-dioxin.

(f) - Provisional information provided in Risk Assessment Issue paper for Tetrachloroethylene. Superfund Technical Support Center.

(g) - Provisional information provided in Risk Assessment Issue paper for Trichloroethylene. Superfund Technical Support Center.

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APPENDIX A

TABLE 2

Discussed in Section II.B.2

CATEGORY I CONTAMINANTS PROPOSED TO BE RECLASSIFIED AS CATEGORY II CONTAMINANTS

Contaminant	US EPA Weight of Evidence	IARC Group Classification	CPFi [1/(mg/kg-day)]	CPFo [1/(mg/kg-day)]	RfC (ug/m ³)	TLV (ug/m ³)	PEL (ug/m ³)	REL (ug/m ³)	Time Factor	Uncertainty Factor (a)	Proposed Revised HAAS (ug/m ³)	Existing HAAS (ug/m ³)
Arsine	No Data	No Data			0.05	160	200	2 (c,d)		10 (e)	0.005	0.01
1,1-Biphenyl	D	No Data				1,300	1,000		4.2	100	2.38 *	0.01
Diazomethane	No Data	3				340 (a)	400	400	4.2	1000 (e)	0.081	0.01
Methyl bromide	D	3			5	3,900	80,000 (b)	(d)		10 (e)	0.5*	0.01
Methyl iodide	No Data	3				12,000	28,000	10,000 (d)	4.2	1000 (e)	2.38*	0.01
Propylene imine	No Data	No Data				4,700	5,000	5,000 (d)	4.2	1000 (e)	1.12*	0.01

Notes:

Shading indicates basis of proposed HAAS.

* - Indicates proposed revised HAAS differs from existing HAAS by at least an order of magnitude.

ACGIH - American Conference of Governmental Industrial Hygienists

CPFi - Inhalation Cancer Potency Factor

CPFo - Oral Cancer Potency Factor

HAAS - Hazardous Ambient Air Standard

IARC - International Agency for Research on Cancer

PEL - Permissible Exposure Limit established by federal Occupational Safety and Health Administration (OSHA), downloaded September 29, 1997.

REL - Recommended Exposure Limit established by federal National Institute for Occupational Safety and Health (NIOSH), June 1994.

RfC- Inhalation Reference Concentration as cited in US EPA Integrated Risk Information System database.

TLV - Threshold Limit Value as cited in 1997 Threshold Limit Values for Chemical Substances and Physicals Agents and Biological Indices, ACGIH.

US EPA - United States Environmental Protection Agency

(a) - Identified as A2: Suspected Human Carcinogen by ACGIH.

(b) - Value represents a PEL ceiling level which is not to be exceeded at any time.

(c) - Value represents REL ceiling level not to be exceeded at any time.

(d) - Identified as potential occupational carcinogen by NIOSH.

(e) - Includes an extra uncertainty factor of 10 because compound is identified as potential carcinogen by ACGIH or NIOSH.

