



Health Effects Assessment Summary Tables

**First/Second Quarters
FY - 1990**

DISCLAIMER

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INTRODUCTION

This document is a combined First/Second Quarter update of the Health Effects Assessment Summary Tables (HEAST) prepared for Superfund use by the Environmental Criteria and Assessment Office (ECAO-Cin) in EPA's Office of Health and Environmental Assessment. No separate first or second quarters were published. We apologize for any confusion this may have caused. This is the only time that combined quarters will be published. Please expect to receive separate third and fourth quarters for FY90 HEAST. This update completely replaces the previous edition of this document. Chemicals considered are those for which Health Effects Assessment Documents, Health and Environmental Effects Profiles, Health and Environmental Effects Documents, Health Assessment documents or Air Quality Criteria Documents have been prepared by ECAO. Radionuclides considered are those believed to be most commonly encountered at Superfund sites. This report is an excellent "pointer" system to identify current literature or changes in assessment criteria for many chemicals of interest to the Superfund program.

It is important to remember that the numbers in these tables alone tell one very little about the adverse effects of a chemical or the quality of evidence on which toxicity criteria are based. Original assessment documents must be consulted by risk assessors in order for them to fully appreciate the strengths and limitations of a specific data base. Original source documents will allow for the most complete characterization of potential toxicity associated with the range of exposure pathways generally evaluated at Superfund sites. The HEAST is structured to point the user to these sources.

We recognize that at any one time there may be multiple Agency documents or data bases that present conflicting values or assessments on a specific chemical. For this reason the following hierarchy of sources is recommended in evaluating chemical toxicity for Superfund sites:

1. The Agency's Integrated Risk Information System (IRIS) and cited references. This data base is updated monthly but may still have data gaps. Call IRIS USER Support at 513/569-7254 (FTS 684-7254) for further information.
2. The Health Effects Assessment Summary Tables (HEAST) and cited references. Limited copies of the HEAST are available for EPA staff, States, other Federal agencies and contractors working directly for Superfund. If you fall into one of these groups and wish to be on the mailing list, call Superfund's Toxics Integration Branch, (202) 475-9490. Those individuals not falling into one of these groups must purchase the document from:

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
(703)487-4650

The order number to be placed on the subscription list to receive all of the FY90 HEASTs is PB-90921100. There is a charge to this publication from NTIS.

3. Consultation with EPA staff (ECAO's Chemical Mixtures Assessment Branch at 513/569-7300; FTS 684-7300).
4. Do not consult either the toxicity tables (Appendix A) in the Superfund Public Health Evaluation Manual (SPHEM, U.S. EPA, 1986) or the September 1988 Public Health Risk Evaluation Data Base (PHRED) as these sources are likely to contain numerous values that have since become out-of-date.

Most cited Agency references (e.g., HEAs, HEEPs, HEEDs, etc.), are (or will soon be) available through the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161 (703/487-4650 or 800/336-4700).

Questions regarding the contents of the HEAST (e.g., chemicals not covered, pending RfDs) should be directed to EPA's Environmental Criteria and Assessment Office in Cincinnati, OH at (513)569-7300.

WHAT'S NEW IN FIRST/SECOND QUARTER FY90 HEAST

GENERIC ISSUES:

A minor change in format has been introduced in the FY90 update of the HEA Summary Tables (HEAST). This change pertains to Table B: Carcinogenicity, and consists of the addition of unit risk estimates for oral exposure to chemicals.

Another minor change is that citations to the IRIS data base have been changed to conform to current citation guidelines.

RfD and CRAVE Workgroup status reports dated 03/31/90 were used in this update of the Tables.

CHEMICAL-SPECIFIC CHANGES TO TABLE A: OTHER THAN CARCINOGENICITY

Acenaphthene

Risk assessment values have now been incorporated to this entry. The chronic RfD is verified, pending input into IRIS.

Acrolein

Footnote d was removed since it had been incorrectly placed on acrolein. Footnote d refers to ammonia, and already appears in the entry for that chemical.

Acrylic acid

The subchronic oral RfD value has been revised.

Anthracene

Risk assessment values have now been incorporated to this entry. The chronic RfD is verified, pending input into IRIS.

1-Butanol

A footnote was added to indicate that the chronic oral RfD is verified and available on IRIS.

Cacodylic acid

Two footnotes were added to indicate that the chronic oral RfD is under review and that the chronic and subchronic values are based on arsenic equivalents.

Chlorotoluene, o-

This is a new entry from a HEED. A footnote was added to indicate that the chronic oral RfD is verified and available on IRIS.

Crotonaldehyde

This is a new entry from a HEED. The appropriate references have been added to reference list A.

Cycloate

A footnote was added to indicate that this chemical is under review by the oral RfD Work Group.

Decabromodiphenyl ether and Decabromodiphenyl oxide

Because these names are synonyms for a single chemical, these entries were combined into a single entry.

Dichloroprop

A footnote was added to indicate that this chemical is under review by the oral RfD Work Group.

4,6-Dinitro-o-cresol

The oral RfD was removed from the Table since it had been derived from the occupational Threshold Limit Value (TLV). The entry now indicates that data are inadequate for quantitative risk assessment.

Ethyl ether

The footnote has been changed to indicate that the chronic oral RfD is verified, but has not yet been entered into IRIS.

Fluoranthene

This is a new entry and a footnote was added to indicate that the chronic oral RfD is verified pending input into IRIS.

Fluorene

This is a new entry and a footnote was added to indicate that the chronic oral RfD is verified, pending input into IRIS.

Maleic hydrazide

A footnote was added to indicate that the chronic oral RfD is verified and available on IRIS.

Maneb

A footnote was added to indicate that the chronic oral RfD is verified and available on IRIS.

Mercury, alkyl and inorganic

This entry has been changed to Methyl mercury, which is how it appears on IRIS. The footnote was changed to indicate that the chronic oral RfD is being reconsidered.

Mercury, mercurial

This entry has been changed to Mercury, inorganic, which is how it appears on the RfD Workgroup status report.

Methylene chloride

A new citation to an Updated HEA was added to the reference column and also to the reference list A.

Naphthalene

A footnote was added to indicate that the chronic oral RfD is under review.

Nitrite

A footnote was added to indicate that the chronic oral RfD is verified and available on IRIS.

Phosphine

This is a new entry from a recently finalized HEED. The corresponding references were added to reference list A.

Pyrene

Risk assessment values have now been incorporated to this entry. The chronic oral RfD is verified pending input into IRIS.

Simazine

Risk assessment values have now been incorporated to this entry. These values were derived from a Ciba-Geigy CBI study. The chronic oral RfD is verified and is available on IRIS.

Styrene

A citation to a recently finalized HEA has been added to the reference column and to the reference list A. A typographical error in the chronic oral RfD has been corrected.

2,4,5-Trichlorophenoxy acetic acid

This is a new entry from a recently finalized HEA. The appropriate references were added to reference list A.

1,3,5-Trinitrobenzene

A footnote has been added to indicate that the chronic oral RfD is verified and available on IRIS.

Zinc

A footnote was added to indicate that the chronic oral RfD is under review by the RfD Work Group.

CHEMICAL-SPECIFIC CHANGES TO TABLE B: CARCINOGENICITY

Alachlor

This is a new entry and a footnote was added to indicate that the values have been verified, but have not yet been input into IRIS.

Allyl chloride

A footnote was added to indicate that the classification has been verified, but has not yet been loaded into IRIS.

Benzene

A citation to a recently finalized HEA has been added to the reference column and to the reference list B.

Benzo(a)anthracene

This is a new entry and a footnote was added to indicate that the classification has been verified.

Benzo(b) fluoranthene

This is a new entry and a footnote was added to indicate that the classification has been verified.

Beryllium

A footnote was added to the oral slope factor to indicate that the corrected oral assessment has been added to IRIS.

Bis(2-chloro-1-methylethyl)ether

The inhalation unit risk value, listed as $2\text{E}-3$, has been changed to the correct value of $2\text{E}-5$.

Bromoethene

The inhalation unit risk value of $3.2\text{E}-2$ has been changed to the correct value of $3.2\text{E}-5$.

Bromoform

A footnote was added to indicate that the inhalation slope factor has been verified, pending input into IRIS.

Captan

This is a new entry and a footnote was added to indicate that the classification and slope factor have been verified, but have not yet been loaded into IRIS.

Chlorthalonil

A footnote was added to the oral slope factor to indicate that the value has been verified, but has not yet been loaded into IRIS.

Chrysene

This is a new entry and a footnote was added to indicate that the classification has been verified, but has not yet been loaded into IRIS.

Creosol, o-, m-, and p-

This is a new entry and a footnote was added to indicate that the classification has been verified, but has not yet been loaded into IRIS.

Crotonaldehyde

This is a new entry from a recently finalized HEED. The corresponding references were added to reference list B.

Dibenzo(a,h)anthracene

This is a new entry and a footnote was added to indicate that the classification has been verified, but has not yet been loaded into IRIS.

1,1-Dichloroethane

A footnote was added to the oral slope factor to indicate that the value has been verified, but has not yet been loaded into IRIS.

1,1-Dichloroethylene

A footnote was added to indicate that the inhalation slope factor is based on metabolized dose.

Epichlorohydrin

This entry now includes data used in the derivation of a verified oral slope factor. This value is available on IRIS.

Ethyl acrylate

A footnote was added to indicate that CRAVE is reviewing the carcinogenicity risk assessment for this chemical.

Hydrazine/hydrazine sulfate

A footnote was added to the oral slope factor to indicate that this value has been verified and is available on IRIS.

Selenium sulfide

This is a new entry from a recently finalized HEED. The corresponding references were added to reference list B.

Simazine

This is a new entry and a footnote was added to indicate that the classification and slope factor have been verified, but have not yet been loaded into IRIS.

Styrene

This is a new entry from a recently finalized Updated HEA. The appropriate references were added to reference list B.

2,3,7,8-TCDD

A footnote was added to indicate that an absorption factor of 75% was used in calculating the inhalation unit risk from the oral slope factor.

Trichloroethylene

A footnote was added to the inhalation and oral slope factor to indicate that both values were derived from metabolized doses and that new verified values are pending input into IRIS.

2,4,6-Trichlorophenol

The footnote on the oral slope factor was changed to indicate that the value was removed from IRIS pending further review, and that a new verified value is pending input into IRIS.

USER'S GUIDE: CHEMICAL TOXICITY

The Health Effects Assessment Summary Tables A & B summarize reference doses (RfDs) for toxicity from subchronic and chronic inhalation and oral exposure (Table A) and slope factors and unit risk values for carcinogenicity based on lifetime inhalation and oral exposure (Table B). A more complete discussion of how Superfund develops and considers the toxicity assessment in hazardous waste sites is presented in Chapter 7 of Risk Assessment Guidance for Superfund: Human Health Evaluation Manual Part A. The chemicals included in the tables are the subjects of final documents of Health Effects Assessment documents (HEAs), Health and Environmental Effects Profiles (HEEPs), Health and Environmental Effects Documents (HEEDs), Health Assessment Documents (HADs) and Air Quality Criteria Documents (AQCDs). The information in HEA Summary Tables A and B is excerpted from the HEAs, HEEP, HEEDs, HADs and AQCDs, and expanded and updated quarterly to include chemicals addressed in HEAs, HEEDs, HADs and AQCDs that have been finalized since the last update and to bring existing values into conformity with more recent EPA assessments, especially RfD or CRAVE Work Group verifications. The references listed for each chemical in the Reference column and References section represent not only the study or studies that are the basis for the RfD, slope factor or unit risk, but also the U.S. EPA reference that is the source of the Agency analysis or risk assessment values and the IRIS citation for values verified by the RfD or CRAVE work group. Verified values are indicated in the tables by a footnote.

The following documents cited in this section may be obtained from their respective sources:

From the Center for Environmental Research Information (513) 569-7562.
Risk Assessment Guidance: Volume 1, Human Health Evaluation
Manual, Part A. EPA/540/1-89/002.
Air Quality Criteria Documents.

From the National Technical Information Service (NTIS) (703)487-4780.
Interim Methods for Development of Inhalation
Reference Doses. EPA/600/8-88/006F. Order number
PB90-145723. The price is \$31.00.

Table A: Subchronic and Chronic Toxicity (other than Carcinogenicity)

The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of the daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a portion of the lifetime, in the case of a subchronic RfD (designated "RfD_s" in Table A and formerly called AIS), or during the lifetime, in the case of a chronic RfD (designated "RfD" in Table A and formerly called AIC). The RfD values are listed in Table A in the column under "Reference Dose." The RfD is derived by dividing the NOAEL (or LOAEL if a suitable NOAEL is not available) for subchronic or chronic exposure by an uncertainty factor (UF) times a modifying factor (MF):

$$RfD = \frac{NOAEL \text{ or } LOAEL}{UF \times MF}$$

In Table A, the NOAEL or LOAEL that is the basis for the RfD value is listed under "Exposure." When a NOAEL or LOAEL is reported in terms of exposure concentration and schedule, the calculated mg/kg/day dose is given in parentheses. The species in which the NOAEL or LOAEL was determined and the effect of concern are also described, and the reference for the study is presented. The effect of concern listed is that associated with the chemical and not with the dose listed. In the "Exposure," "Effect of

Concern" and "Reference" columns, information for the inhalation route is given first, separated from information for the oral route by a semicolon or slash.

The uncertainty factor used in calculating the RfD reflects scientific judgment regarding the various types of data used to estimate RfD values. An uncertainty factor of 10 is usually used to account for variations in human sensitivity when extrapolating from valid human studies involving subchronic (for RfD_s) or long-term (for RfD) exposure of average, healthy subjects. An additional 10-fold factor is usually used for each of the following extrapolations: from long-term animal studies to the case of humans, from a LOAEL to a NOAEL, and from subchronic studies to a chronic RfD. In order to reflect professional assessment of the uncertainties of the study and data base not explicitly addressed by the above uncertainty factors (e.g., completeness of the overall data base), an additional uncertainty factor or modifying factor ranging from greater than 0 to less than or equal to 10 is applied. The default value for this modifying factor is 1.

A subchronic RfD is usually derived, if not previously derived in health effects documents that originally addressed the chemical, for chemicals for which a chronic RfD is presented in Table A. The subchronic RfD is derived in either of two ways. If an uncertainty factor to expand from subchronic to chronic exposure was used in the derivation of the chronic RfD, the subchronic RfD is derived from the same benchmark dose without application of the uncertainty factor to expand from subchronic to chronic exposure. If, however, the chronic RfD was derived without use of an uncertainty factor to expand from subchronic to chronic exposure, the chronic RfD is adopted as the subchronic RfD.

Table A lists the uncertainty factor and modifying factor, multiplied together to form a single factor, under the heading "Uncertainty Factor." For example, the uncertainty factor of 500 listed for the chronic oral RfD for cyanide reflects an uncertainty factor of 100 and a modifying factor of 5; the uncertainty factor of 100 listed for the subchronic inhalation RfD for bromomethane reflects an uncertainty factor of 100 and a modifying factor of 1.

RfD values are specific for the route of exposure for which they are listed on Table A. In the few instances where an oral RfD has been extrapolated from inhalation data, the extrapolation is indicated by footnoting the value.

The interim methods for the derivation of inhalation RfDs were adopted by the Agency in 1988. These methods are different from those used for oral RfDs because of (1) the dynamics of the respiratory system and its diversity across species, and (2) differences in the physicochemical properties of contaminants (such as the size and shape of a particle or whether the contaminant is an aerosol or a gas). Parameters such as deposition, clearance mechanisms and the physicochemical properties of the inhaled agent are taken into the determination of the effective dose delivered to the target organ. Additional information concerning this methodology can be found in "Interim Methods for Development of Inhalation Reference Doses" (U.S. EPA, 1989, EPA/600/8-88/066F). An RfD value calculated using this interim methodology is generally reported as a concentration in air (mg/m^3), although it may be converted to a corresponding inhaled dose ($\text{mg}/\text{kg}/\text{day}$) by dividing by 70 kg (an assumed human body weight) and multiplying by 20 m^3/day (an inhalation rate).

RfD values reported in HEAs and early HEEDs, that were finalized prior to the implementation of the interim methods, were calculated using methods similar in concept to those used for oral RfDs and the values are reported both as a concentration in air (in mg/m^3 for continuous, 24 hours/day exposure) and as a corresponding inhaled dose (in $\text{mg}/\text{kg}/\text{day}$).

RfD values for oral exposure are reported as $\text{mg}/\text{kg}/\text{day}$. An oral RfD value can be converted to a corresponding concentration in drinking water, assuming human body weight of 70 kg and water consumption of 2 l/day , as follows:

$$\text{mg/l in water} = \frac{\text{oral RfD (in mg/kg/day)} \times 70 \text{ kg}}{2 \text{ l/day}}$$

The RfD is used as a reference point for gauging the potential effects of other doses. Usually, doses that are less than the RfD are not likely to be associated with health risks. As the frequency of exposures exceeding the RfD increases, and as the size of the excess increases, the probability increases that adverse health effects may be observed in a human population. Nonetheless, a clear distinction that would categorize all doses below the RfD as "acceptable" (risk-free) and all doses in excess of the RfD as "unacceptable" (causing adverse effects) cannot be made. In addition, RfD values, and particularly those with limitations in the quality or quantity of supporting data, are subject to change as additional information becomes available.

When RfD values are listed for chemicals that are carcinogens, the entry under "Effect of Concern" in Table A will list cancer and will refer to Table B if additional information concerning carcinogenicity is available in

that table. RfD values that have been derived for carcinogens are based on noncancer endpoints only and should not be assumed to be protective against carcinogenicity.

Table B: Carcinogenicity

In assessing the carcinogenic potential of a chemical, the Human Health Assessment Group (HHAG) of the U.S. EPA classifies the chemical into one of the following groups, according to the weight of evidence from epidemiological studies and animal studies:

- Group A - Human Carcinogen (sufficient evidence of carcinogenicity in humans)
- Group B - Probable Human Carcinogen (B1 - limited evidence of carcinogenicity in humans; B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans)
- Group C - Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data)
- Group D - Not Classifiable as to Human Carcinogenicity (inadequate or no evidence)
- Group E - Evidence of Noncarcinogenicity for Humans (no evidence of carcinogenicity in adequate studies).

These classifications are shown under "EPA Group" on Table B.

Quantitative carcinogenic risk assessments are performed for chemicals in Groups A and B, and on a case-by-case basis for chemicals in Group C. Cancer slope factors (formerly called cancer potency factors in the Superfund Public Health Evaluation Manual) are estimated through the use of mathematical extrapolation models, most commonly the linearized multistage model, for estimating the largest possible linear slope (within the 95% confidence limit) at low extrapolated doses that is consistent with the data. The slope factor or risk is characterized as an upper-bound estimate, i.e., the true risk to humans, while not identifiable, is not likely to exceed the upper-bound estimate and in fact may be lower.

Quantitative carcinogenic estimates listed in Table B include the following:

slope factor = risk per unit dose = risk per mg/kg/day

route-specific unit risk for inhalation exposure = risk per concentration unit in air = risk per $\mu\text{g}/\text{m}^3$

Unit risk estimates for inhalation and oral exposure can be calculated by dividing the appropriate slope factor by 70 kg and multiplying by the inhalation rate ($20 \text{ m}^3/\text{day}$) or the water consumption rate (2 L/day), respectively, for risk associated with unit concentration in air or water. Hence,

$$\text{risk per } \mu\text{g}/\text{m}^3 \text{ (air)} = \frac{\text{slope factor (risk per mg/kg/day)} \times \frac{1}{70 \text{ kg}} \times 20 \text{ m}^3/\text{day} \times 10^{-3} \text{ (mg}/\mu\text{g)}}{}$$

$$\text{risk per } \mu\text{g}/\text{L} \text{ (water)} = \frac{\text{slope factor (risk per mg/kg/day)} \times \frac{1}{70 \text{ kg}} \times 2 \text{ L/day} \times 10^{-3} \text{ (mg}/\mu\text{g)}}{}$$

Quantitative estimates of carcinogenic risk are listed under "Unit Risk [slope factor]" in Table B. Information on the study and data set used for estimation of the slope factor is given in the other columns of Table B. In the "Exposure" and "Reference" columns, information for the inhalation route is given first, separated from information for the oral route by a semicolon or slash.

Quantitative carcinogenic estimates are specific for the route of exposure for which they are listed on Table B. Footnotes are used in Table B to indicate those instances in which the values for inhalation or oral exposure are based on extrapolation from another route of exposure.

To estimate risk-specific concentrations in air from the unit risk in air as presented in Table B, the specified level of risk is divided by the

unit risk for air. Hence the air concentration (in $\mu\text{g}/\text{m}^3$) corresponding to an upper-bound increased lifetime cancer risk of 1×10^{-5} is calculated as follows:

$$\mu\text{g}/\text{m}^3 \text{ in air} = \frac{1 \times 10^{-5}}{\text{unit risk in } (\mu\text{g}/\text{m}^3)^{-1}}$$

To estimate risk-specific concentrations in drinking water from the oral slope factor values presented in Table B, the specified level of risk is multiplied by 70 kg and divided by the slope factor and by 2 l/day. Hence, the water concentration corresponding to an upper-bound increased lifetime cancer risk of 1×10^{-5} is calculated as follows:

$$\text{mg}/\text{l} \text{ in water} = \frac{1 \times 10^{-5} \text{ } 70 \text{ kg}}{\text{slope factor in } (\text{mg}/\text{kg}/\text{day})^{-1} \times 2 \text{ l}/\text{day}}$$

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A. SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation, Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Acenaphthene subchronic (RfD _S)	NA; 175 mg/kg/day by gavage for 90 days	NA	mouse	NA; hepatotoxicity	ND	6E-1	NA	300	U S. EPA, 1989
chronic (RfD)	NA; 175 mg/kg/day by gavage for 90 days	NA	mouse	NA; hepatotoxicity	ND	6E-2 ¹	NA	3000	U S. EPA, 1989
Acenaphthylene	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U S. EPA, 1987
Acephate subchronic (RfD _S)	NA; 2 ppm in the diet for 13 weeks (0.135 mg/kg/day)	NA	rat	NA; inhibition of brain AChase	ND	4E-3	NA	30	U S. EPA, 1990/ Chevron Chem Co., 1989; U.S. EPA, 1984, U.S. EPA, 1990
chronic (RfD)	NA; 2 ppm in the diet for 13 weeks (0.135 mg/kg/day)	NA	rat	NA; inhibition of brain AChase (also see Table B)	ND	4E-3 ^a	NA	30	U S. EPA, 1987/ Chevron Chem Co., 1989, U.S. EPA, 1984, U S. EPA, 1989
Acetone subchronic (RfD _S)	NA; 100 mg/kg/day for 90 days by gavage	NA	rat	NA; increased liver and kidney weight, nephro- toxicity	ND	NA	NA	100	U S. EPA, 1988/ U S. EPA, 1986, 1988, 1990
chronic (RfD)	NA; 100 mg/kg/day for 90 days by gavage	NA	rat	NA; increased liver and kidney weight, nephro- toxicity	ND	1E-1 ^{a,1}	NA	1000	U S. EPA, 1988/ U S. EPA, 1986, 1988, 1990
Acetone cyanohydrin subchronic (RfD _S)	10.1 ppm (35.2 mg/m ³) 6 hours/day, 5 days/week for 14 weeks (4.0 mg/kg/ day); 10.8 mg CN/kg/day for 104 weeks from diet treated with HCN	rat	rat	CNS signs; body weight, thyroid and CNS effects	1E-1 (4E-2)	7E-2 ⁿ	100	500	Blank and Ihake 1984, U S. EPA, 1988/Howard and Hanzal, 1955, U S. EPA, 1985a,b, 1988

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update. March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	10.1 ppm (35.2 mg/m ³) 6 hours/day, 5 days/week for 14 weeks (4.0 mg/kg/ day), 10.8 mg CN/kg/day for 104 weeks from diet treated with HCN	rat	rat	CNS signs; body weight, thyroid and CNS effects	1E-1 (4E-2)	7E-2 ⁿ	100	500	Blank and Thake, 1984; U.S. EPA, 1988/Howard and Hanzal, 1955, U.S. EPA, 1985a,b, 1988
Acetonitrile subchronic (RfD _s)	100 ppm (168 mg/m ³) 6 hours/day, 65/92 days (39.0 mg/kg/day); 100 ppm (168 mg/m ³) 6 hours/day, 65/92 days (19.3 mg/kg/day)	mouse	mouse	elevated relative liver weight, elevated relative liver weight	5E-1 (1E-1)	6E-2	300	300	Coate, 1983, U.S. EPA, 1987/ Coate, 1983, U.S. EPA, 1987, 1990
chronic (RfD)	100 ppm (168 mg/m ³) 6 hours/day, 65/92 days (39.0 mg/kg/day); 100 ppm (168 mg/m ³) 6 hours/day, 65/92 days (19.3 mg/kg/day)	mouse	mouse	decreased RBC counts and hemato- crit and hepatic lesions; decreased RBC counts and hematocrit and hepatic lesions	5E-2 (1E-2)	6E-3 ^{b,z}	3000	3000	Coate, 1983; U.S. EPA, 1987/ Coate, 1983; U.S. EPA, 1987, 1990
Acetophenone subchronic (RfD _s)	0.007 mg/m ³ contin- uously for 70 days (0.0045 mg/kg/day); 10,000 ppm diet (8450 ppm, correcting for volatilization) for 17 weeks (423 mg/kg/day)	rat	rat	congestion of cardiac vessels and liver dys- trophy, reduced albumin/globulin ratio; none observed	2E-4(5E-5)	1E+0	100	300	Imasheva, 1966; U.S. EPA, 1987/ Hagan et al., 1967; U.S. EPA, 1990
chronic (RfD)	0.007 mg/m ³ contin- uously for 70 days (0.0045 mg/kg/day); 10,000 ppm diet (8450 ppm, correcting for volatilization) for 17 weeks (423 mg/kg/day)	rat	rat	congestion of cardiac vessels and liver dys- trophy, reduced albumin/globulin ratio; none observed	2E-5(5E-6)	1E-1 ^a	1000	3000	Imasheva, 1966; U.S. EPA, 1987/ Hagan et al., 1967; U.S. EPA, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Acrolein subchronic (RfD _S)	0.4 ppm, 6 hours/day, 5 days/week for 62 days; NA	rat	NA	pulmonary function and lung composi- tion; NA	1E-3	ND	300	NA	Costa et al., 1986, Kutzman, 1981, 1985, U.S. EPA, 1981/ U.S. EPA, 1981
chronic (RfD)	0.4 ppm, 6 hours/day, 5 days/week for 62 days; NA	rat	NA	pulmonary function and lung composi- tion; NA (also see Table B)	1E-4	ND	3000	NA	Costa et al., 1986, Kutzman, 1981, 1985, U.S. EPA, 1981, 1989/U.S. EPA, 1981
Acrylamide subchronic (RfD _S)	NA; 0.2 mg/kg/day in the drinking water for 90 days	NA	rat	NA; nerve damage	ND	2E-3	NA	100	U.S. EPA, 1990/ Burek et al., 1980; U.S. EPA, 1985, U.S. EPA, 1990
chronic (RfD)	NA; 0.2 mg/kg/day in the drinking water for 90 days	NA	rat	NA; nerve damage (also see Table B)	ND	2E-4 ^a	NA	1000	U.S. EPA, 1990/ Burek et al., 1980, U.S. EPA, 1985, U.S. EPA, 1990
Acrylic acid subchronic (RfD _S)	NA, 83 mg/kg/day in the water for 3 months	NA	rat	NA; reduced body weight, altered organ weights	ND	8E-1	NA	100	U.S. EPA, 1984/ DePass et al., U.S. EPA, 1984, 1990
chronic (RfD)	NA, 83 mg/kg/day in the water for 3 months	NA	rat	NA, reduced body weight, altered organ weights	ND	8E-2 ^a	NA	1000	U.S. EPA, 1984/ DePass et al., U.S. EPA, 1984, 1990
Adiponitrile				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1981

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation, Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Alachlor subchronic (RfD _s)	NA; 1 mg/kg/day by gavage for 1 year	NA	dog	NA; hemolytic anemia, hemo- siderosis (also see Table B)	ND	1E-2	NA	100	U.S. EPA, 1990/ Monsanto Company, 1984, U.S. EPA, 1984; U.S. EPA, 1990
	chronic (RfD)	NA	dog	NA; hemolytic anemia, hemo- siderosis	ND	1E-2 ^a	NA	100	U.S. EPA, 1990/ Monsanto Company, 1984; U.S. EPA, 1984; U.S. EPA, 1990
Aldrin subchronic (RfD _s)	NA; 0.5 ppm in diet for 2 years (0.025 mg/kg/day)	NA	rat	NA; liver lesions	ND	3E-5	NA	1000	NA/Fitzhugh, et al., 1964; U.S. EPA, 1990, 1987
	chronic (RfD)	NA	rat	NA; liver lesions (also see Table B)	ND	3E-5 ^a	NA	1000	NA/Fitzhugh et al., 1964, U.S. EPA, 1990, 1987
Allidochlor	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U.S. EPA, 1984
Allyl alcohol subchronic (RfD _s)	NA; 50 ppm in the drinking water for 15 weeks (4.8 mg/kg/day)	NA	rat	NA; liver and kidney	ND	5E-2	NA	100	U.S. EPA, 1985, 1990/ Carpinini et al., 1978; U.S. EPA, 1985, 1990
	chronic (RfD)	NA	rat	NA; liver and kidney	ND	5E-3 ^a	NA	1000	U.S. EPA, 1985, 1990/ Carpinini et al., 1978; U.S. EPA, 1985, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation, Oral	Species		Effect of Concern Inhalation; Oral.	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Allyl chloride (3-chloropropene)									
subchronic (RfD _S)	occupational; NA	human	NA	liver; NA	ND	2E-3 ^b	NA	100	U.S. EPA, 1983/ ACGIH, 1980; U.S. EPA, 1983
chronic (RfD)	occupational; NA	human	NA	liver; NA (also see Table B)	ND	2E-3 ^b	NA	100	U.S. EPA, 1983/ ACGIH, 1980, U.S. EPA, 1983
Aluminum				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
Ametryn									
subchronic (RfD _S)	NA; 10 mg/kg/day, 6 days/week for 13 weeks by gavage	NA	rat	NA; liver	ND	9E-2	NA	100	U.S. EPA, 1990/ Ciba-Geigy, 1961; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 10 mg/kg/day, 6 days/week for 13 weeks by gavage	NA	rat	NA; liver	ND	9E-3 ^a	NA	1000	U.S. EPA, 1990/ Ciba-Geigy, 1961; U.S. EPA, 1984, 1990
1-Amino-2-naphthol and 1-Amino-2-naphthol hydrochloride				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986
m-Aminophenol									
subchronic (RfD _S)	NA; 1300 ppm in the diet for 13 weeks (65 mg/kg/day)	NA	rat	NA; thyroid and body weight	ND	7E-1	NA	100	NA/Re et al., 1984; U.S. EPA, 1985
chronic (RfD)	NA; 1300 ppm in the diet for 13 weeks (65 mg/kg/day)	NA	rat	NA; thyroid and body weight	ND	7E-2	NA	1000	NA/Re et al., 1984, U.S. EPA, 1985
o-Aminophenol				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
p-Aminophenol				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
4-Aminopyridine									
subchronic (RfD _S)	NA; 3 ppm in diet for 90 days (0.15 mg/kg/day)	NA	rat	NA; increased liver (males) and brain weight (females)	ND	2E-4	NA	1000	U.S. EPA, 1989/ Kohn, 1968, U.S. EPA, 1980, 1989

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation, Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA, 3 ppm in diet for 90 days (0.15 mg/kg/day)	NA	rat	NA; increased liver (males) and brain weight (females)	ND	2E-59	NA	10,000	U.S. EPA, 1989/ Kohn, 1968, U.S. EPA, 1980, 1989
Ammonia subchronic (RfD _s)	0.36 mg/m ³ continuous; 9934 mg/l in drinking water	human	human	odor threshold, taste threshold	0.36 ^c	34 mg/l in drinking water ^d	none	none	Carson et al., 1981; U.S. EPA, 1987/Campbell et al., 1958, U.S. EPA, 1981, 1987, WHO, 1986
chronic (RfD)	0.36 mg/m ³ continuous; 34 mg/l in drinking water	human	human	odor threshold; taste threshold	0.36 ^{c,g}	34 mg/l in drinking water ^d	none	none	Carson et al., 1981, U.S. EPA, 1987/Campbell et al., 1958, U.S. EPA, 1981, 1987; WHO, 1986
Anthracene subchronic (RfD _s)	NA; 1000 mg/kg/day by gavage for 90 days	NA	mouse	NA; No effects	NA	3E+0	NA	300	U.S. EPA, 1987, U.S. EPA, 1989
chronic (RfD _s)	NA; 1000 mg/kg/day by gavage for 90 days	NA	mouse	NA; No effects	NA	3E-11.1	NA	3000	
Antimony subchronic (RfD _s)	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day)	NA	rat	cancer; reduced lifespan, altered blood chemistries	ND ^e	4E-4	NA	1000	U.S. EPA, 1987/ Schroeder et al., 1970; U.S. EPA, 1990
chronic (RfD)	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day)	NA	rat	cancer; reduced lifespan, altered blood chemistries	ND ^e	4E-4 ^a	NA	1000	U.S. EPA, 1987/ Schroeder et al., 1970, U.S. EPA, 1985, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation, Oral	Species		Effect of Concern- Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Antimony pentoxide subchronic (RfD _S)	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day, 0.46 mg Sb ₂ O ₅ kg/day)	NA	rat	cancer; reduced lifespan, altered blood chemistries	ND ^e	5E-4 ^f	NA	1000	U.S. EPA, 1987/ Schroeder et al., 1970; U.S. EPA, 1990
chronic (RfD)	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day, 0.46 mg Sb ₂ O ₅ kg/day)	NA	rat	cancer; reduced lifespan, altered blood chemistries	ND ^e	5E-4 ^f	NA	1000	U.S. EPA, 1987/ Schroeder et al., 1970; U.S. EPA, 1985, 1987, 1990
Antimony potassium tartrate subchronic (RfD _S)	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day, 0.93 mg SbK tartrate/ kg/day)	NA	rat	cancer; reduced lifespan, altered blood chemistries	ND ^e	9E-4 ^f	NA	1000	U.S. EPA, 1987/ Schroeder et al., 1970; U.S. EPA, 1990
chronic (RfD)	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day, 0.93 mg SbK tartrate/ kg/day)	NA	rat	cancer; reduced lifespan, altered blood chemistries	ND ^e	9E-4 ^f	NA	1000	U.S. EPA, 1987/ Schroeder et al., 1970; U.S. EPA, 1987, 1990
Antimony tetroxide subchronic (RfD _S)	NA; 5 ppm Sb from anti- mony potassium tartrate in drinking water, life- time (0.35 mg Sb/kg/day, 0.44 mg Sb ₂ O ₄ /kg/day)	NA	rat	cancer; reduced lifespan, altered blood chemistries	ND ^e	4E-4 ^f	NA	1000	U.S. EPA, 1987/ Schroeder et al., 1970; U.S. EPA, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 5 ppm Sb from anti-mony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day, 0.44 mg Sb ₂ O ₄ /kg/day)	NA	rat	cancer; reduced lifespan, altered blood chemistries	ND ^e	4E-4 ^f	NA	1000	U.S. EPA, 1987/Schroeder et al., 1970; U.S. EPA, 1985, 1987, 1990
Antimony trioxide subchronic (RfD _S)	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day, 0.42 mg Sb ₂ O ₃ /kg/day)	NA	rat	cancer; reduced lifespan, altered blood chemistries	ND ^e	4E-4 ^f	NA	1000	U.S. EPA, 1987/Schroeder et al., 1970; U.S. EPA, 1990
chronic (RfD)	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day, 0.42 mg Sb ₂ O ₃ /kg/day)	NA	rat	cancer; reduced lifespan, altered blood chemistries	ND ^e	4E-4 ^f	NA	1000	U.S. EPA, 1987/Schroeder et al., 1970; U.S. EPA, 1985, 1987, 1990
Aramite subchronic (RfD _S)	NA; 500 ppm in diet for 52 weeks (12.5 mg/kg/day)	NA	dog	NA; degenerative liver effect	ND	1E-1	NA	100	U.S. EPA, 1989/Oser and Oser, 1960
chronic (RfD)	NA; 100 ppm in diet for 104 weeks (5 mg/kg/day)	NA	rat	NA; increased liver weight (also see Table B)	ND	5E-2	NA	100	U.S. EPA, 1989/Popper et al., 1960; Oser and Oser, 1962
Arsenic subchronic (RfD _S)	NA; 1 µg/kg/day	NA	human	NA; keratosis and hyperpigmentation	ND	1E-3	NA	1	U.S. EPA, 1984/Tseng, 1977
chronic (RfD)	NA; 1 µg/kg/day	NA	human	cancer; keratosis and hyperpigmentation (also see Table B)	ND	1E-3 ^g	NA	1	U.S. EPA, 1984/Tseng, 1977