APPENDIX A
TABLE 3
Discussed in Section II.B.2

CATEGORY I CONTAMINANTS: UPDATED TOXICITY VALUES

Category I Contaminant:	Updated Cancer Potency Factor [(mg/kg/day) ⁻¹](a)	Toxicity Value Associated with Existing HAAS
With Static Inhalation Cancer Potency Factor		
Acrylonitrile	2.4E-01 (b)	Same
Benzene	2.9E-02 (b)	Same
Benzidine	2.3E+02 (c)	Same
Chromium, total	4.1E+01 (b,d)	Same
Ethylene oxide	3.5E-01 (b)	Same
Formaldehyde	4.5E-02 (b)	Same
With Updated Inhalation Cancer Potency Factor		
Beryllium, total	8.4E+00 (b)	2.60E+00
1,3-Butadiene	1.8E+00 (b,c)	1.00E-01
Cadmium, total	6.3E+00 (e)	6.10E+00
Carbon tetrachloride	5.3E-02 (b)	1.30E-01
Nickel, total (f)	8.4E-01 (b)	1.05E+00
Vinyl chloride	3.0E-01 (b)	1.75E-02
Formerly with Only Oral Cancer Potency Factor, Now With Inhalation Cancer Potency Factor		
Arsenic, total	1.5E+01 (e)	1.50E+01 (Oral)
Benzo(a)pyrene	6.1E+00 (g)	1.15E+01 (Oral)
Chloroform	8.1E-02 (b)	8.10E-02 (Oral)
Dichloroethyl ether	1.1E+00 (b)	1.14E+00 (Oral)
Epichlorohydrin	4.2E-03 (b)	9.90E-03 (Oral)
Ethylene dibromide	7.6E-01 (b)	4.10E+01 (Oral)
Ethylene dichloride	9.1E-02 (b)	9.10E-02 (Oral)
Hexachlorobenzene	1.6E+00 (b)	1.67E+00 (Oral)
Hexachlorobutadiene	7.8E-02 (b)	7.75E-02 (Oral)
Hexachloroethane	1.4E-02 (b)	1.42E-02 (Oral)
Methylene chloride	4.7E-7 (unit risk) (h,i)	1.40E-02 (Oral)
PCDDs/PCDFs	1.5E+05 (b,j)	1.56E+05 (Oral)
Polychlorinated Biphenyls	2.0E+00 (k)	4.34E+00 (Oral)
1,1,1,2-Tetrachloroethane	2.0E-01 (b)	2.00E-01 (Oral)
Tetrachloroethylene	2.0E-03 (l,m)	5.10E-02 (Oral)
1,1,1,2-Trichloroethane	5.7E-02 (b)	5.73E-02 (Oral)
Trichloroethylene	6.0E-03 (n)	1.10E-02 (Oral)
2,4,6-Trichlorophenol	1.0E-02 (b)	1.99E-02 (Oral)

APPENDIX A
TABLE 3
Discussed in Section II.B.2

CATEGORY I CONTAMINANTS: UPDATED TOXICITY VALUES

Category I Contaminant:	Updated Cancer Potency Factor [(mg/kg/day) ⁻¹] (a)	Toxicity Value Associated with Existing HAAS
Formerly Without Toxicity Values, Now With Inhalation Cancer Potency Factor		
Acrylamide	4.50E+00 (b,o)	
Bromoform	3.9E-03 (e)	
Methyl chloride	6.3E-03 (b)	
2-Nitropropane	9.4E+00 (b)	
Propylene oxide	1.3E-02 (c)	
Formerly Without Toxicity Values, Now With Oral Cancer Potency Factor		
Aniline	.0057 (Oral) (p)	
Dioxane	.011 (Oral) (p)	
Propylene dichloride	.068 (Oral)	
Still With no inhalation or Oral Cancer Potency Factor or Inhalation Reference Concentration		
1,1-Biphenyl *		
Diazomethane *		
Dimethyl sulfate		
Methyl iodide *		
Nickel carbonyl		
Propylene imine *		
o-Toluidine		
With no inhalation or Oral Cancer Potency Factor but with Inhalation Reference Concentration		
Antimony trioxide	.2 (RfC)	
Arsine *	.05 (RfC)	
Chloroprene	7 (RfC)	
Methyl bromide *	5 (RfC)	
Allyl chloride	1 (RfC)	0.0119 (Oral)
With Only Updated Oral Cancer Potency Factor		
2,4-Dinitrotoluene	.68 (Oral) (q)	3.10E-01 (Oral)
Mineral Fiber		
Asbestos	.23 [(fibers/milliliter) ⁻¹] (r)	

Notes:

CAS - Chemical Abstracts Service.

HAAS- Hazard Ambient Air Standard in ug/cubic meter.

Oral - Indicates that existing HAAS may be based upon an oral cancer slope factor

RfC - Inhalation Reference Concentration in micrograms of compound per cubic meter of ambient air

* - Compound proposed to be reclassified as Category II contaminant.