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Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation, Oral	Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
Atrazine subchronic (RfD _s)	NA; 15 ppm in the diet for 52 weeks (0.5 mg/kg/day)	NA	dog	NA, cardiac effects	ND	5E-3	NA	100	U S EPA, 1990/ Ciba-Geigy, 1987, U S EPA, 1984, 1990
chronic (RfD)	NA, 15 ppm in the diet for 52 weeks (0.5 mg/kg/day)	NA	dog	NA, cardiac effects	ND	5E-3 ^y	NA	100	U S EPA, 1990/ Ciba-Geigy, 1987, U S EPA, 1984, 1990
Barium subchronic (RfD _s)	1.15 mg BaCO ₃ /m ³ (0.80 mg Ba/m ³) 4 hours/day for 4 months (0.14 mg Ba/kg/day); 100 ppm Ba from BaCl ₂ (5.1 mg Ba/kg/day) in drinking water for 4 <16 months	rat	rat	fetotoxicity; increased blood pressure	5E-3 (1E-3) ^{bb}	5E-2	100	100	Iaraskenko et al, 1977, U S EPA, 1984/ Perry et al, 1983, U S EPA, 1990
chronic (RfD)	1.15 mg BaCO ₃ /m ³ (0.80 mg Ba/m ³) 4 hours/day for 4 months (0.14 mg Ba/kg/day), 100 ppm Ba from BaCl ₂ (5.1 mg Ba/kg/day) in drinking water for ≤16 months	rat	rat	fetotoxicity; increased blood pressure	5E-4 (1E-4) ^{bb}	5E-2 ^z	1000	100	Iaraskenko et al, 1977, U S EPA, 1984/ Perry et al, 1983, U S EPA, 1984, 1985, 1990
Benefin subchronic (RfD _s)	NA; 25 mg/kg/day in the diet for 1 year	NA	dog	NA; hematological effects	ND	3E-1	NA	100	U S EPA, 1990/ Eli Lilly Co., 1972, U S EPA, 1984, 1990
chronic (RfD)	NA, 25 mg/kg/day in the diet for 1 year	NA	dog	NA, hematological effects	ND	3E-1 ^a	NA	100	U S EPA, 1990/ Eli Lilly Co., 1972, U S EPA, 1984, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Benzal chloride				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
Benzaldehyde subchronic (RfD _s)	NA; 200 mg/kg/day by gavage 5 days/week for 13 weeks	NA	rat	NA; kidney, forestomach	ND	1E+0	NA	100	U.S. EPA, 1990/ Kluwe et al., 1983; U.S. EPA, 1985, 1990
chronic (RfD)	NA; 200 mg/kg/day by gavage 5 days/week for 13 weeks	NA	rat	NA; kidney, forestomach	ND	1E-1 ^a	NA	1000	U.S. EPA, 1990/ Kluwe et al., 1983; U.S. EPA, 1985, 1990
Benzaldehyde cyanohydrin				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1988
Benzidine subchronic (RfD _s)	NA; 160 ppm benzidine dihydrochloride in drinking water for 33 months (27.2 mg/kg/day)	NA	mouse	NA; brain cell and liver cell changes	ND	3E-3	NA	1000	U.S. EPA, 1987/ Littlefield et al., 1983; U.S. EPA, 1990
chronic (RfD)	NA; 160 ppm benzidine dihydrochloride in drinking water for 33 months (27.2 mg/kg/day)	NA	mouse	NA; brain cell and liver cell changes (also see Table B)	ND	3E-3 ^a	NA	1000	U.S. EPA, 1987/ Littlefield et al., 1983; U.S. EPA, 1990
Benzoic acid subchronic (RfD _s)	NA; per capita daily dietary intake of benzoic acid equiva- lent to 312 mg/day	NA	human	NA; irritation, malaise	ND	4E+0	NA	1	U.S. EPA, 1987/ FASEB, 1973; U.S. EPA, 1987
chronic (RfD)	NA; per capita daily dietary intake of benzoic acid equiva- lent to 312 mg/day	NA	human	NA; irritation, malaise	ND	4E+0 ^a	NA	1	U.S. EPA, 1987/ FASEB, 1973; U.S. EPA, 1987, 1990
Benzyl Alcohol subchronic (RfD _s)	NA; 200 mg/kg by gavage 5 days/week for 13 weeks (143 mg/kg/day)	NA	rat	NA; decrease in body weight	ND	1E+0	NA	1000	U.S. EPA, 1989/ NTP, 1988; U.S. EPA, 1989

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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 400 mg/kg by gavage 5 days/week for 103 weeks (286 mg/kg/day)	NA	rat	NA; hyperplasia of the epithelium of the forestomach	ND	3E-1	NA	1000	U.S. EPA, 1989/ NTP, 1988; U.S. EPA, 1989
Beryllium subchronic (RfD _s)	NA; 5 ppm in drinking water for lifetime (0.54 mg/kg/day)	NA	rat	NA; none observed	ND	5E-3	NA	100	U.S. EPA, 1987/ Schroeder and Mitchener, 1975; U.S. EPA, 1990
chronic (RfD)	NA; 5 ppm in drinking water for lifetime (0.54 mg/kg/day)	NA	rat	NA; none observed (also see Table B)	ND	5E-3 ^a	NA	100	U.S. EPA, 1987/ Schroeder and Mitchener, 1975; U.S. EPA, 1990
1,1'-Biphenyl subchronic (RfD _s)	NA; 0.1% in the diet for 700 days (50 mg/kg/day)	NA	rat	NA; kidney damage	ND	5E-2	NA	1000	NA/Ambrose et al., 1960; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 0.1% in the diet for 700 days (50 mg/kg/day)	NA	rat	NA; kidney damage	ND	5E-2 ^a	NA	1000	NA/Ambrose et al., 1960; U.S. EPA, 1984, 1990
Bis(2-ethylhexyl) phthalate subchronic (RfD _s)	NA; 0.04% of diet for 1 year (19 mg/kg/day)	NA	guinea pig	NA; increased relative liver weight	ND	2E-2	NA	1000	U.S. EPA, 1987/ Carpenter et al., 1953; U.S. EPA, 1990
chronic (RfD)	NA; 0.04% of diet for 1 year (19 mg/kg/day)	NA	guinea pig	NA; increased relative liver weight (also see Table B)	ND	2E-2 ^a	NA	1000	U.S. EPA, 1987/ Carpenter et al., 1953; U.S. EPA, 1990
Bisphenol A subchronic (RfD _s)	NA; 0-1000 ppm for 18 weeks, 2 generations (NOAEL 750 ppm = 62 mg/kg/day)	NA	rat	NA; reduced body weight	ND	6E-1	NA	100	U.S. EPA, 1988/ U.S. EPA, 1984, 1988, 1990

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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 0, 1,000, 2,000 ppm (1000 ppm = 50 mg/kg/day)	NA	rat	NA; reduced body weight	ND	5E-2 ^a	NA	1,000	U.S. EPA, 1988a/ NTP, 1982; U.S. EPA, 1988, 1990
Boron subchronic (RfD _s)	NA; 350 ppm in diet (8.75 mg/kg/day) for 2 years	NA	dog	NA; testicular lesions	ND	9E-2	NA	100	U.S. EPA, 1987/ Weir and Fisher, 1972; U.S. EPA, 1987
chronic (RfD)	NA; 350 ppm in diet (8.75 mg/kg/day) for 2 years	NA	dog	NA; testicular lesions	ND	9E-2 ^b	NA	100	U.S. EPA, 1987/ Weir and Fisher, 1972; U.S. EPA, 1987
Brominated dibenzo-p-dioxins and dibenzofurans				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (also see Table B)					U.S. EPA, 1985a,b, 1986
Bromoacetone				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986
Bromochloroethane				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
Bromodichloromethane subchronic (RfD _s)	NA; 25 mg/day by gavage 5 days/week for 102 weeks (17.9 mg/kg/day)	NA	mouse	NA; renal cytomegaly	ND	2E-2	NA	1000	U.S. EPA, 1987/ NTP, 1986/ U.S. EPA, 1990
chronic (RfD)	NA; 25 mg/day by gavage 5 days/week for 102 weeks (17.9 mg/kg/day)	NA	mouse	NA, renal cytomegaly (also see Table B)	ND	2E-2 ^a	NA	1000	U.S. EPA, 1987/ NTP, 1986; U.S. EPA, 1990
Bromoform subchronic (RfD _s)	NA; 25 mg/kg by gavage 5 days/week for 13 weeks (17.9 mg/kg/day)	NA	rat	NA; liver effects	ND	2E-1	NA	100	U.S. EPA, 1987/ NTP, 1988; U.S. EPA, 1989, 1990

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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 25 mg/kg by gavage 5 days/week for 13 weeks (17.9 mg/kg/day)	NA	rat	NA; liver effects (also see Table B)	ND	2E-2 ^a	NA	1000	U.S. EPA, 1987/ NTP, 1988; U.S. EPA, 1989, 1990
Bromomethane subchronic (RfD _S)	26.6 ppm (103 mg/m ³) 7.5 hours/day, 4 days/ week for 8 months (HEC= 18 mg/m ³); 2 mg/kg 5 days/week for 13 weeks (1.4 mg/kg/day)	rabbit	rat	neurotoxicity; hyperplasia of forestomach epithelium	6E-2	1E-2	300	100	Russo et al., 1984/Danse et al., 1984; U.S. EPA, 1987
chronic (RfD)	26.6 ppm (103 mg/m ³) 7.5 hours/day, 4 days/ week for 8 months (HEC= 18 mg/m ³); 2 mg/kg 5 days/week for 13 weeks (1.4 mg/kg/day)	rabbit	rat	neurotoxicity; hyperplasia of forestomach epithelium	6E-2 ^b	1E-3 ^a	3000	1000	Russo et al., 1984/Danse et al., 1984; U.S. EPA, 1986a, 1987, 1990
4-Bromophenyl phenyl ether				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986
Bromophos subchronic (RfD _S)	NA; 5 mg/kg/day in the diet for 3 generations	NA	rat	NA; depression of plasma and liver cholin- esterase	ND	5E-2	NA	100	U.S. EPA, 1986/ Leuschner et al., 1967; U.S. EPA, 1986
chronic (RfD)	NA; 5 mg/kg/day in the diet for 3 generations	NA	rat	NA; depression of plasma and liver cholin- esterase (also see Table B)	ND	5E-3	NA	1000	U.S. EPA, 1986/ Leuschner et al., 1967; U.S. EPA, 1986
Bromoxynil subchronic (RfD _S)	NA; 100 ppm in the diet for 2 years (5 mg/kg/ day)	NA	rat	NA; no adverse effects	ND	2E-2	NA	300	U.S. EPA, 1990/ Union Carbide, 1982; U.S. EPA, 1984, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation, Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 100 ppm in the diet for 2 years (5 mg/kg/day)	NA	rat	NA; no adverse effects	ND	2E-2 ^a	NA	300	U.S. EPA, 1990/Union Carbide, 1982; U.S. EPA, 1984, 1990
Bromoxynil octanoate subchronic (RfD _S)	NA; 100 ppm in the diet for 2 years (5 mg/kg/day)	NA	rat	NA; no adverse effects	ND	2E-2	NA	300	U.S. EPA, 1990/Union Carbide, 1982; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 100 ppm in the diet for 2 years (5 mg/kg/day)	NA	rat	NA; no adverse effects	ND	2E-2 ^a	NA	300	U.S. EPA, 1990/Union Carbide, 1982; U.S. EPA, 1984, 1990
Busan 77				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Busan 90				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
1-Butanol Subchronic (RfD _S)	NA; 125 mg/kg/day by gavage for 13 weeks	NA	rat	NA; effects on erythrocyte	ND	1E+0	ND	100	U.S. EPA, 1989/ U.S. EPA, 1986, 1989, 1990
chronic (RfD)	NA; 125 mg/kg/day by gavage for 13 weeks	NA	rat	NA; effects on erythrocyte	ND	1E-1 ^a	ND	1000	U.S. EPA, 1989/ U.S. EPA, 1986, 1989, 1990
Butylate subchronic (RfD _S)	NA; 5 mg/kg/day by gavage for 12 months	NA	dog	NA; liver effects	ND	5E-2	NA	100	U.S. EPA, 1984/ Stauffer Chem. Co., 1987; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 5 mg/kg/day by gavage for 12 months	NA	dog	NA; liver effects	ND	5E-2 ^a	NA	100	U.S. EPA, 1984/ Stauffer Chem. Co., 1987, U.S. EPA, 1984, 1989, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	Inhalation [mg/m ³]	Oral [mg/kg/day]	Inhalation	Oral	Inhalation/Oral
Butyl benzyl phthalate subchronic (RfD _s)	NA; 0.28% of diet for 26 weeks (159 mg/kg/day)	NA	rat	NA; effects on body weight gain, testes, liver, kidney	ND	2E+0	NA	100	U.S. EPA, 1987 1989/NTP, 1985; U.S. EPA, 1986, 1987, 1989, 1990
chronic (RfD)	NA; 0.28% of diet for 26 weeks (159 mg/kg/day)	NA	rat	NA; effects on body weight gain, testes, liver, kidney (also see Table B)	ND	2E-1 ^a	NA	1000	U.S. EPA, 1987 1989/NTP, 1985; U.S. EPA, 1986, 1987, 1989, 1990
t-Butylchloride				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1988/ U.S. EPA, 1988
Butyrolactone, gamma				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Cacodylic acid subchronic (RfD _s)	NA; 184 mg/kg cacodylic acid in diet for 90 days (9.2 mg/kg/day)	NA	rat	NA; none	NA	3E-2 ^{cc}	NA	300	U.S. EPA, 1989/ Nees, 1968; U.S. EPA, 1989
chronic (RfD)	NA; 184 mg/kg cacodylic acid in diet for 90 days (9.2 mg/kg/day)	NA	rat	NA; none	NA	3E-3 ^{g,cc}	NA	3000	U.S. EPA, 1989/ Nees, 1968; U.S. EPA, 1989
Cadmium subchronic (RfD _s)	NA; NA	NA	NA	cancer; NA	ND	ND ^h	NA	NA	U.S. EPA, 1984/ U.S. EPA, 1984
chronic (RfD)	NA; NA	NA	human	cancer (see Table B); renal damage	ND	1E-3 (food) ^{a,1} 5E-4 (water)	NA	10	U.S. EPA, 1984/ U.S. EPA, 1988, 1990
Caprolactam subchronic (RfD _s)	NA; 0.1% diet 90 days (50 mg/kg/day)	NA	rat	NA; renal effects	ND	5E-1	NA	100	U.S. EPA, 1988/ Powers et al., 1984; U.S. EPA, 1988
chronic (RfD)	NA; 1000 ppm for 3 generations (50 mg/kg/day)	NA	rat	NA; reduced body weight	ND	5E-1 ^a	NA	100	U.S. EPA, 1988a/ Serota et al., 1984; U.S. EPA, 1988, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Captafol subchronic (RfD _s)	NA; 2 mg/kg/day in capsules for 12 months	NA	dog	NA; kidney and bladder effects	ND	2E-3	NA	1000	U.S. EPA, 1990/Ortho-Chevron Chemical Co., 1985; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 2 mg/kg/day in capsules for 12 months	NA	dog	NA; kidney and bladder effects (also see Table B)	ND	2E-3 ^a	NA	1000	U.S. EPA, 1990/Ortho-Chevron Chemical Co., 1985; U.S. EPA, 1984, 1990
Captan subchronic (RfD _s)	NA; 12.5 mg/kg/day in the diet (multi-generation)	NA	rats	NA; decreased body weight	ND	1E-1	NA	100	U.S. EPA, 1990/Stauffer Chem. Co., 1982; Chevron Chem. Co., 1982; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 12.5 mg/kg/day in the diet (multi-generation)	NA	rats	NA; decreased body weight	ND	1E-1 ^a	NA	100	U.S. EPA, 1990/Stauffer Chem. Co., 1982; Chevron Chem. Co., 1982; U.S. EPA, 1984, 1990
Carbaryl subchronic (RfD _s)	NA; 200 ppm in the diet for 2 years (9.6 mg/kg/day)	NA	rat	NA; kidney and liver toxicity	ND	1E-1	NA	100	U.S. EPA, 1990/Carpenter et al., 1961; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 200 ppm in the diet for 2 years (9.6 mg/kg/day)	NA	rat	NA; kidney and liver toxicity	ND	1E-1 ^a	NA	100	U.S. EPA, 1990/Carpenter et al., 1961; U.S. EPA, 1984, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Carbofuran subchronic (RfD _S)	NA; 0.5 mg/kg/day in the diet for 1 year	NA	dog	NA; hematolog- ical, testicular and uterine effects	ND	5E-3	NA	100	U.S. EPA, 1990/ FMC Corp., 1983; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 0.5 mg/kg/day in the diet for 1 year	NA	dog	NA; hematolog- ical, testicular and uterine effects	ND	5E-3 ^a	NA	100	U.S. EPA, 1990/ FMC Corp., 1983, U.S. EPA, 1984, 1990
Carbon tetrachloride subchronic (RfD _S)	NA; 1 mg/day, 5 days/ week for 12 weeks (0.71 mg/kg/day)	NA	rat	NA; liver lesions	ND	7E-3	NA	100	U.S. EPA, 1984/ Bruckner et al. 1986; U.S. EPA, 1990
chronic (RfD)	NA; 1 mg/day, 5 days/ week for 12 weeks (0.71 mg/kg/day)	NA	rat	NA; liver lesions (also see Table B)	ND	7E-4 ^a	NA	1000	U.S. EPA, 1984/ Bruckner et al., 1986; U.S. EPA, 1990
Chloral subchronic (RfD _S)	NA; 15.7 mg/kg/day from drinking water	NA	mouse	NA; hepatotoxicity	ND	2E-2	NA	1000	U.S. EPA, 1988/ Sanders et al., 1982; U.S. EPA, 1988
chronic (RfD)	NA; 15.7 mg/kg/day from drinking water	NA	mouse	NA; hepatotoxicity (also see Table B)	ND	2E-3 ^a	NA	10,000	U.S. EPA, 1988/ Sanders et al., 1982; U.S. EPA, 1988, 1990
Chlordane subchronic (RfD _S)	NA; 1 ppm in diet for 130 weeks (0.045 mg/kg/day)	NA	rat	NA; liver necrosis	ND	6E-5	NA	1000	U.S. EPA, 1988/ Velsicol Chemical Corp., 1983; U.S. EPA, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)

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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 1 ppm in diet for 130 weeks (0.045 mg/kg/day)	NA	rat	NA; liver necrosis (also see Table B)	ND	6E-5 ^a	NA	1000	U.S. EPA, 1988/Velsicol Chemical Corp., 1983; U.S. EPA, 1990
Chloroacetaldehyde				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1988
Chloroacetic acid subchronic (RfD _s)	NA; 30 mg/kg, 5 days/week for 13 weeks (21.4 mg/kg/day)	NA	rat	NA; myocarditis	ND	2E-2	NA	1000	U.S. EPA, 1988/IRDC, 1982; U.S. EPA, 1988
chronic (RfD)	NA; 30 mg/kg, 5 days/week for 13 weeks (21.4 mg/kg/day)	NA	rat	NA; myocarditis	ND	2E-3	NA	10,000	U.S. EPA, 1988/IRDC, 1982; U.S. EPA, 1988
2-Chloroaniline				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (SEE TABLE B)					U.S. EPA, 1987
3-Chloroaniline				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (SEE TABLE B)					U.S. EPA, 1987
4-Chloroaniline (p-Chloroaniline) subchronic (RfD _s)	NA; 250 ppm in diet for 78 weeks (12.5 mg/kg/day)	NA	rat	NA; proliferative lesions of the spleen	ND	4E-3	NA	3000	U.S. EPA, 1987/NCI, 1979; U.S. EPA, 1990
chronic (RfD)	NA; 250 ppm in diet for 78 weeks (12.5 mg/kg/day)	NA	rat	NA; proliferative lesions of the spleen (also see Table B)	ND	4E-3 ^a	NA	3000	U.S. EPA, 1987/NCI, 1979; U.S. EPA, 1990
Chlorobenzene subchronic (RfD _s)	75 ppm (345 mg/m ³) 7 hours/day, 5 days/week for 120 days (53 mg/kg/day); 27.3 mg/kg/day by capsule for 90 days	rat	dog	liver and kidney effects; liver and kidney effects	2E-1 (5E-2)	2E-1	1000	100	Dille, 1977; U.S. EPA, 1984/Monsanto, 1967; U.S. EPA, 1985, 1989, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic (RfD)	75 ppm (345 mg/m ³) 7 hours/day, 5 days/ week for 120 days (53 mg/kg/day); 27.3 mg/kg/day by capsule for 90 days	rat	dog	liver and kidney effects; liver and kidney effects (also see Table B)	2E-2 (5E-3)	2E-2 ^a	10,000	1000	Dilley, 1977; U.S. EPA, 1984/ Monsanto, 1967; U.S. EPA, 1985, 1989, 1990
p-Chlorobenzoic acid subchronic (RfD _S)	NA; 0.2% in diet for 5 months (173.3 mg/kg/day)	NA	rat	NA; none observed	ND	2E+0	NA	100	U.S. EPA, 1987/ Kleeckebusch et al., 1960; U.S. EPA, 1987
chronic (RfD)	NA; 0.2% in diet for 5 months (173.3 mg/kg/day)	NA	rat	NA; none observed	ND	2E-1	NA	1000	U.S. EPA, 1987/ Kleeckebusch et al., 1960; U.S. EPA, 1987
4-Chlorobenzotrifluoride subchronic (RfD _S)	NA; 15 mg/kg/day by gavage daily for 90 days	NA	rat	NA; renal tubular degeneration	ND	2E-1	NA	100	U.S. EPA, 1988/ Hooker Chemical Co., 1981; U.S. EPA, 1988
chronic (RfD)	NA; 15 mg/kg/day by gavage daily for 90 days	NA	rat	NA; renal tubular degeneration	ND	2E-2	NA	1000	U.S. EPA, 1988/ Hooker Chemical Co., 1981; U.S. EPA, 1988
2-Chloro-1,3-butadiene (Chloroprene) subchronic (RfD _S)	10 ppm, 6 hours/day, 5 days/week for 2 years (36 mg/m ³); NA	rat	NA	alopecia, retarded growth; NA	1E-1(4E-2)	2E-2 ^{b,q}	100	NA	Du Pont, 1985; U.S. EPA, 1989/U.S. EPA, 1989
chronic (RfD)	10 ppm, 6 hours/day, 5 days/week for 2 years (36 mg/m ³); NA	rat	NA	alopecia, retarded growth; NA	1E-1(4E-2)	2E-2 ^{b,q}	100	NA	Du Pont, 1985; U.S. EPA, 1989/U.S. EPA, 1989

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation, Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
1-Chlorobutane									
subchronic (RfD) _s	NA, 120 mg/kg, 5 days/ week for 13 weeks by gavage (86 mg/kg/day)	NA	rat	NA, CNS and hematopoietic effects	ND	9E-1	NA	100	U.S. EPA, 1988/ NTP, 1986, U.S. EPA, 1988
chronic (RfD)	NA, 60 mg/kg, 5 days/ week for 103 weeks by gavage (43 mg/kg/day)	NA	rat	NA; mortality, CNS and hemato- logic effects	ND	4E-1 ¹	NA	100	U.S. EPA, 1988/ NTP, 1986, U.S. EPA, 1988
2-Chlorobutane				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹					U.S. EPA, 1988/ U.S. EPA, 1988
Chlorocyclopentadiene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1988
Chlorodibromomethane									
subchronic (RfD) _s	NA; 30 mg/kg 5 days/week for 13 weeks (21.4 mg/kg/day)	NA	NA	NA; liver lesions	ND	2E-1	NA	100	U.S. EPA, 1987/ NTP, 1985; U.S. EPA, 1990
chronic (RfD)	NA, 30 mg/kg 5 days/week for 13 weeks (21.4 mg/kg/day)	NA	rat	NA; liver lesions (also see Table B)	ND	2E-2 ^a	NA	1000	U.S. EPA, 1987/ NTP, 1985, U.S. EPA, 1990
p-Chloro m-cresol									
subchronic (RfD) _s	NA; 200 mg/kg/day for 28 days	NA	rat	NA; decrease in weight gain	ND	2E+0	NA	100	U.S. EPA, 1988/ Madsen et al., 1986; U.S. EPA, 1988
chronic (RfD)	NA; NA	NA	NA	NA; NA	ND	ND	NA	NA	U.S. EPA, 1988/ U.S. EPA, 1988
Chloroform									
subchronic (RfD) _s	NA; 15 mg/kg, 6 days/ week for 7.5 years (12.9 mg/kg/day)	NA	dog	NA; liver lesions	ND	1E-2	NA	1000	U.S. EPA, 1988/ Heywood et al., 1979; U.S. EPA, 1990
chronic (RfD)	NA; 15 mg/kg, 6 days/ week for 7.5 years (12.9 mg/kg/day)	NA	dog	NA; liver lesions (also see Table B)	ND	1E-2 ^a	NA	1000	U.S. EPA, 1988/ Heywood et al., 1979; U.S. EPA, 1990

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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
m-Chloronitrobenzene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
Chlorophenol, 3- and 4-				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
2-Chlorophenol subchronic (RfD _S)	NA; 50 ppm in drinking water from weaning through birth of first litter (5 mg/kg/day)	NA	rat	NA; reproductive effects	ND	5E-3	NA	1000	U.S. EPA, 1987a,b/Exon and Koeller, 1982; U.S. EPA, 1987a,b, 1990
chronic (RfD)	NA; 50 ppm in drinking water from weaning through birth of first litter (5 mg/kg/day)	NA	rat	NA; reproductive effects	ND	5E-3 ^a	NA	1000	U.S. EPA, 1987a,b/Exon and Koeller, 1982; U.S. EPA, 1987a,b, 1990
2-Chloropropane subchronic (RfD _S)	250 ppm (803 mg/m ³), 6 hours/day, 5 days/weeks for 4 weeks (91.4 mg/kg/day); NA	rat	NA	liver effects; NA	3E+0 (9E-1)	ND	100	NA	Gage, 1970; U.S. EPA, 1987/ U.S. EPA, 1987
chronic (RfD)	250 ppm (803 mg/m ³), 6 hours/day, 5 days/weeks for 4 weeks (91.4 mg/kg/day); NA	rat	NA	liver effects; NA	3E-1 (9E-2)	ND	1000	NA	Gage, 1970; U.S. EPA, 1987/ U.S. EPA, 1987
3-Chloropropene (see Allyl chloride)									
Chlorotoluenes, m- and p-				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
o-Chlorotoluene subchronic	NA; 20 mg/kg/day by gavage for 103 or 104 days	NA	rat	NA; decreased body weight gain	NA	2E-1	NA	100	U.S. EPA, 1990/ Gibson et al., 1974; U.S. EPA 1990
chronic (RfD)	NA; 20 mg/kg/day by gavage for 103 or 104 days	NA	rat	NA; decreased body weight gain	NA	2E-2 ^a	NA	1000	U.S. EPA, 1990/ Gibson et al., 1974; U.S. EPA 1990

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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
Chlorpyrifos subchronic (RfD _s)	NA; 0.03 mg/kg/day by capsule for 20 days or 0.1 mg/kg/day for 9 days	NA	human	NA; decreased plasma cholinesterase	ND	3E-3	NA	10	U.S. EPA, 1990/ Dow Chemical Co., 1972; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 0.03 mg/kg/day by capsule for 20 days or 0.1 mg/kg/day for 9 days	NA	human	NA; decreased plasma cholinesterase	ND	3E-3 ^a	NA	10	U.S. EPA, 1990/ Dow Chemical Co., 1972; U.S. EPA, 1984, 1990
Chlorpyrifos-methyl subchronic (RfD _s)	NA; 3-generation study in rats, 2-year study in dogs	NA	rats, dogs	NA; reduced fertility in rats, liver effects in dogs	ND	1E-2	NA	100	U.S. EPA, 1984/ U.S. EPA, 1984
chronic (RfD)	NA; 3-generation study in rats, 2-year study in dogs	NA	rats, dogs	NA; reduced fertility in rats, liver effects in dogs	ND	1E-2 ^g	NA	100	U.S. EPA, 1984/ U.S. EPA, 1984
Chlorthalonil subchronic (RfD _s)	NA; 60 ppm in the diet for 2 years (1.5 mg/kg/day)	NA	dog	NA; kidney lesions	ND	1.5E-2	NA	100	U.S. EPA, 1990/ Diamond Shamrock Chem. Co., 1970, U.S. EPA, 1990
chronic (RfD)	NA; 60 ppm in the diet for 2 years (1.5 mg/kg/day)	NA	dog	NA; kidney lesions (also see Table B)	ND	1.5E-2 ^a	NA	100	U.S. EPA, 1990/ Diamond Shamrock Chem. Co., 1970, U.S. EPA, 1990
Chlorthiophos subchronic (RfD _s)	NA; 1.6 ppm in the diet for 2 years (0.08 mg/kg/day)	NA	rat	NA; no effect on erythrocyte cholinesterase	ND	8E-4	NA	100	U.S. EPA, 1986/ Worthing and Walker, 1983; U.S. EPA, 1986
chronic (RfD)	NA; 1.6 ppm in the diet for 2 years (0.08 mg/kg/day)	NA	rat	NA; no effect on erythrocyte cholinesterase	ND	8E-4	NA	100	U.S. EPA, 1986/ Worthing and Walker, 1983; U.S. EPA, 1986

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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Chromium (III) subchronic (RfD _S)	NA; 5% Cr ₂ O ₃ in diet 5 days/week for 90 days (1400 mg Cr/kg/day)	NA	rat	NA; hepatotoxicity	ND	1E+1	NA	100	U.S. EPA, 1984/ Ivankovic and Preussman, 1975; U.S. EPA, 1984
chronic (RfD)	NA; 5% Cr ₂ O ₃ in diet 5 days/week for 600 feedings (1468 mg Cr/kg/day)	NA	rat	NA; hepatotoxicity	ND	1E+0 ^a	NA	1000	U.S. EPA, 1984/ Ivankovic and Preussman, 1975; U.S. EPA, 1984, 1990
Chromium (VI) subchronic (RfD _S)	NA; 25 ppm Cr VI in drinking water for 1 year (2.4 mg/kg/day)	NA	rat	cancer; not defined	ND	2E-2	NA	100	U.S. EPA, 1984/ MacKenzie et al., 1958; U.S. EPA, 1984
chronic (RfD)	NA; 25 ppm Cr VI in drinking water for 1 year (2.4 mg/kg/day)	NA	rat	cancer (see Table B); not defined	ND	5E-3 ^a	NA	500	U.S. EPA, 1984/ MacKenzie et al., 1958; U.S. EPA, 1984, 1990
Chrysene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Copper subchronic (RfD _S)	NA; 5.3 mg, single dose	NA	human	NA; local GI irritation	ND	1.3 mg/t ^k	NA	NA	U.S. EPA, 1984/ U.S. EPA, 1987
chronic (RfD)	NA; NA	NA	human	NA; local GI irritation ¹	ND	1.3 mg/t ^k	NA	NA	U.S. EPA, 1984/ U.S. EPA, 1987
m-Cresol subchronic (RfD _S)	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neuro- toxicity	ND	5E-1	NA	100	U.S. EPA, 1984, 1985/Micro- biological Associates, 1986; Toxicity Research Labora- tories, 1987; U.S. EPA, 1990

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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neuro- toxicity	ND	5E-2 ^a	NA	1000	U.S. EPA, 1984, 1985/Micro- biological Associates, 1986; Toxicity Research Labora- tories, 1987; U.S. EPA, 1990
o-Cresol subchronic (RfD _S)	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neuro- toxicity	ND	5E-1	NA	100	U.S. EPA, 1984, 1985/Micro- biological Associates, 1986; Toxicity Research Labora- tories, 1987; U.S. EPA, 1990
chronic (RfD)	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neuro- toxicity	ND	5E-2 ^a	NA	1000	U.S. EPA, 1984, 1985/Micro- biological Associates, 1986; Toxicity Research Labora- tories, 1987; U.S. EPA, 1990
p-Cresol subchronic (RfD _S)	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neuro- toxicity	ND	5E-1	NA	100	U.S. EPA, 1984, 1985/Micro- biological Associates, 1986; Toxicity Research Labora- tories, 1987; U.S. EPA, 1990
chronic (RfD)	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neuro- toxicity	ND	5E-2 ^a	NA	1000	U.S. EPA, 1984, 1985/Micro- biological Associates, 1986; Toxicity Research Labora- tories, 1987; U.S. EPA, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral		Inhalation	Oral	Inhalation	Oral	Inhalation/Oral
					[mg/m ³ (mg/kg/day)]	(mg/kg/day)			
Cumene									
subchronic (RfD _s)	105.1 ppm (517 mg/m ³) for 6 hrs/day, 5 days/wk for 4 weeks; 110 mg/kg/day for 194 days	rat	rat	CNS involvement, nasal irritation; renal	9E-2	4E-1	1000	300	Monsanto Company 1986; U.S. EPA, 1987, 1990/ Wolfe, 1956; U.S. EPA, 1990
chronic (RfD)	105.1 ppm (517 mg/m ³) for 6 hrs/day, 5 days/wk for 4 weeks; 110 mg/kg for 194 days	rat	rat	CNS involvement, nasal irritation; renal	9E-3 ¹	4E-2 ^a	10000	3000	Monsanto Company 1986; U.S. EPA, 1987, 1990/ Wolfe et al., 1956; U.S. EPA, 1987, 1990
Cyanazine									
subchronic (RfD _s)	NA; 25 ppm in the diet for 1 year (0.625 g/kg/ day)	NA	dog	NA; body weight loss, hemato- logic and clin- ical chemistry parameters	ND	2E-3	NA	300	U.S. EPA, 1990/ Shell Chem. Co., 1986; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 25 ppm in the diet for 1 year (0.625 g/kg/ day)	NA	dog	NA; body weight loss, hemato- logic and clin- ical chemistry parameters	ND	2E-3 ^a	NA	300	U.S. EPA, 1990/ Shell Chem. Co., 1986; U.S. EPA, 1984, 1990
Cyanide									
subchronic (RfD _s)	NA; 10.8 mg/CN/kg/day for 104 weeks from diet treated with HCN	NA	rat	NA; weight loss, thyroid effects and myelin degeneration	ND	2E-2	NA	500	U.S. EPA, 1984/ Howard and Hanzal, 1955; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 10.8 mg CN/kg/day for 104 weeks from diet treated with HCN	NA	rat	NA; weight loss, thyroid effects and myelin degeneration ¹	ND	2E-2 ^a	NA	500	U.S. EPA, 1984/ Howard and Hanzal, 1955, U.S. EPA, 1984, 1990
Cycloate	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ⁹								U.S. EPA, 1984

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral		Inhalation	Oral	Inhalation	Oral	Inhalation/Oral
					[mg/m ³ (mg/kg/day)]	(mg/kg/day)			
Cyclohexanol	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U.S. EPA, 1985
Cyclohexylamine subchronic (RfD _S)	NA; 600 ppm cyclohexylamine-HCl in diet for 90 days (30 mg/kg/day cyclohexylamine)	NA	rat	NA; reduced body weight	ND	3E-1	NA	100	U.S. EPA, 1987/ Gaunt et al., 1974; U.S. EPA, 1987
chronic	NA; 600 ppm cyclohexylamine-HCl in diet for 2 years (18 mg/kg/day cyclohexylamine)	NA	rat	NA; testicular effects	ND	2E-1 ^a	NA	100	U.S. EPA, 1987/ Gaunt et al., 1976; U.S. EPA, 1987, 1990
Cyclopentadiene subchronic (RfD _S)	250 ppm (676 mg/m ³) for 135, 7-hour exposures in 194 days (87.3 mg/kg/day); NA	rat	NA	liver and kidney lesions; NA	3E+0 (9E-1)	ND	100	NA	Dow, 1987; U.S. EPA, 1987/ U.S. EPA, 1987
Cyclopentadiene chronic (RfD)	NA; NA	NA	NA	NA; NA	ND	ND	NA	NA	U.S. EPA, 1987/ U.S. EPA, 1987
Dacthal (DCPA) subchronic (RfD _S)	NA; 1000 ppm in the diet for 2 years (50 mg/kg/day)	NA	rat	NA; kidney and adrenal weights	ND	5E-1	NA	100	U.S. EPA, 1990/ Diamond Shamrock Co., 1963; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 1000 ppm in the diet for 2 years (50 mg/kg/day)	NA	rat	NA; kidney and adrenal weights	ND	5E-1 ^a	NA	100	U.S. EPA, 1990/ Diamond Shamrock Co., 1963; U.S. EPA, 1984, 1990
Dalapon (sodium salt) subchronic (RfD _S)	NA; 15 mg/kg/day in the diet for 2 years	NA	rat	NA; increased relative kidney weight	ND	3E-2	NA	300	U.S. EPA, 1990/ Paynter et al., 1960; U.S. EPA, 1984, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 15 mg/kg/day in the diet for 2 years	NA	rat	NA; increased relative kidney weight	ND	3E-2 ^a	NA	300	U.S. EPA, 1990/ Paynter et al., 1960; U.S. EPA, 1984, 1990
2,4-DB subchronic (RfD _s)	NA; 8 mg/kg/day in the diet for 90 days	NA	dog	NA; internal hemorrhage, mortality	ND	8E-2	NA	100	U.S. EPA, 1990/ Rhodia Inc., 1969; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 8 mg/kg/day in the diet for 90 days	NA	dog	NA; internal hemorrhage, mortality	ND	8E-3 ^a	NA	1000	U.S. EPA, 1990/ Rhodia Inc., 1969; U.S. EPA, 1984, 1990
DDT subchronic (RfD _s)	NA; 1 ppm in diet for 27 weeks (0.05 mg/kg/day)	NA	rat	NA; liver lesions	ND	5E-4	NA	100	U.S. EPA, 1984/ Laug et al., 1950; U.S. EPA, 1990
chronic (RfD)	NA; 1 ppm in diet for 27 weeks (0.05 mg/kg/day)	NA	rat	NA; liver lesions (also see Table B)	ND	5E-4 ^a	NA	100	U.S. EPA, 1984/ Laug et al., 1950; U.S. EPA, 1988, 1990
Decabromodiphenyl ether (Decabromodiphenyl oxide) subchronic (RfD _s)	NA; 1.0 mg/kg/day in the diet for 2 years	NA	rat	NA; liver enlargement	ND	1E-2	NA	100	U.S. EPA, 1987/ Kociba et al., 1975; Morris et al., 1973, 1975; U.S. EPA, 1987; U.S. EPA, 1990
chronic (RfD)	NA; 1.0 mg/kg/day in the diet for 2 years	NA	rat	NA; liver enlargement (also see Table B)	ND	1E-2 ^a	NA	100	U.S. EPA, 1987/ Kociba et al., 1975; Morris et al., 1973, 1975; U.S. EPA, 1987; U.S. EPA, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Diazinon									
subchronic (RfD _s)	NA; 1.0 ppm (0.09 mg/kg/day) in the diet for 35-42 days	NA	rat	NA; inhibition of plasma cholinesterase activity	ND	9E-4	NA	100	U.S. EPA, 1984/ Davies and Holub, 1979, 1980a,b; U.S. EPA, 1984
chronic (RfD)	NA; 1.0 ppm (0.09 mg/kg/day) in the diet for 35-42 days	NA	rat	NA; inhibition of plasma cholinesterase activity	ND	9E-49	NA	100	U.S. EPA, 1984/ Davies and Holub, 1979, 1980a,b; U.S. EPA, 1984
Dibenzofuran				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹					U.S. EPA, 1987
1,4-Dibromobenzene									
subchronic (RfD _s)	NA; 10 mg/kg/day by gavage for 45 or 90 days	NA	rat	NA; liver weight and liver enzymes	ND	1E-1	NA	100	U.S. EPA, 1990/ Carlson and Tardiff, 1977; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 10 mg/kg/day by gavage for 45 or 90 days	NA	rat	NA; liver weight and liver enzymes	ND	1E-2 ^a	NA	1000	U.S. EPA, 1990/ Carlson and Tardiff, 1977; U.S. EPA, 1984, 1990
Dibromochloromethane									
subchronic (RfD _s)	NA; 30 mg/kg/day by gavage, 5 days/week for 13 weeks (21 mg/kg/day)	NA	rat	NA; liver lesions	ND	2E-1	NA	100	U.S. EPA, 1990/ NTP, 1985; U.S. EPA, 1985, 1989, 1990
chronic (RfD)	NA; 30 mg/kg/day by gavage, 5 days/week for 13 weeks (21 mg/kg/day)	NA	rat	NA; liver lesions (also see Table B)	ND	2E-2 ^a	NA	1000	U.S. EPA, 1990/ NTP, 1985; U.S. EPA, 1985, 1989, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
D1-n-butyl phthalate subchronic (RfD _s)	NA; 0.25% of diet for 52 weeks (125 mg/kg/day)	NA	rat	NA; mortality	ND	1E+0	NA	100	U.S. EPA, 1987/ Smith, 1953; U.S. EPA, 1987
chronic (RfD)	NA; 0.25% of diet for 52 weeks (125 mg/kg/day)	NA	rat	NA; mortality ¹	ND	1E-1 ^a	NA	1000	U.S. EPA, 1987/ Smith, 1953; U.S. EPA, 1987 1990
1,2-Dichlorobenzene subchronic (RfD _s)	290 mg/m ³ 7 hours/day, 5 days/week for up to 7 months (44 mg/kg/day); 125 mg/kg/day, 5 days/ week for 13 weeks (89 mg/kg/day)	rat	rat	decreased body weight gain; liver effects (also see Table B)	2E+0 (4E-1)	9E-1	100	100	Hollingsworth et al., 1958; U.S. EPA, 1987/ NTP, 1985; U.S. EPA, 1987, 1990
chronic (RfD)	290 mg/m ³ 7 hours/day, 5 days/week for up to 7 months (44 mg/kg/day); 125 mg/kg/day, 5 days/ week for 13 weeks (89 mg/kg/day)	rat	rat	decreased body weight gain; liver effects (also see Table B)	2E-1 (4E-2)	9E-2 ^{a,1}	1000	1000	Hollingsworth et al., 1958; U.S. EPA, 1987/ NTP, 1985; U.S. EPA, 1987, 1990
1,4-Dichlorobenzene (p-dichlorobenzene) subchronic (RfD _s)	75 ppm (454.6 mg/m ³) 5 hours/day, 5 days/week for 76 weeks; NA	rat	NA	liver and kidney effects; NA	7E-1	ND	100	NA	Riley et al., 1980/U.S. EPA, 1987
chronic (RfD)	75 ppm (454.6 mg/m ³) 5 hours/day, 5 days/week for 76 weeks; NA	rat	NA	liver and kidney effects (also see Table B)	7E-1 ¹	ND	100	NA	Riley et al., 1980/U.S. EPA, 1987
Dichlorobutenes	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (CANCER: SEE TABLE B)								U.S. EPA, 1987