(a) - Value cited is inhalation cancer potency factor unless otherwise noted.

(b) - Value cited in HEAST, July 1997.

(c) - Cancer slope factor presented in IRIS citation.

(d) - Exposure was to both Chromium III and VI. Since only Cr VI has been found to be carcinogenic in animal studies, US EPA classified only Cr VI as a human carcinogen. US EPA assumed Cr VI to be 1/7th of total Chromium.

(e) Cancer slope factor derived from unit risk by assuming inhalation rate of 20 cubic meters/day and 70 kilogram body weight.

(f) - Values are for nickel refinery dust. Per IRIS citation 12/96, "Nickel refinery dust is a mix of many nickel species and it is not certain what the carcinogenic nickel species is in the refinery dust."

(g) Value removed from IRIS in 1993 but still conservatively employed by many in risk assessment community.

(h) - Because this unit risk was derived using a pharmacokinetic model, it is not suitable for use in the calculation of a cancer slope factor.

(i) - This unit risk may not be applicable to acute, high level exposures.

(j) - Information is representative of 2,3,7,8-Tetrachlorodibenzo-p-dioxin (1746-01-6).

(k) - Upper bound slope estimate for high risk and persistence. Recently recommended for use in evaluation of inhalation of dust or aerosol exposures. US EPA, 1996.

PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures and adopted by IRIS 10/1/96.

(l) - Provisional Information. Risk Assessment Issue Paper for Tetrachloroethylene. Superfund Technical Support Center.

(m) - Based on geometric mean of unit risks reported in Risk Assessment Issue Paper for Tetrachloroethylene.

(n) - Provisional information. Risk Assessment Issue Paper for Trichloroethylene. Superfund Technical Support Center.

(o) - Inhalation unit risk is based on oral data.

(p) - Indicates compounds also with a noncarcinogenic inhalation reference concentration.

(q) - Value cited is oral cancer potency factor derived for a mixture of 2,4 and 2,6 dinitrotoluene.

(r) - Unit risk. Additive combined risk of lung cancer and mesothelioma.