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Dichlorodifluoromethane (F-12) subchronic (RfD ₅)	4136 mg/m ³ , 8 hours/ day, 5 days/week for 6 weeks (482.3 mg/kg/ day); 90 mg/kg/day for 90 days	guinea pig	dog	lung and liver lesions; none	2E+0 (5E-1)	9E-1	1000	100	Prendergast et al., 1967; U.S. EPA, 1987/ Clayton, 1967; U.S. EPA, 1987
chronic (RfD)	4136 mg/m ³ , 8 hours/ day, 5 days/week for 6 weeks (482.3 mg/kg/ day); 15 mg/kg/day for 2 years	guinea pig	rat	lung and liver lesions; depressed body weight gain	2E-1 (5E-2)	2E-1 ^a	10,000	100	Prendergast et al., 1967; U.S. EPA, 1987/ Sherman, 1974; U.S. EPA, 1982, 1987, 1990
1,1 Dichloroethane subchronic (RfD ₅)	500 ppm (2025 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (138 mg/kg/ day); 500 ppm (2025 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (115 mg/kg/day)	cat	rat	kidney damage; none	5E+0 (1E+0)	1E+0	100	100	Hofmann et al., 1971; U.S. EPA, 1984/Hofmann et al., 1971; U.S. EPA, 1983, 1984
chronic (RfD)	500 ppm (2025 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (138 mg/kg/ day); 500 ppm (2025 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (mg/kg/day)	cat	rat	kidney damage; none (also see Table B)	5E-1 (1E-1)	1E-19	1000	1000	Hofmann et al., 1971; U.S. EPA, 1984/Hofmann et al., 1971; U.S. EPA, 1983, 1984
1,1-Dichloroethylene subchronic (RfD ₅)	NA; 50 ppm in drinking water for 2 years (9 mg/kg/day)	NA	rat	NA; liver lesions	ND	9E-3	NA	1000	U.S. EPA, 1984/ Quast et al., 1983; U.S. EPA, 1988, 1990
chronic (RfD)	NA; 50 ppm in drinking water for 2 years (9 mg/kg/day)	NA	rat	NA; liver lesions (also see Table B)	ND	9E-3 ²	NA	1000	U.S. EPA, 1984/ Quast et al., 1983; U.S. EPA, 1988, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
1,2-c-Dichloroethylene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
1,2-t-Dichloroethylene subchronic (RfD _s)	NA; 0.1 mg/L in drinking water for 90 days (17 mg/kg/day)	NA	mouse	NA; increased serum alkaline phosphatase	ND	2E-1	NA	100	U.S. EPA, 1984/ Barnes et al., 1985; U.S. EPA, 1990
chronic (RfD)	NA; 0.1 mg/L in drinking water for 90 days (17 mg/kg/day)	NA	mouse	NA; increased serum alkaline phosphatase	ND-	2E-2 ^a	NA	1000	U.S. EPA, 1984/ Barnes et al., 1985; U.S. EPA, 1990
2,4-Dichlorophenol subchronic (RfD _s)	NA; 3 ppm in drinking water for 2 generations (0.3 mg/kg/day)	NA	rat	NA; immune function	ND	3E-3	NA	100	U.S. EPA, 1987a,b/Exon and Koller, 1985; U.S. EPA, 1987a,b, 1990
chronic (RfD)	NA; 3 ppm in drinking water for 2 generations (0.3 mg/kg/day)	NA	rat	NA; immune function	ND	3E-3 ^a	NA	100	U.S. EPA, 1987a,b/Exon and Koller, 1985; U.S. EPA, 1986 1987a,b, 1990
Dichlorophenol, 2,3-, 2,5-, 2,6-, 3,4- and 3,5-				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
Dichloroprop				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ⁹					U.S. EPA, 1984
Dichloropropanes (1,1-, 1,2-, 1,3-, 2,2-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (also see Table B)					U.S. EPA, 1985
1,3-Dichloropropene subchronic (RfD _s)	10 ppm (45.4 mg/m ³) 6 hours/day, 5 days/week for 13 weeks; 3 mg/kg/ day in the diet for 90 days	rat	rat	degeneration changes in nasal mucosa; increased organ weight	1E-2	3E-3	100	1000	Stott et al., 1982; U.S. EPA, 1989/Dow Chemical Co., 1973; U.S. EPA 1989, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)

Update: March, 1990

Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	10 ppm (45.4 mg/m ³); 6 hours/day, 5 days/week for 13 weeks; 3 mg/kg/day in the diet for 90 days	rat	rat	degenerative changes in nasal mucosa; increased organ weights (also see Table 8)	1E-2	3E-4 ^a	100	10,000	Stott et al., 1982; U.S. EPA 1989/Dow Chemical Co., 1973; U.S. EPA 1989, 1990
Dicyclopentadiene subchronic (RfDs)	1 ppm (5.4 mg/m ³), 6 hours/day, 5 days/ week for 90 days (0.61 mg/kg/day); 690 ppm in diet for 3 generations (32 mg/kg/day for males)	rat	rat	liver dysfunction; none	2E-3 (6E-4)	3E-1	1000	100	Dodd et al., 1982; U.S. EPA, 1987/Litton Bionetics, 1980; U.S. EPA, 1987
chronic (RfD)	1 ppm (5.4 mg/m ³), 6 hours/day, 5 days/ week for 90 days (0.61 mg/kg/day); 690 ppm in diet for 3 generations (32 mg/kg/day for males)	rat	rat	liver dysfunction; none	2E-4 (6E-5)	3E-2	10,000	1000	Dodd et al., 1982; U.S. EPA, 1987/Litton Bionetics, 1980; U.S. EPA, 1987
Dieldrin subchronic (RfDs)	NA; 0.1 ppm in diet for 2 years (0.005 mg/kg/day)	NA	rat	NA; liver lesions	ND	5E-5	NA	100	U.S. EPA, 1987/ Walker et al., 1969; U.S. EPA, 1990
chronic (RfD)	NA; 0.1 ppm in diet for 2 years (0.005 mg/kg/day)	NA	rat	NA; liver lesions (Cancer: see Table 8)	ND	5E-5 ^a	NA	100	U.S. EPA, 1987/ Walker et al., 1969; U.S. EPA, 1990
N,N-Diethylaniline				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
Diethylene glycol monoethyl ether subchronic (RfDs)	NA; diet provided 500 mg/kg/day for 90 days	NA	rat	NA; impaired renal function, increased testes weight	ND	5E+0	NA	100	U.S. EPA, 1984/ Hall et al., 1966; U.S. EPA, 1984

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 0.2% in drinking water (200 mg/kg/day) for 2 years	NA	rat	NA; kidney histopathology	ND	2E+0	NA	100	U.S. EPA, 1984/ Smyth et al., 1964; U.S. EPA, 1984
Diethylformamide subchronic (RfD _s)	NA; 546 µg/day (1.56 mg/kg/day) in diet x 5 days/week for 73 weeks	NA	rats	NA; no effect	ND	1.1E-1	NA	100	U.S. EPA, 1986/ Argus et al., 1965; U.S. EPA, 1986
chronic (RfD)	NA; 546 µg/day (1.56 mg/kg/day) in diet x 5 days/week for 73 weeks	NA	rats	NA; no effect	ND	1.1E-1	NA	100	U.S. EPA, 1986/ Argus et al., 1965; U.S. EPA, 1986
1,2-Diethylhydrazine				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Diethyl-p-nitrophenyl phosphate (paraoxon)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1989
Diethyl phthalate subchronic (RfD _s)	NA; 1% in diet for 16 weeks (750 mg/kg/day)	NA	rat	NA; reduced terminal body weight	ND	8E+0	NA	100	U.S. EPA, 1987/ Brown et al., 1978; U.S. EPA, 1987
chronic (RfD)	NA; 1% in diet for 16 weeks (750 mg/kg/day)	NA	rat	NA; reduced terminal body weight ¹	ND	8E-1 ^a	NA	1000	U.S. EPA, 1987/ Brown et al., 1978; U.S. EPA, 1987, 1990
Dimethoate subchronic (RfD _s)	NA; 1 ppm (0.05 mg/kg/day) in diet for 2 years	NA	rat	NA; brain cholinesterase inhibition	ND	2E-4	NA	300	U.S. EPA, 1985/ American Cyanimid Co., 1986; U S EPA, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty factor		Reference Inhalation/Oral
	Inhalation, Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 1 ppm (0.05 mg/kg/day) in diet for 2 years	NA	rat	NA; brain cholinesterase inhibition	ND	2E-4 ^a	NA	300	U.S. EPA, 1985/ American Cyanamid Co., 1986; U.S. EPA, 1990
N,N-Dimethylaniline subchronic (RfD _S)	NA; 31.25 mg/kg/day by gavage x 5/7 days for 13 weeks	NA	rat	NA; splenomegaly and splenic hemosiderosis	ND	2E-2	NA	1000	U.S. EPA, 1986/ Abdo et al., 1984; U.S. EPA, 1990
chronic (RfD)	NA; 31.25 mg/kg/day by gavage x 5/7 days for 13 weeks	NA	rat	NA; splenomegaly and splenic hemosiderosis	ND	2E-3 ^a	NA	10,000	U.S. EPA, 1986/ Abdo et al., 1984; U.S. EPA, 1990
N,N-Dimethylformamide subchronic (RfD _S)	NA; 540 ppm (96 mg/kg/day) in diet for 119 days	NA	mouse	NA; increased liver weight	ND	1E+0	NA	100	U.S. EPA, 1986/ Beck et al., 1983; U.S. EPA, 1986
chronic (RfD)	NA; 540 ppm (96 mg/kg/day) in diet for 119 days	NA	mouse	NA; increased liver weight	ND	1E-1	NA	1000	U.S. EPA, 1986/ Beck et al., 1983; U.S. EPA, 1986
Dimethylphenols (2,3-, 2,4-, 2,5-, 2,6-)	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (Cancer: see Table B)								U.S. EPA, 1986
2,6-Dimethylphenol subchronic (RfD _S)	NA; 0.6 mg/kg/day for 8 months	NA	rat	NA; effects on blood pressure, weight gain and histological appearance of several organs	ND	6E-3	NA	100	U.S. EPA, 1987/ Veldre and Janes, 1979; U.S. EPA, 1987, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
2,6-Dimethylphenol chronic (RfD)	NA; 0.6 mg/kg/day for 8 months	NA	rat	NA; effects on blood pressure, weight gain and histological appear- ance of several organs	ND	6E-4 ^a	NA	1000	U.S. EPA, 1987/ Veldre and Janes, 1979; U.S. EPA, 1987, 1990
3,4-Dimethylphenol subchronic (RfD _S)	NA; 1.4 mg/kg/day for 8 months	NA	rat	NA; reduced growth, internal lesions	ND	1E-2	NA	100	U.S. EPA, 1987/ Veldre and Janes, 1979; U.S. EPA, 1987, 1990
chronic (RfD)	NA; 1.4 mg/kg/day for 8 months	NA	rat	NA; reduced growth, internal lesions	ND	1E-3 ^a	NA	1000	U.S. EPA, 1987/ Veldre and Janes, 1979; U.S. EPA, 1987, 1990
Dimethyl phthalate				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ^{9,1}					U.S. EPA, 1987
Dimethyl terephthalate subchronic (RfD _S)	NA; 2500 ppm (125 mg/kg/day) in diet for 103 weeks	NA	rat	NA; chronic kidney inflam- mation	ND	1E-1	NA	1000	U.S. EPA, 1984/ NCI, 1979; U.S. EPA, 1990
chronic (RfD)	NA; 2500 ppm (125 mg/kg/day) in diet for 103 weeks	NA	rat	NA; chronic kidney inflam- mation	ND	1E-1 ^a	NA	1000	U.S. EPA, 1984/ NCI, 1979; U.S. EPA, 1990
N,N-Dimethylurea				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
m-Dinitrobenzene subchronic (RfD _S)	NA; 3 ppm (0.40 mg/kg/ day) in drinking water for 16 weeks	NA	rat	NA; increased splenic weight	ND	1E-3	NA	300	U.S. EPA, 1985/ Cody et al., 1981; U.S. EPA, 1990

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 3 ppm (0.40 mg/kg/day) in drinking water for 16 weeks	NA	rat	NA; increased splenic weight	ND	1E-4 ^a	NA	3000	U.S. EPA, 1985/ Cody et al., 1981; U.S. EPA, 1990
Dinitrobenzenes (o-, p-) subchronic (RfDs)	NA; 3 ppm (0.40 mg/kg/day) in drinking water for 16 weeks	NA	rat	NA; increased splenic weight	ND	4E-3	NA	100	U.S. EPA, 1985/ Cody et al., 1981; U.S. EPA, 1985
chronic (RfD)	NA; 3 ppm (0.40 mg/kg/day) in drinking water for 16 weeks	NA	rat	NA; increased splenic weight	ND	4E-4	NA	1000	U.S. EPA, 1985/ Cody et al., 1981; U.S. EPA, 1985
2,6-Dinitro-p-cresol				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
4,6-Dinitro-o-cresol				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986/ U.S. EPA, 1986
Dinitrophenols (2,3-; 2,5-; 2,6-; 3,5-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Dinitrotoluenes (2,3-; 2,4-; 2,5-; 2,6-; 3,4-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (Cancer: see Table B)					U.S. EPA, 1986
Di-n-octyl phthalate				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
Dinoseb subchronic (RfDs)	NA; 1 mg/kg/day in diet for 29 weeks	NA	rat	NA; decreased fetal weight	ND	1E-3 ^{bb}	NA	1000	U.S. EPA, 1984/ Dow Chemical Co., 1981; U.S. EPA, 1990
chronic (RfD)	NA; 1 mg/kg/day in diet for 29 weeks	NA	rat	NA; decreased fetal weight	ND	1E-3 ^{a, 1.bb}	NA	1000	U.S. EPA, 1984/ Dow Chemical Co., 1981; U.S. EPA, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
N,N-Diphenylamine subchronic (RfD _S)	NA; 0.0170 (2.5 mg/kg/day) in diet for 2 years	NA	dog	NA; decreased body weight gain and increased liver and kidney weights	ND	2.5E-2	NA	100	U.S. EPA, 1985/Thomas et al., 1967; U.S. EPA, 1990
chronic (RfD)	NA; 0.0170 (2.5 mg/kg/day) in diet for 2 years	NA	dog	NA; decreased body weight gain and increased liver and kidney weights (also see Table B)	ND	2.5E-2 ^a	NA	100	U.S. EPA, 1985/Thomas et al., 1967; U.S. EPA, 1990
Direct Lightfast Blue				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (also see Table B)					U.S. EPA, 1987
Endosulfan subchronic (RfD _S)	NA; 3 ppm in diet in 2-generation reproductive study (0.15 mg/kg/day)	NA	rat	NA; mild kidney lesions	ND	2E-4	NA	1000	U.S. EPA, 1987/Huntington Research Center, 1984; U.S. EPA, 1987, 1990
chronic (RfD)	NA; 3 ppm in diet in 2-generation reproductive study (0.15 mg/kg/day)	NA	rat	NA; mild kidney lesions	ND	5E-5 ^a	NA	3000	U.S. EPA, 1987/Huntington Research Center, 1984; U.S. EPA, 1987, 1990
Endothall subchronic (RfD _S)	NA; 100 ppm disodium endothall in the diet for 2 years (2 mg endothall 10n/kg/day)	NA	dog	NA; stomach effect	ND	2E-2	NA	100	U.S. EPA, 1989/Keller, 1965; Pennwalt Agchem, n.d.; U.S. EPA, 1989, 1990
chronic (RfD)	NA; 100 ppm disodium endothall in the diet for 2 years (2 mg endothall 10n/kg/day)	NA	dog	NA; stomach effect	ND	2E-2 ^a	NA	100	U.S. EPA, 1989/Keller, 1965; Pennwalt Agchem, n.d.; U.S. EPA, 1989, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)