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APPENDIX A

TABLE 4

Discussed in Section II.B.2

CATEGORY I CONTAMINANTS: PROPOSED REVISED HAZARDOUS AMBIENT AIR STANDARDS

Category I Contaminant	CAS Number	Proposed Revised HAAS (ug/m ³)	Existing HAAS (ug/m ³)
Acrylamide	79-06-1	0.00078 I	0.01 D
Acrylonitrile	107-13-1	0.015 I	0.015 I
Allyl chloride	107-05-1	0.10 R	0.29 O
Aniline	62-53-3	0.61 O	0.01 D
Antimony trioxide	1309-64-4	0.02 R	0.01 D
Arsenic, total	7440-38-2	0.00023 I	0.00023 O
Arsine	7784-42-1	(a)	0.01 D
Asbestos	1332-21-4	.000004 (b)	0.00012
Benzene	71-43-2	0.12 I	0.12 I
Benzidine	92-87-5	0.000015 I	0.000015 I
Benzo(a)pyrene	50-32-8	0.00057 I	0.0003 O
Beryllium, total	7440-41-7	0.00042 I	0.0013 I
1,1-Biphenyl	92-52-4	(a)	0.01 D
Bromoform	75-25-2	0.90 I	0.01 D
1,3-Butadiene	106-99-0	0.0019 I	0.035 I
Cadmium, total	7440-43-9	0.00056 I	0.00057 I
Carbon tetrachloride	56-23-5	0.07 I	0.067 I
Chloroform	67-66-3	0.043 I	0.043 O
Chloroprene	126-99-8	0.70 R	0.01 D
Chromium, total (c)	18540-29-9 (d)	0.000085 I	0.000085 I
Diazomethane	334-88-3	(a)	0.01 D
Dichloroethyl ether	111-44-4	0.0032 I	0.0031 O
Dimethyl sulfate	77-78-1	0.01 D	0.01 D
2,4-Dinitrotoluene	121-14-2	0.005 (e) O	0.011 O
Dioxane	123-91-1	0.32 O	0.01 D
Epichlorohydrin	106-89-8	0.83 I	0.35 O
Ethylene dibromide	106-93-4	0.0046 I	0.000085 O
Ethylene dichloride	107-06-2	0.038 I	0.038 O
Ethylene oxide	75-21-8	0.01 I	0.010 I
Formaldehyde	50-00-0	0.078 I	0.08
Hexachlorobenzene	118-74-1	0.0022 I	0.0021 O
Hexachlorobutadiene	87-68-3	0.045 I	0.045 O
Hexachloroethane	67-72-1	0.25 I	0.25 O
Methyl bromide	74-83-9	(a)	0.01 D
Methyl chloride	74-87-3	0.56 I	0.01 D
Methylene chloride	75-9-2	2.0 (b)	2.00 O
Methyl iodide	74-88-4	(a)	0.01 D
Nickel carbonyl	13463-39-3	0.01 D	0.01 D
Nickel, total (f)		0.0042 I	0.0033 I
2-Nitropropane	79-46-9	0.00037 I	0.01 D
PCDDs/PCDFs (g)		2.33e-08 I	2.00e-08 O
Polychlorinated Biphenyls	1336-36-3	0.0018 (h) I	0.00081 O
Propylene dichloride	78-87-5	0.051 O	0.01 D
Propyleneimine	75-55-8	(a)	0.01 D
Propylene oxide	75-56-9	0.27 I	0.01 D
1,1,2,2-Tetrachloroethane	79-34-5	0.018 I	0.017 O
Tetrachloroethylene	127-18-4	1.8 (i) I	0.41 O
o-Toluidine	95-53-4	0.01 D	0.01 D
1,1,2-Trichloroethane	79-00-5	0.061 I	0.061 O
Trichloroethylene	79-1-6	.58 (j) I	0.42 O
2,4,6-Trichlorophenol	88-06-2	0.35 I	0.18 O
Vinyl chloride	75-01-4	0.012 I	0.20 I

Notes:

Indicates compound where proposed revised HAAS differs by at least one order of magnitude from existing HAAS.

CAS - Chemical Abstracts Service.

D - Indicates default standard of .01 ug/cubic meter.

HAAS- Hazard Ambient Air Standard in ug/cubic meter.

I - Indicates value derived using an inhalation cancer potency factor.

O - Indicates value derived using an oral cancer potency factor as a surrogate.

R - Indicates value derived using one-tenth an inhalation reference concentration.

(a) - Proposed to be reclassified as Category II compound. Please see Appendix A, Table 2.

(b) - Value cited in US EPA Integrated Risk Information System database as corresponding to an excess lifetime cancer risk of one in one million.

(c) - Exposure was to both Chromium III and VI. Since only Cr VI has been found to be carcinogenic in animal studies, US EPA classified only Cr VI as a human carcinogen. US EPA assumed Cr VI to be 1/7th of total Chromium.

(d) - CAS number is for Chromium VI.

(e) - Value cited is oral cancer potency factor derived for a mixture of 2,4 and 2,6 dinitrotoluene.

(f) - Values are for nickel refinery dust. Per IRIS citation 12/96, "Nickel refinery dust is a mix of many nickel species and it is not certain what the carcinogenic nickel species is in the refinery dust."

(g) - Information is representative of 2,3,7,8-Tetrachlorodibenzo-p-dioxin (1746-01-6).

(h) - Derived using upper bound slope estimate for high risk and persistence. Recently recommended for use in evaluation of inhalation of dust or aerosol exposures. US EPA, 1996. PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures and adopted by IRIS 10/1/96.

(i) - Based on provisional information in Risk Assessment Issue Paper for Tetrachloroethylene. Superfund Technical Support Center.

(j) - Based on provisional information provided in Risk Assessment Issue Paper for Trichloroethylene. Superfund Technical Support Center.

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