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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Endrin									
subchronic (RfD _s)	NA; 1 ppm in diet for 18 months (0.045 mg/kg/day)	NA	dog	NA; increased relative organ weights	ND	5E-4	NA	100	U.S. EPA, 1987/ Treon et al., 1955; U.S. EPA, 1985, 1987, 1990
chronic (RfD)	NA; 1 ppm in diet for >2 years (0.025 mg/kg/day)	NA	dog	NA; convulsions and liver lesions	ND	3E-4 ^a	NA	100	U.S. EPA, 1987/ CBI; U.S. EPA, 1985, 1987, 1990
Epichlorohydrin									
subchronic (RfD _s)	5 ppm, 6 hours/day, 5 days/week for 87-88 days (HEC=0.25 mg/m ³); 10 ppm (37.8 mg/m ³), 6 hours/day, 5 days/week for 136 weeks	mouse	rat	nasal turbinate injury; kidney damage	3E-3	2E-2	100	100	Quast et al., 1979/Laskin et al., 1980; U.S. EPA, 1984, 1990
chronic (RfD)	5 ppm, 6 hours/day, 5 days/week for 87-88 days (HEC=0.25 mg/m ³); 10 ppm (37.8 mg/m ³), 6 hours/day, 5 days/week for 136 weeks	mouse	rat	nasal turbinate injury; kidney damage (also see Table B)	3E-4 ^j	2E-3 ^{a,b}	1000	1000	Quast et al., 1979/Laskin et al., 1980; U.S. EPA, 1984, 1990
EPTC (see S-Ethyl dipropylthiocarbamate)									
Ethoprop				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
2-Ethoxyethanol									
subchronic (RfD _s)	10 ppm (37 mg/m ³) 6 hours/day on days 6-15 of gestation (6.8 mg/kg/ day); 50 μ l (46.6 mg/kg/ day) on days 1-21 of gestation	rat	rat	fetotoxicity; fetotoxicity	2E-1 (7E-2) ^{bb}	5E-1 ^{bb}	100	100	Doe, 1984a; U.S. EPA, 1984/ Stenger et al., 1971; U.S. EPA, 1984

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	100 ppm (369 mg/m ³) 6 hours/day, 5 days/ week for 13 weeks (49.9 mg/kg/day) 500 mg/kg 5 days/week for 103 weeks (357 mg/kg/day)	rat	rat	altered hematology; reduced body weight (also see Table B)	2E-1 (5E-2)	4E-1	1000	1000	Barbee et al., 1984; U.S. EPA, 1984/Melnick, 1984; U.S. EPA, 1985
2-Ethoxyethanol acetate subchronic (RfD _s)	NA; 50 ppm (30.1 mg/kg) x 6 hours/day on gesta- tional day 6-18	NA	rat	NA; decreased ossification	ND	3E-1b,bb	NA	100	U.S. EPA, 1985/ Union Carbide, 1984; U.S. EPA, 1985
chronic (RfD)	NA; 50 ppm (30.1 mg/kg) x 6 hours/day on gesta- tional day 6-18	NA	rat	NA; decreased ossification	ND	3E-1b,bb	NA	100	U.S. EPA, 1985/ Union Carbide, 1984; U.S. EPA, 1985
2-Ethoxyethanol esters 2-ethoxyethanol acrylate, 2-ethoxyethyl methacrylate, 2-ethoxyethanol phosphated, 2-ethoxyethyl dodecanoate)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
Ethyl acetate subchronic (RfD _s)	NA; 900 mg/kg/day by gavage for 90 days	NA	rat	NA; mortality, body weight loss	ND	9E+0	NA	100	U.S. EPA, 1990/ U.S. EPA, 1986a,b, 1990
chronic (RfD)	NA; 900 mg/kg/day by gavage for 90 days	NA	rat	NA; mortality, body weight loss (also see Table B)	ND	9E-1a	NA	1000	U.S. EPA, 1990/ U.S. EPA, 1986a,b, 1990
n-Ethylaniline				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986
Ethylbenzene subchronic (RfD _s)	NA; 136 mg/kg 5 days/week for 182 days (97.1 mg/kg/day)	NA	rat	NA; hepatotoxicity and nephrotoxicity	ND	1E+0	NA	100	U.S. EPA, 1984/ Wolf et al., 1956; U.S. EPA, 1984, 1986, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 136 mg/kg 5 days/week for 182 days (97.1 mg/kg/day)	NA	rat	NA; hepatotoxicity and nephrotoxicity ¹	ND	1E-1 ^a	NA	1000	U.S. EPA, 1984/ Wolf et al., 1956; U.S. EPA, 1984, 1986, 1990
Ethyl chloride				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
S-Ethyl dipropylthiocarbamate subchronic (RfD _s)	NA; 50 ppm in diet for 2 generations (2.5 mg/kg/day)	NA	rat	NA; degenerative cardiomyopathy	ND	2.5E-2	NA	100	U.S. EPA, 1984/ PPG Industries, 1986; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 50 ppm in diet for 2 generations (2.5 mg/kg/day)	NA	rat	NA; degenerative cardiomyopathy	ND	2.5E-2 ^a	NA	100	U.S. EPA, 1984/ PPG Industries, 1986; U.S. EPA, 1984, 1990
Ethylene cyanohydrin subchronic (RfD _s)	NA; 30 mg/kg/day in drinking water for 90 days	NA	rat	NA; decreased heart and brain weights	ND	3E-1	NA	100	U.S. EPA, 1988/ Sauerhoff et al., 1976; U.S. EPA, 1988
chronic (RfD)	NA; 30 mg/kg/day in drinking water for 90 days	NA	rat	NA; decreased heart and brain weights	ND	3E-1	NA	100	U.S. EPA, 1988/ Sauerhoff et al., 1976; U.S. EPA, 1988
Ethylenediamine subchronic (RfD _s)	59 ppm (145 mg/m ³) 7 hours/day, 5 days/week for 30 days (25.8 mg/kg/day); 3-month dietary study with 50 mg/kg/day ethylenediamine dihydrochloride (22.6 mg ethylenediamine/kg/day)	rat	rat	death, kidney and liver lesions; liver and hematologic changes	1E+0 (3E-1)	2E-1	100	100	Pozzani and Carpenter, 1954; U.S. EPA, 1988/ Yang et al., 1983; U.S. EPA, 1988

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 3-month dietary study with 50 mg/kg/day ethylenediamine dihydrochloride (22.6 mg ethylenediamine/kg/day)	NA	rat	NA; liver and hematologic changes	ND	2E-2	NA	1000	U.S. EPA, 1988/ Yang et al., 1983; U.S. EPA, 1988
Ethylene glycol subchronic (RfD ₅)	NA; 200 mg/kg/day in developmental toxicity	NA	rat	NA; fetotoxicity	ND	2E+0 ^{bb}	NA	100	U.S. EPA, 1987/ Maronpot et al., 1983; U.S. EPA, 1987a, 1990
chronic (RfD)	NA; 200 mg/kg/day in 2-year dietary study	NA	rat	NA; mortality, liver and kidney effects	ND	2E+0 ^a	NA	100	U.S. EPA, 1987/ DePass et al., 1986a; U.S. EPA, 1987a, 1990
Ethylene glycol monobutyl ether subchronic (RfD ₅)	25 ppm (121 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (16 mg/kg/day); NA	rat	NA	altered hematology; NA	6E-1 (2E-1)	ND	100	NA	Dodd et al., 1983/U.S. EPA, 1984
chronic (RfD)	25 ppm (121 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (16 mg/kg/day); NA	rat	NA	altered hematology; NA	6E-2 (2E-2)	ND	1000	NA	Dodd et al., 1983/U.S. EPA, 1984
Ethylene thiourea	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ⁹ (also see Table B)								U.S. EPA, 1984
Ethyl ether subchronic (RfD ₅)	NA; 500 mg/kg/day for 90 days	NA	rat	NA; liver effects	ND	5E+0	NA	100	U.S. EPA, 1987/ American Biogenics Corp., 1986; U.S. EPA, 1987

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 500 mg/kg/day for 90 days	NA	rat	NA; liver effects	ND	5E-11	NA	1000	U.S. EPA, 1987/ American Biogenics Corp., 1986; U.S. EPA, 1987
Ethyl methacrylate subchronic (RfD _s)	NA; 65 ppm (7.5 mg/kg/day) methyl methacrylate x 114.5/100.13 (molecular weight ratio) in drinking water for 2 years	NA	rat	NA; increased kidney weight	ND	9E-2	NA	100	U.S. EPA, 1986/ Borzelleca et al., 1964; U.S. EPA, 1986
chronic (RfD)	NA; 65 ppm (7.5 mg/kg/day) methyl methacrylate x 114.5/100.13 (molecular weight ratio) in drinking water for 2 years	NA	rat	NA; increased kidney weight (also see Table B)	ND	9E-29	NA	100	U.S. EPA, 1986/ Borzelleca et al., 1964; U.S. EPA, 1986
Ethyl toluene (o-, p-, m-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
4-Ethyl-o-xylene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Fluoranthene subchronic (RfD _s)	NA; 125 mg/kg/day by gavage for 90 days	NA	mouse	NA; nephropathy, liver weight changes hematological changes	ND	4E-1	NA	300	U.S. EPA, 1988
chronic (RfD)	NA; 125 mg/kg/day by gavage for 90 days	NA	mouse	NA; nephropathy, liver weight changes hematological changes	ND	4E-21	NA	3000	U.S. EPA, 1988
Fluorene subchronic (RfD _s)	NA; 125 mg/kg/day by gavage for 13 weeks	NA	mouse	NA; hematological changes (decreased RBC)	ND	4E-1	NA	300	U.S. EPA, 1989
chronic (RfD)	NA; 125 mg/kg/day by gavage for 13 weeks	NA	mouse	NA; hematological changes (decreased RBC)	ND	4E-21	NA	3000	U.S. EPA, 1989

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Fluorides									
subchronic (RfD _s)	NA; 0.06 mg fluoride/kg/ day in drinking water	NA	human	NA: dental fluorosis at higher levels	ND	6E-2	NA	1	U.S. EPA, 1989/ Hodge, 1950; U.S. EPA, 1989, 1990
chronic (RfD _s)	NA; 0.06 mg fluoride/kg/ day in drinking water	NA	human	NA: dental fluorosis at higher levels	ND	6E-2 ^a	NA	1	U.S. EPA, 1989/ Hodge, 1950; U.S. EPA, 1989, 1990
Fluridone									
subchronic (RfD _s)	NA; 200 ppm in the diet for 2 years (8 mg/kg/ day)	NA	rat	NA; kidney and testes	ND	8E-2	NA	100	U.S. EPA, 1990/ Eli Lilly and Co., 1980; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 200 ppm in the diet for 2 years (8 mg/kg/ day)	NA	rat	NA; kidney and and testes	ND	8E-2 ^a	NA	100	U.S. EPA, 1990/ Eli Lilly and Co., 1980; U.S. EPA, 1984, 1990
Folpet									
subchronic (RfD _s)	NA; 10 mg/kg/day in capsules for 1 year	NA	dog	NA; body weight gain, blood chemistry	ND	1E-1	NA	100	U.S. EPA, 1990/ Chevron Chemical Corp., 1986; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 10 mg/kg/day in capsules for 1 year	NA	dog	NA; body weight gain, blood chemistry (also see Table B)	ND	1E-1 ^a	NA	100	U.S. EPA, 1990/ Chevron Chemical Corp., 1986; U.S. EPA, 1984, 1990
Formaldehyde cyanohydrin				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1988

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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Furan									
subchronic (RfD _s)	NA; 2 mg/kg, 5 days/week for 13 weeks (1.4 mg/kg/day)	NA	mouse	NA; hepatic lesions	ND	1E-2	NA	100	U.S. EPA, 1987/SRI, 1982; U.S. EPA, 1987
chronic (RfD)	NA; 2 mg/kg, 5 days/week for 13 weeks (1.4 mg/kg/day)	NA	mouse	NA; hepatic lesions	ND	1E-3 ^a	NA	1000	U.S. EPA, 1987/SRI, 1982; U.S. EPA, 1987, 1990
Furfural									
subchronic (RfD _s)	20 ppm (77 mg/m ³), 6 hours/day, 5 days/week for 13 weeks (13 mg/kg); 11 mg/kg, 5 days/week for 13 weeks (7.9 mg/kg/day)	hamster	rat	olfactory degeneration; hepatotoxicity	5E-1 (1E-1)	3E-2	100	300	Feron et al., 1979; U.S. EPA, 1988/SRI, 1981; U.S. EPA, 1990
chronic (RfD)	20 ppm (77 mg/m ³), 6 hours/day, 5 days/week for 13 weeks (13 mg/kg); 11 mg/kg, 5 days/week for 13 weeks (7.9 mg/kg/day)	hamster	rat	olfactory degeneration; hepatotoxicity	5E-2 (1E-2)	3E-3 ^a	1000	3000	Feron et al., 1979; U.S. EPA, 1988/SRI, 1981; U.S. EPA, 1990
Glycidaldehyde									
subchronic (RfD _s)	10 ppm (29 mg/m ³), 4 hours/day, 5 days/week for 12 weeks (HEC, 3.5 mg/m ³); 1.1 mg/kg/day	rat	rat	decreased body weight and kidney effects; decreased body weight and kidney effects	1E-2	4E-3	300	300	Hine et al., 1961; U.S. EPA, 1989/Hine et al., 1961; U.S. EPA, 1989, 1990
chronic (RfD _s)	10 ppm (29 mg/m ³), 4 hours/day, 5 days/week for 12 weeks (HEC, 3.5 mg/m ³); 1.1 mg/kg/day	rat	rat	decreased body weight and kidney effects; decreased body weight and kidney effects (also see Table B)	1E-3	4E-4 ^a	3000	3000	Hine et al., 1961; U.S. EPA, 1989/Hine et al., 1961; U.S. EPA, 1989, 1990
Heptachlor									
subchronic (RfD _s)	NA; 3 ppm in diet for 2 years (0.15 mg/kg/day)	NA	rat	NA; increased liver weight	ND	5E-4	NA	300	U.S. EPA, 1987/Velsicol Chemical, 1955; U.S. EPA, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 3 ppm in diet for 2 years (0.15 mg/kg/day)	NA	rat	NA; increased liver weight (also see Table B)	ND	5E-4 ^a	NA	300	U.S. EPA, 1987/Velsicol Chemical, 1955; U.S. EPA, 1990
n-Heptane	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U.S. EPA, 1989/U.S. EPA, 1989
Hexabromobenzene subchronic (RfD _s)	NA; 40 ppm in the diet for 12 weeks (2 mg/kg/day)	NA	rat	NA; induced carboxylesterase activity	ND	2E-2	NA	100	U.S. EPA, 1990/Mendoza et al., 1977; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 40 ppm in the diet for 12 weeks (2 mg/kg/day)	NA	rat	NA; induced carboxylesterase activity	ND	2E-3 ^a	NA	1000	U.S. EPA, 1990/Mendoza et al., 1977; U.S. EPA, 1984, 1990
Hexachlorobenzene subchronic (RfD _s)	NA; 1.6 ppm in diet for 130 weeks (0.08 mg/kg/day)	NA	rat	NA; liver and hematologic effects	ND	8E-4	NA	100	U.S. EPA, 1984/Arnold et al., 1985; U.S. EPA, 1990
chronic (RfD)	NA; 1.6 ppm in diet for 130 weeks (0.08 mg/kg/day)	NA	rat	NA; liver and hematologic effects (also see Table B)	ND	8E-4 ^a	NA	100	U.S. EPA, 1984/Arnold et al., 1985; U.S. EPA, 1990
Hexachlorobutadiene subchronic (RfD _s)	NA; 2 year dietary study (0.2 mg/kg/day)	NA	rat	NA; kidney toxicity	ND	2E-3	NA	100	U.S. EPA, 1984/Kociba et al., 1977; U.S. EPA, 1990
chronic (RfD)	NA; 2 year dietary study (0.2 mg/kg/day)	NA	rat	NA; kidney toxicity (Cancer: see Table B)	ND	2E-3 ^a	NA	100	U.S. EPA, 1984/Kociba et al., 1977; U.S. EPA, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Hexachlorocyclohexane, gamma (Lindane) subchronic (RfD _s)	NA; 4 ppm in diet for 12 weeks (0.33 mg/kg/ day)	NA	rat	NA; liver and and kidney toxicity	ND	3E-3	NA	100	U.S. EPA, 1984/ Zoecon Corp., 1983; U.S. EPA, 1990
chronic (RfD)	NA; 4 ppm in diet for 12 weeks (0.33 mg/kg/ day)	NA	rat	NA; liver and kidney toxicity (Cancer: see Table B)	ND	3E-4 ^a	NA	1000	U.S. EPA, 1984/ Zoecon Corp., 1983; U.S. EPA, 1990
Hexachlorocyclopentadiene subchronic (RfD _s)	0.15 ppm (1.67 mg/m ³ 6 hours/day, 5 days/ week for 13 weeks (0.2 mg/kg/day); 10 mg/kg, 5 days/week for 13 weeks (7.1 mg/kg/day)	rat	rat	respiratory tract lesions; fore- stomach lesions	7E-4 (2E-4)	7E-2	100	100	Battelle Northwest Laboratories, 1984; U.S. EPA, 1984/SRI, 1981; Abdo et al., 1984; U.S. EPA, 1990
chronic (RfD)	0.15 ppm (1.67 mg/m ³ 6 hours/day, 5 days/ week for 13 weeks (0.2 mg/kg/day); 10 mg/kg, 5 days/week for 13 weeks (7.1 mg/kg/day)	rat	rat	respiratory tract lesions; fore- stomach lesions	7E-5 (2E-5)	7E-3 ^a	1,000	1,000	Battelle Northwest Laboratories, 1984; U.S. EPA, 1984/SRI, 1981; Abdo et al., 1984; U.S. EPA, 1990
Hexachloroethane subchronic (RfD _s)	NA; 16 week dietary study (1 mg/kg/day)	NA	rat	NA; kidney degenera- tion	ND	1E-2	NA	100	U.S. EPA, 1987/ Gorzinski et al., 1985; U.S. EPA, 1989, 1990
chronic (RfD)	NA; 16 week dietary study (1 mg/kg/day)	NA	rat	NA; kidney degenera- tion (also see Table B)	ND	1E-3 ^a	NA	1000	U.S. EPA, 1987/ Gorzinski et al., 1985; U.S. EPA, 1989, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Reference Dose		Uncertainty factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Hexachlorophene subchronic (RfD _s)	NA; 30 ppm in the diet for 13 weeks (0.75 mg/ kg/day)	NA	dog	NA; nervous system effects (also see Table B)	ND	3E-3	NA	300	U.S. EPA, 1990/ Nationwide Chem. Corp. 1974; U.S. EPA, 1986, 1990
chronic (RfD)	NA; 30 ppm in the diet for 13 weeks (0.75 mg/ kg/day)	NA	dog	NA; nervous system effects (also see Table B)	ND	3E-4 ^a	NA	3000	U.S. EPA, 1990/ Nationwide Chem. Corp. 1974; U.S. EPA, 1986, 1990
Hexamethylenediamine	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U.S. EPA, 1985
N-Hexane subchronic (RfD _s)	200 ppm (705 mg/m ³) 12 hours/day, 7 days/ week for 24 weeks (HEC, 352 mg/m ³); 570 mg/kg/day	rat	rat	axonopathy and nerve condition altera- tions; neuropathy or testicular atrophy	4E-1	6E-1	1000	1000	Ono et al., 1982; U.S. EPA, 1989/Krasavage et al., 1980; U.S. EPA, 1989
chronic (RfD)	200 ppm (705 mg/m ³) 12 hours/day, 7 days/ week for 24 weeks (HEC, 352 mg/m ³); 570 mg/kg/day	rat	rat	axonopathy and nerve condition altera- tions; neuropathy or testicular atrophy	4E-2	6E-2	10,000	10,000	Ono et al., 1982; U.S. EPA, 1989/Krasavage et al., 1980; U.S. EPA, 1989
2-Hexanone	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U.S. EPA, 1989
p-Hydroquinone subchronic (RfD _s)	NA; 300 mg/day for 3-5 months (4.29 mg/kg/day)	NA	human	NA; hematological effects	ND	4E-1	NA	10	U.S. EPA, 1987/ Carlson and Brewer, 1953; U.S. EPA, 1987
chronic (RfD)	NA; 300 mg/day for 3-5 months (4.29 mg/kg/day)	NA	human	NA; hematological effects	ND	4E-2	NA	100	U.S. EPA, 1987/ Carlson and Brewer, 1953; U.S. EPA, 1987

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Iron				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Isobutyl alcohol subchronic (RfD _S)	NA; 316 mg/kg/day in the diet for 13 weeks	NA	rat	NA; hypoactivity and ataxia	ND	3E+0	NA	100	U.S. EPA, 1986a/ U.S. EPA, 1986a,b, 1990
chronic (RfD)	NA; 316 mg/kg/day in the diet for 13 weeks	NA	rat	NA; hypoactivity and ataxia	ND	3E-1 ^a	NA	1000	U.S. EPA, 1986a/ U.S. EPA, 1986a,b, 1990
Isophorone subchronic (RfD _S)	NA; 90-day oral (capsules) study (150 mg/kg/day)	NA	dog	NA; kidney lesions	ND	2E+0	NA	100	U.S. EPA, 1987/ Rohm and Haas, 1972; NTP, 1986; U.S. EPA, 1990
chronic (RfD)	NA; 90-day oral (capsules) study (150 mg/kg/day)	NA	dog	NA; kidney lesions (Cancer: see Table B)	ND	2E-1 ^a	NA	1000	U.S. EPA, 1987/ Rohm and Haas, 1972; NTP, 1986; U.S. EPA, 1990
Isopropalin subchronic (RfD _S)	NA; 250 ppm in the diet for 90 days (15 mg/kg/day)	NA	rat	NA; hematological effects, altered organ weights	ND	1.5E-1	NA	100	U.S. EPA, 1990/ Eli Lilly Co., 1985; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 250 ppm in the diet for 90 days (15 mg/kg/day)	NA	rat	NA; hematological effects, altered organ weights	ND	1.5E-2 ^a	NA	1000	U.S. EPA, 1990/ Eli Lilly Co., 1985; U.S. EPA, 1984, 1990
Lactonitrile				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1988
Lead subchronic (RfD _S)	NA; NA	NA	NA	NA; NA	NDP	ND	NA	NA	U.S. EPA, 1984, 1986/U.S. EPA, 1984, 1986
chronic (RfD)	NA; NA	NA	NA	CNS effects; CNS effects (also see Table B)	NDP	ND ^q	NA	NA	U.S. EPA, 1984, 1986/U.S. EPA, 1984, 1986

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Lead alkyls: tetrabutyl, tetraethyl, tetramethyl, tetrapropyl, triethyl, trimethyl, tripropyl, trimethylethyl, dimethylethyl, methyltriethyl subchronic (RfD _s)	NA; 0.00017 mg/kg/day by gavage for 20 weeks	NA	rat	NA; liver and neuronal damage	ND	1E-6	NA	1000	U.S. EPA, 1985/ Schepers, 1964; U.S. EPA, 1985
chronic (RfD)	NA; 0.00017 mg/kg/day by gavage for 20 weeks	NA	rat	NA; liver and neuronal damage	ND	1E-7 ^x	NA	10,000	U.S. EPA, 1985/ Schepers, 1964; U.S. EPA, 1985
Lindane (see Hexachlorocyclohexane, gamma)									
Linuron subchronic (RfD _s)	NA; 25 ppm in the diet for 2 years (0.625 mg/ kg/day)	NA	dog	NA; hematological	ND	2E-3	NA	300	U.S. EPA, 1990/ Du Pont de Nemours and Co., 1962; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 25 ppm in the diet for 2 years (0.625 mg/ kg/day)	NA	dog	NA; hematological (also see Table B)	ND	2E-3 ^{a,u}	NA	300	U.S. EPA, 1990/ Du Pont de Nemours and Co., 1962; U.S. EPA, 1984, 1990
Malathion subchronic (RfD _s)	NA; 16 mg/day in cap- sules for 47 days (0.23 mg/kg/day)	NA	human	NA; hematological	ND	2E-2	NA	10	U.S. EPA, 1990/ Moeller and Rider, 1962; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 16 mg/day in cap- sules for 47 days (0.23 mg/kg/day)	NA	human	NA; hematological	ND	2E-2 ^a	NA	10	U.S. EPA, 1990/ Moeller and Rider, 1962; U.S. EPA, 1984, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Maleic anhydride subchronic (RfD _s)	NA; 10 mg/kg/day in the diet for 2 years	NA	rat	NA; kidney lesions	ND	1E-1	NA	100	U.S. EPA, 1990/ Jessup et al., 1982; Preache, 1983; U.S. EPA, 1986, 1990
chronic (RfD)	NA; 10 mg/kg/day in the diet for 2 years	NA	rat	NA; kidney lesions (also see Table B)	ND	1E-1 ^a	NA	100	U.S. EPA, 1990/ Jessup et al., 1982; Preache, 1983; U.S. EPA, 1986, 1990
Maleic hydrazide subchronic (RfD _s)	NA; 1% in diet for 28 months (500 mg/kg/ day)	NA	rat	NA; altered kidney function	ND	5E-1	NA	1000	U.S. EPA, 1989/ Van der Haljden et al., 1981; U.S. EPA, 1989, 1990
chronic(RfD)	NA; 1% in diet for 28 months (500 mg/kg/ day)	NA	rat	NA; altered kidney function	ND	5E-1 ^a	NA	1000	U.S. EPA, 1989/ Van der Haljden et al., 1981 U.S. EPA, 1989, 1990
Malononitrile subchronic (RfD _s)	NA; 0.25 mg/kg/day by gavage 6 days/week for 120 days	NA	rat	NA; liver and spleen	ND	2E-4	NA	1000	U.S. EPA, 1986/ Panov et al., 1972; U.S. EPA, 1986
chronic (RfD)	NA; 0.25 mg/kg/day by gavage 6 days/week for 120 days	NA	rat	NA; liver and spleen (also see Table B)	ND	2E-5 ^a	NA	1000 ^o	U.S. EPA, 1986/ Panov et al., 1972; U.S. EPA, 1986
Mancozeb subchronic (RfD _s)	NA; 50 ppm in the diet for 90 weeks (2.9 mg/kg day)	NA	rat	NA; goitrogenic effects	ND	3E-2	NA	100	U.S. EPA, 1984/ U.S. EPA, 1984

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 50 ppm in the diet for 90 weeks (2.9 mg/kg/day)	NA	rat	NA; gonitrogenic effects	ND	3E-2	NA	100	U.S. EPA, 1984/ U.S. EPA, 1984
Maneb subchronic (RfD _S)	NA; 300 ppm in diet for 6 months (5 mg/kg/day)	NA	monkey	NA; increased thyroid weight	ND	5E-2	NA	100	U.S. EPA, 1984/ Rohm and Haas Co., 1977; Maneb Data Task Force, 1986; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 300 ppm in diet for 6 months (5 mg/kg/day)	NA	monkey	NA; increased thyroid weight	ND	5E-2 ^a	NA	100	U.S. EPA, 1984/ Rohm and Haas Co., 1977; Maneb Data Task Force, 1986; U.S. EPA, 1984, 1990
Manganese subchronic RfD _S)	0.3 mg/m ³ occupational (2.1 mg/day); 1050 ppm Mn from Mn ₃ O ₄ from day 1 of gestation through 224 days of age (52.5 mg Mn/kg/day)	human	rat	CNS; reproductive	1E-3(3E-4)	5E-1	100	100	Saric et al., 1977; U.S. EPA, 1984a,b/Laskey et al., 1982; U.S. EPA, 1984a,b
chronic (RfD)	0.3 mg/m ³ occupational (2.1 mg/day); 1 mg MnCl ₂ ·4 H ₂ O/l for >2 years (22 mg Mn/kg/day) in drinking water	human	rat	CNS; CNS ¹	1E-3(3E-4)	2E-1	100	100	Saric et al., 1977; U.S. EPA, 1984/Leung et al., 1981; Lai et al., 1982c; U.S. EPA, 1984a,b
MCPA (see 2-Methyl-4-chlorophenoxyacetic acid)									
MCPB (see 4-(2-Methyl-4-chlorophenoxy)butyric acid)									
MCPP (see 2-(2-Methyl-4-chlorophenoxy)propionic acid)									

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)

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Compound	Exposure		Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty factor		Reference Inhalation/Oral
	Inhalation; Oral		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Mephosfolan subchronic (RfD _s)	NA; 1.25 ppm in the diet for 17 weeks (0.09 mg/kg/day)	NA	rat		NA; liver and kidney weights, reduced plasma, RBC and brain cholinesterase activities	ND	9E-4	NA	100	U.S. EPA, 1984/ U.S. EPA, 1984
chronic (RfD)	NA; 1.25 ppm in the diet for 17 weeks (0.09 mg/kg/day)	NA	rat		NA; liver and kidney weights, reduced plasma, RBC and brain cholinesterase activities	ND	9E-5	NA	1000	U.S. EPA, 1984/ U.S. EPA, 1984
Mercury, inorganic subchronic (RfD _s)	NA; several oral and parenteral studies in the Brown Norway rat	NA	rat		NA; kidney effects	ND	3E-4	NA	1000	U.S. EPA, 1984/ Fitzhugh et al., 1950; Dru et al., 1978; Bernaudin et al., 1981; Andres, 1984; U.S. EPA, 1987
chronic (RfD)	NA; several oral and parenteral studies in the Brown Norway rat	NA	rat		NA; kidney effects ¹	ND	3E-4	NA	1000	U.S. EPA, 1984/ Fitzhugh et al., 1950; Dru et al., 1978; Bernaudin et al., 1981; Andres, 1984; U.S. EPA, 1987
Merphos subchronic (RfD _s)	NA; 0.1 mg/kg/day in capsules for 3 months	NA	hen		NA; ataxia, delayed neurotoxicity	ND	3E-4	NA	300	U.S. EPA, 1990/ Abou-Donia et al., 1980; U.S. EPA, 1984, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 0.1 mg/kg/day in capsules for 3 months	NA	hen	NA; ataxia, delayed neurotoxicity	ND	3E-5 ^a	NA	3000	U.S. EPA, 1990/ Abou-Donia et al., 1980; U.S. EPA, 1984, 1990
Mephos oxide subchronic (RfD _s)	NA; 0.1 mg/kg/day in capsules for 3 months	NA	hen	NA; ataxia, delayed neurotoxicity	ND	3E-4	NA	300	U.S. EPA, 1990/ Abou-Donia et al., 1979; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 0.1 mg/kg/day in capsules for 3 months	NA	hen	NA; ataxia, delayed neurotoxicity	ND	3E-5 ^a	NA	3000	U.S. EPA, 1990/ Abou-Donia et al., 1979; U.S. EPA, 1984, 1990
Methacrylonitrile subchronic (RfD _s)	3.2 ppm (9 mg/m ³), 7 hours/day, 5 days/week for 90 days (0.63 mg/kg/day); 3.2 ppm (9 mg/m ³) 7 hours/day 5 days/week for 90 days (0.32 mg/kg/day)	dog	dog	Increased SGOT and SGPT, loss of hind-limb motor control, brain lesions; increased SGOT and SGPT, loss of hind-limb motor control, brain lesions	7E-3 (2E-3) ^m	1E-3 ^b	300	300	Pozzani et al., 1968; U.S. EPA, 1990/Pozzani et al., 1968; U.S. EPA, 1990
chronic (RfD)	3.2 ppm (9 mg/m ³), 7 hours/day, 5 days/week for 90 days (0.63 mg/kg/day); 3.2 ppm (9 mg/m ³) 7 hours/day 5 days/week for 90 days (0.32 mg/kg/day)	dog	dog	Increased SGOT and SGPT, loss of hind-limb motor control, brain lesions; increased SGOT and SGPT, loss of hind-limb motor control, brain lesions	7E-4 (2E-4) ^m	1E-4 ^{a,b}	3000	3000	Pozzani et al., 1968; U.S. EPA, 1990/Pozzani et al., 1968; U.S. EPA, 1990

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³]	Oral (mg/kg/day)	Inhalation	Oral	
Methomyl subchronic (RfD ₅)	NA; 100 ppm in diet (2.5 mg/kg/day) for 24 months	NA	dog	NA, kidney lesions	ND	3E-2	NA	100	U.S. EPA, 1988/ Kaplan and Sherman, 1977; U.S. EPA, 1988, 1990
chronic (RfD ₅)	NA; 100 ppm in diet (2.5 mg/kg/day) for 24 months	NA	dog	NA; kidney lesions	ND	3E-2 ^a	NA	100	U.S. EPA, 1988/ Kaplan and Sherman, 1977; U.S. EPA, 1988, 1990
Methoxychlor subchronic (RfD ₅)	NA; 200 ppm (10 mg/kg/ day in diet during gestation	NA	rat	NA; fetotoxicity	ND	1E-1 ^{bb}	NA	100	U.S. EPA, 1984/ U.S. EPA, 1984
chronic (RfD)	NA; 200 ppm (10 mg/kg/ day) in diet during gestation	NA	rat	NA; fetotoxicity	ND	1E-1 ^{1,bb}	NA	100	U.S. EPA, 1984/ U.S. EPA, 1984
2-Methoxyethanol subchronic (RfD ₅)	10 ppm (31 mg/m ³) 6 hours/day, 5 days/ week for 13 weeks (2.9 mg/kg/day); 10 ppm (31 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (1.47 mg/kg/day)	rabbit	rabbit	fetotoxicity and testicular effects; fetotoxicity and testicular effects	1E-1 (3E-2) ^{0,bb}	1E-2 ^{b,bb}	100	100	Miller et al., 1982; U.S. EPA, 1986/Miller et al., 1982; U.S. EPA, 1986
chronic (RfD)	10 ppm (31 mg/m ³) 6 hours/day, 5 days/ week for 13 weeks (2.9 mg/kg/day); 10 ppm (31 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (1.47 mg/kg/day)	rabbit	rabbit	fetotoxicity and testicular effects; fetotoxicity and testicular effects (also see Table B)	1E-2 (3E-3) ^{0,bb}	1E-3 ^{b,9,bb}	1000	1000	Miller et al., 1982; U.S. EPA, 1986/Miller et al., 1982; U.S. EPA, 1986

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
2-Methoxyethanol acetate subchronic (RfD _S)	NA; 10 ppm (31 mg/m ³) 2-methoxyethanol x 18.13/76.09 (molecular weight ratio) x 6 hours/ day x 5 days/week x 0.5 absorption factor for 13 weeks	NA; rabbits		NA; testicular degeneration	ND	2E-2 ^b	NA	100	U.S. EPA, 1987/ Miller et al., 1982; U.S. EPA, 1987
chronic (RfD)	NA; 10 ppm (31 mg/m ³) 2-methoxyethanol x 18.13/76.09 (molecular weight ratio) x 6 hours/ day x 5 days/week x 0.5 absorption factor for 13 weeks	NA; rabbits		NA; testicular degeneration (also see Table B)	ND	2E-3 ^b	NA	1000	U.S. EPA, 1987/ Miller et al., 1982; U.S. EPA, 1987
Methyl acetate subchronic (RfD _S)	NR; 500 mg/kg/day methanol by gavage for 90 days x 74.08/32.04 (molecular weight ratio)	NA	rat	NA; liver damage	ND	10	NA	100	U.S. EPA, 1986/ Toxicity Research Labora- tory, 1986; U.S. EPA, 1986
chronic (RfD)	NR; 500 mg/kg/day methanol by gavage for 90 days x 74.08/32.04 (molecular weight ratio)	NA	rat	NA; liver damage (also see Table B)	ND	10	NA	1000	U.S. EPA, 1986/ Toxicity Research Labora- tory, 1986; U.S. EPA, 1986
Methyl acrylate subchronic (RfD _S)	NA; 15 ppm (53 mg/m ³) x 6 hours/day x 5 days/ week for 2 years x 0.5 absorption factor	NA	rat	NA; no effect	ND	3E-2	NA	100	U.S. EPA, 1987/ Klimisch and Reininghaus, 1984; U.S. EPA, 1987
chronic (RfD)	NA; 15 ppm (53 mg/m ³) x 6 hours/day x 5 days/ week for 2 years x 0.5 absorption factor	NA	rat	NA; no effect (also see Table B)	ND	3E-2	NA	100	U.S. EPA, 1987/ Klimisch and Reininghaus, 1984; U.S. EPA, 1987

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Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty factor		Reference
	Inhalation, Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
<hr/>									
Methyl bromide (Bromomethane)									
subchronic (RfD _s)	NA, 2 mg/kg/day x 5 days/week by gavage for 13 weeks	NA	rat	NA, epithe- lial hyper- plasia of fore stomach	ND	1.4E-2	NA	100	U.S. EPA, 1986 Danse et al., 1984, U.S. EPA, EPA, 1990
chronic (RfD)	NA; 2 mg/kg/day x 5 days/week by gavage for 13 weeks	NA	rat	NA, epithe- lial hyper- plasia of fore stomach	ND	1.4E-3 ^{a,1}	NA	1000	U.S. EPA, 1986 Danse et al., 1984, U.S. EPA, EPA, 1990
Methyl chloride				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (also see Table B)					U.S. EPA, 1986
Methyl Chlorocarbonate				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1989
2 Methyl-4-chlorophenoxy- acetic acid (MCPA)									
subchronic (RfD _s)	NA; 6 ppm in the diet for 52 weeks (0.15 mg/ kg/day)	NA	dog	NA; kidney and and liver	ND	5E-4	NA	300	U.S. EPA, 1990/ Industry Task Force, 1986, U.S. EPA, 1984, 1990
chronic (RfD)	NA; 6 ppm in the diet for 52 weeks (0.15 mg/ kg/day)	NA	dog	NA; kidney and and liver	ND	5E-4 ^a	NA	300	U.S. EPA, 1990/ Industry Task Force, 1986, U.S. EPA, 1984, 1990
4 (2 Methyl-4-chlorophenoxy)- butyric acid (MCPB)									
subchronic (RfD _s)	NA; 12 mg/kg/day in the diet for 13 weeks	NA	rat, dog	NA, reproductive toxicity in dogs, liver and kidney effects in rats	ND	1E-1	NA	100	U.S. EPA, 1990/ Rhodia Inc., 1970a,b; U.S. EPA, 1984, 1990

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Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral		Inhalation (mg/m ³ (mg/kg/day))	Oral (mg/kg/day)	Inhalation	Oral	
chronic	NA; 12 mg/kg/day in the diet for 13 weeks	NA	rat, dog	NA, reproductive toxicity in dogs, liver and kidney effects in rats	ND	1E-2 ^a	NA	1000	U S EPA, 1990/ Rhodia Inc., 1970a,b, U S EPA, 1984, 1990
2 (2-Methyl-4-chlorophenoxy)- propionic acid (MCPP) subchronic (RfD ₅)	NA; 50 ppm in the diet for 90 days (3 mg/kg/day)	NA	rat	NA; kidney weight	ND	1E-2	NA	300	U S EPA, 1990/ BASF Akt., 1985, U S EPA, 1984, 1990
chronic (RfD)	NA; 50 ppm in the diet for 90 days (3 mg/kg/day)	NA	rat	NA; kidney weight	ND	1E-3 ^a	NA	3000	U S EPA, 1990/ BASF Akt., 1985, U S EPA, 1984, 1990
Methylcyclohexane				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U S EPA, 1984
Methylene bromide subchronic (RfD ₅)	NA; 25 ppm (178 mg/m ³) x 6 hours/day x 63 days/90 days for 90 days x 0.5 absorption factor (11.0 mg/kg/day)	NA	rat	NA; increased carboxyhemoglobin	ND	1E-1 ^b	NA	100	U S EPA, 1987/ Keyes et al., 1982, U S EPA, 1987
chronic (RfD)	NA; 25 ppm (178 mg/m ³) x 6 hours/day x 63 days/90 days for 90 days x 0.5 absorption factor (11.0 mg/kg/day)	NA	rat	NA; increased carboxyhemoglobin (also see Table B)	ND	1E-2 ^b	NA	1000	U S EPA, 1987/ Keyes et al., 1982, U S EPA, 1987
Methylene chloride (dichloromethane) subchronic (RfD ₅)	200 ppm (694.8 mg/m ³) 6 hours/day, 5 days/week for 7 years; 24 month drinking water study [5.85 mg/kg/day (males) 6.41 mg/kg/day (females)]	rat	rat	NA, liver toxicity.	3	6E-2	100	100	Mitschke et al., 1988/ National Coffee Association, 1982, U S EPA, 1989, 1990

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference
	Inhalation, Oral	Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic (RfD)	200 ppm (694.8 mg/m ³) 6 hours/day, 5 days/week for 2 years; 24-month drinking water study (5.85 mg/kg/day (males) 6.47 mg/kg/day (females))	rat	rat	NA; liver toxicity; (Cancer: see Table B)	3J	6E-2 ^a	100	100	Mitschke et al., 1988; National Coffee Associa- tion, 1982; U.S. EPA, 1989, 1990
4,4'-Methylenediphenyl isocyanate	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U.S. EPA, 1985
Methyl ethyl benzenes (see Ethyltoluene)									
Methyl ethyl ketone subchronic (RfD _s)	235 ppm (693 mg/m ³) 7 hours/day, 5 days/ week for 12 weeks (92 mg/kg/day); 235 ppm (693 mg/m ³) 7 hours/ day, 5 days/week for 12 weeks (46 mg/kg/day)	rat	rat	CNS; fetotoxicity	3E-0 (9E-1) ^s	5E-1 ^{b.bb}	100	100	LaBelle and Brieger, 1955; U.S. EPA, 1990/ LaBelle and Brieger, 1955; U.S. EPA, 1985, 1989, 1990
chronic (RfD)	235 ppm (693 mg/m ³) 7 hours/day, 5 days/ week for 12 weeks (92 mg/kg/day); 235 ppm (693 mg/m ³) 7 hours/ day, 5 days/week for 12 weeks (46 mg/kg/day)	rat	rat	CNS; fetotoxicity	3E-1 (9E-2) ^s	5E-2 ^{a,b.1.bb}	1000	1000	LaBelle and Brieger, 1955; U.S. EPA, 1990/ LaBelle and Brieger, 1955; U.S. EPA, 1985, 1989, 1990
Methyl isobutyl ketone subchronic (RfD _s)	50 ppm (205 mg/m ³) 6 hours/day, 5 days/ week for 90 days (23.3 mg/kg/day); 50 mg/kg/day by gavage for 13 weeks	rat	rat	liver and kidney effects; liver and kidney effects	8E-1 (2E-1)	5E-1	100	100	Union Carbide Corp., 1983b, U.S. EPA, 1987/ Microbiological Associates, 1986; U.S. EPA, 1987

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A. SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update March, 1990

Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	50 ppm (205 mg/m ³) 6 hours/day, 5 days/ week for 90 days (23.3 mg/kg/day). 50 mg/kg/day by gavage for 13 weeks	rat	rat	liver and kidney effects; liver and kidney effects	8E-2 (2E-2)	5E-2 ^a	1000	1000	Union Carbide Corp., 1983b, U.S. EPA, 1987/ Microbiological Associates, 1986, U.S. EPA, 1987, 1990
Methyl isocyanate				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986
Methyl mercury subchronic (RfD ₅)	NA; 0.003 mg/kg/day in humans associated with Hg in blood at 200 ng/mL	NA	human	NA, CNS effects	ND	3E-4	NA	10	U.S. EPA, 1990/ Clarkson et al., 1976, Nordberg Strangart, 1976; WHO, 1976, U.S. EPA, 1980, 1984, 1990
chronic (RfD)	NA, 0.003 mg/kg/day in humans associated with Hg in blood at 200 ng/mL	NA	human	NA, CNS effects	ND	3E-4 ^{a,2}	NA	10	U.S. EPA, 1990/ Clarkson et al., 1976, Nordberg Strangart, 1976; WHO, 1976, U.S. EPA, 1980, 1984, 1990
Methyl methacrylate subchronic (RfD ₅)	NA, 60 ppm for 4 months then 70 ppm for 20 months in drinking water (7.5 mg/kg/day)	NA	rat	NA; increased relative kidney weight	ND	8E-2	NA	100	U.S. EPA, 1985/ Borgelleca et al., 1964, U.S. EPA, 1985
chronic (RfD)	NA; 60 ppm for 4 months then 70 ppm for 20 months in drinking water (7.5 mg/kg/day)	NA	rat	NA, increased relative kidney weight (also see Table B)	ND	8E-2 ⁹	NA	100	U.S. EPA, 1985/ Borgelleca et al., 1964, U.S. EPA, 1985

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Methyl parathion subchronic (RfD ₅)	NA; 0.5 ppm (0.025 mg/kg/day) in diet for 2 years	NA	rat	NA; reduced hemoglobin, hematocrit and RBCs, cholinesterase inhibition	ND	2.5E-4	NA	100	U.S. EPA, 1984/Monsanto Co., 1983; U.S. EPA, 1990
chronic (RfD)	NA; 0.5 ppm (0.025 mg/kg/day) in diet for 2 years	NA	rat	NA; reduced hemoglobin, hematocrit and RBCs, cholinesterase inhibition	ND	2.5E-4 ^a	NA	100	U.S. EPA, 1984/Monsanto Co., 1983, U.S. EPA, 1990
Methyl styrene (industrial mixture) subchronic (RfD ₅)	10 ppm (48.3 mg/m ³) 6 hours/day, 5 days/week for 103 weeks (11.2 mg/kg/day); 10 ppm (48.3 mg/m ³) 6 hours/day, 5 days/week for 103 weeks (5.6 mg/kg/day)	mouse	mouse	nasal lesions; nasal lesions	4E-2 (1E-2)	6E-3 ^b	1000	1000	MRI, 1984a; U.S. EPA, 1987/ MRI, 1984a; U.S. EPA, 1987
chronic	10 ppm (48.3 mg/m ³) 6 hours/day, 5 days/week for 103 weeks (11.2 mg/kg/day); 10 ppm (48.3 mg/m ³) 6 hours/day, 5 days/week for 103 weeks (5.6 mg/kg/day)	mouse	mouse	nasal lesions; nasal lesions	4E-2 (1E-2)	6E-3 ^b	1000	1000	MRI, 1984a; U.S. EPA, 1987/ MRI, 1984a; U.S. EPA, 1987
Methyl styrene, alpha subchronic (RfD ₅)	970 mg/m ³ , 7.5 hours/day, 5 days/week for 200 days (69 mg/kg/day); NA	rat	NA	liver and kidney; NA	ND	7E-1 ^b	NA	100	U.S. EPA, 1987; Wolf et al., 1956/U.S. EPA, 1987; Wolf et al., 1956
chronic (RfD) subchronic (RfD ₅)	970 mg/m ³ , 7.5 hours/day, 5 days/week for 200 days (69 mg/kg/day); NA	rat	NA	liver and kidney; NA	ND	7E-2 ^b	NA	1000	U.S. EPA, 1987; Wolf et al., 1956/U.S. EPA, 1987; Wolf et al., 1956

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³]	Oral (mg/kg/day)	Inhalation	Oral	
Mirex									
subchronic (RfD _s)	NA; 0.1 ppm in diet, multigenerational study (0.015 mg/kg/day)	NA	prairie vole	NA; decreased pup survival	ND	2E-6	NA	10,000	U.S. EPA, 1987/ Shannon, 1976; U.S. EPA, 1990
chronic (RfD)	NA; 0.1 ppm in diet, multigenerational study (0.015 mg/kg/day)	NA	prairie vole	NA; decreased pup survival (Cancer: see Table B)	ND	2E-6 ^a	NA	10,000	U.S. EPA, 1987/ Shannon, 1976; U.S. EPA, 1990
Molinate									
subchronic (RfD _s)	NA; 0.2 mg/kg/day by gavage	NA	rat	NA; reporductive toxicity	ND	2E-3	NA	100	U.S. EPA, 1984/ Stauffer Chemical Co., 1981; U.S. EPA, 1990
chronic (RfD)	NA; 0.2 mg/kg/day by gavage	NA	rat	NA; reporductive toxicity	ND	2E-3 ^a	NA	100	U.S. EPA, 1984/ Stauffer Chemical Co., 1981; U.S. EPA, 1990
Monochlorobutanes									
subchronic (RfD _s)	NA; 120 mg/kg, 5 days/ week for 13 weeks by gavage	NA	rat	NA; reduced body weight gain; hyperactivity, convulsions	ND	9E-1	NA	100	U.S. EPA, 1989/ NTP, 1986; U.S. EPA, 1989
chronic (RfD)	NA; 60 mg/kg, 5 days/ week for 103 weeks by gavage	NA	rat	NA; mortality	ND	4E-1	NA	100	U.S. EPA, 1989/ NTP, 1986; U.S. EPA, 1989
Naphthalene									
subchronic (RfD _s)	NA; 10-20 mg/day in diet 6 days/week for ≈700 days (41 mg/kg/day) ^s	NA	rat	NA; ocular and internal lesions	ND	4E-3 ^t	NA	10000	U.S. EPA, 1988/ Schmahl, 1955; U.S. EPA, 1988
chronic (RfD)	NA; 10-20 mg/day in diet 6 days/week for ≈700 days (41 mg/kg/day) ^s	NA	rat	NA; ocular and internal lesions	ND	4E-39,1,t	NA	10000	U.S. EPA, 1988/ Schmahl, 1955, U.S. EPA, 1986; 1988

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A. SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
1,4 Naphthoquinone				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (also see Table B)					U.S. EPA, 1986
Nickel subchronic (RfD ₅)	NA; 100 ppm Ni from nickel sulfate in diet for 2 years (5 mg Ni/kg/day)	NA	rat	cancer; reduced body and organ weight	ND	2E-2	NA	300	U.S. EPA, 1984/ Ambrose et al., 1976; U.S. EPA, 1990
chronic (RfD)	NA; 100 ppm Ni from nickel sulfate in diet for 2 years (5 mg Ni/kg/day)	NA	rat	cancer (see Table B), reduced body and organ weight	ND	2E-2 ^a	NA	300	U.S. EPA, 1984/ Ambrose et al., 1976, U.S. EPA, 1990
Nicotinonitrile				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
Nitrite subchronic (RfD ₅)	NA; 10 ppm nitrate in drinking water	NA	human	NA; methemoglo- binemia	ND	1E-1	NA	10	U.S. EPA, 1989/ Walton, 1951, U.S. EPA, 1989, 1990
chronic (RfD)	NA; 10 ppm nitrate in drinking water	NA	human	NA; methemoglo- binemia	ND	1E-1 ^a	NA	10	U.S. EPA, 1989/ Walton, 1951, U.S. EPA, 1989, 1990
Nitroanilines (o-, m-, p-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
Nitrobenzene subchronic (RfD ₅)	5 ppm (25 mg/m ³) 6 hours/day, 5 days/ week for 90 days (HLC=4.5 mg/m ³); 5 ppm (25 mg/m ³) 6 hours/day, 5 days/ week for 90 days (4.64 mg/kg/day)	mouse	mouse	hematological, adrenal, renal and hepatic lesions; hematological, adrenal, renal and hepatic lesions;	2E-2 (6E-3)	5E-3 ^b	300	1000	CIII, 1984; U.S. EPA, 1987/ CIII, 1984; U.S. EPA, 1987

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	5 ppm (25 mg/m ³) 6 hours/day, 5 days/ week for 90 days (HEC=4.5 mg/m ³); 5 ppm (25 mg/m ³) 6 hours/day, 5 days/ week for 90 days (4.64 mg/kg/day)	mouse	mouse	hematological, adrenal, renal and hepatic lesions; hematological, adrenal, renal and hepatic lesions;	2E-3 ¹ (6E-4)	5E-4 ^{b,1,z}	3000	10,000	CIIT, 1984; U.S. EPA, 1987/ CIIT, 1984; U.S. EPA, 1985, 1987, 1990
Nitrofurantoin Subchronic (RfD _S)	NA; 300 ppm diet for 13 weeks, (69.7 mg/kg/ day)	NA	mouse	NA; testicular damage	ND	7E-1	NA	100	U.S. EPA, 1987/ SRI, 1980; U.S. EPA, 1987
chronic RfD	NA; 300 ppm diet for 13 weeks (69.7 mg/kg/ day)	NA	mouse	NA; testicular damage	ND	7E-2	NA	1000	U.S. EPA, 1987/ SRI, 1980; U.S. EPA, 1987
Nitrofurans, other: see Table B									
Nitrogen oxides				RISK ASSESSMENT VALUES NOT DERIVED					U.S. EPA, 1982
Nitromethane				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
Nitrophenols				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
p-Nitrosodiphenylamine				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986
Nitrotoluenes (o-, m-, p-) subchronic (RfD _S)	NA; 200 mg/kg/day o-nitrotoluene x 5 days/week by gavage for 6 months	NA	rat	NA; splenic lesions	ND	1E-1	NA	1000	U.S. EPA, 1986; Ciss et al., 1980; U.S. EPA, 1986
chronic (RfD)	NA; 200 mg/kg/day o-nitrotoluene x 5 days/week by gavage for 6 months	NA	rat	NA; splenic lesions (also see Table B)	ND	1E-2	NA	10,000	U.S. EPA, 1986; Ciss et al., 1980; U.S. EPA, 1986

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation, Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Octamethylpyrophosphoramine									
subchronic (RfD ₅)	NA; 1.5 mg/day for at least 30 days (0.02 mg/kg/day)	NA	human	NA; decreased blood cholinesterase activity	ND	2E-3	NA	10	U.S. EPA, 1989/ Rider et al., 1969; U.S. EPA, 1989
chronic (RfD)	NA; 1.5 mg/day for at least 30 days (0.02 mg/kg/day)	NA	human	NA; decreased blood cholinesterase activity	ND	2E-3 ⁹	NA	10	U.S. EPA, 1989/ Rider et al., 1969; U.S. EPA, 1989
Octobromodiphenyl ether									
subchronic (RfD ₅)	NA; 2.5 mg/kg/day by gavage for 90 days	NA	rat	NA; liver histology	ND	3E-2	NA	100	U.S. EPA, 1990/ Carlson, 1980, U.S. EPA, 1983, 1990
chronic (RfD)	NA; 2.5 mg/kg/day by gavage for 90 days	NA	rat	NA; liver histology	ND	3E-3 ^a	NA	1000	U.S. EPA, 1990/ Carlson, 1980; U.S. EPA, 1983, 1990
Ozone and other photochemical oxidants				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986
Paraldehyde				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (also see Table B)					U.S. EPA, 1986
Parathion									
subchronic (RfD ₅)	NA; CBI	NA	human	NA; cholinesterase inhibition	ND	6E-3	NA	10	U.S. EPA, 1987/ U.S. EPA, 1987
chronic (RfD)	NA; CBI	NA	human	NA; cholinesterase inhibition, cancer ^u	ND	6E-3 ⁹	NA	10	U.S. EPA, 1987/ U.S. EPA, 1987
Particulate matter and sulfur oxides				RISK ASSESSMENT VALUES NOT DERIVED					U.S. EPA, 1982
Pebulate									
subchronic (RfD ₅)	NA; 5 mg/kg/day subchronic feeding study	NA	rat	NA; anticoagulant effects	ND	5E-2	NA	100	U.S. EPA, 1984/ U.S. EPA, 1984

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 5 mg/kg/day subchronic feeding study	NA	rat	NA; anticoagulant effects	ND	5E-2	NA	100	U.S. EPA, 1984/ U.S. EPA, 1984
Pendimethalin subchronic (RfD _s)	NA; 12.5 mg/kg/day, 7 days/week in capsules for 2 years	NA	dog	NA; liver	ND	4E-2	NA	300	U.S. EPA, 1990/ American Cyanimid, 1979, U.S. EPA, 1984, 1990
chronic (RfD)	NA; 12.5 mg/kg/day, 7 days/week in capsules for 2 years	NA	dog	NA; liver	ND	4E-2 ^a	NA	300	U.S. EPA, 1990/ American Cyanimid, 1979; U.S. EPA, 1984, 1990
Pentabromodiphenyl ether subchronic (RfD _s)	NA; 1.8 mg/kg/day by gavage for 90 days	NA	rat	NA; liver enzymes	ND	2E-2	NA	100	U.S. EPA, 1990/ Carlson, 1980; U.S. EPA, 1983, 1990
chronic (RfD)	NA; 1.8 mg/kg/day by gavage for 90 days	NA	rat	NA; liver enzymes	ND	2E-3 ^a	NA	1000	U.S. EPA, 1990/ Carlson, 1980; U.S. EPA, 1983, 1990
Pentachlorobenzene subchronic (RfD _s)	NA; 83 mg/kg/day in the diet for 100 days	NA	rat	NA; liver and kidney toxicity	ND	8E-3	NA	1000	U.S. EPA, 1989/ Linder, 1980; U.S. EPA, 1989, 1990
chronic (RfD)	NA; 83 mg/kg/day in the diet for 100 days	NA	rat	NA; liver and kidney toxicity	ND	8E-4 ^a	NA	10,000	U.S. EPA, 1989/ Linder, 1980, U.S. EPA, 1989, 1990
Pentachlorocyclopentadiene	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U.S. EPA, 1988

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
Pentachloronitrobenzene subchronic (RfD _s)	NA; 30 ppm (0.75 mg/kg/day) in diet for 2 years	NA	dog	NA; liver toxicity	ND	3E-3	NA	300	U.S. EPA, 1986/ Olin Corp., 1968; U.S. EPA, 1990
chronic (RfD)	NA; 30 ppm (0.75 mg/kg/day) in diet for 2 years	NA	dog	NA; liver toxicity (Cancer: see Table B)	ND	3E-3 ^a	NA	300	U.S. EPA, 1986/ Olin Corp., 1968; U.S. EPA, 1990
Pentachlorophenol subchronic (RfD _s)	NA; 3 mg/kg/day by gavage 62 days before mating through gestation	NA	rat	NA; fetotoxicity	ND	3E-2 ^{bb}	NA	100	U.S. EPA, 1984/ Schwetz et al., 1978; U.S. EPA, 1984, 1986, 1990
chronic (RfD)	NA; 3 mg/kg/day by gavage for 22-24 months	NA	rat	NA; liver and kidney pathology	ND	3E-2 ^a	NA	100	U.S. EPA, 1984/ Schwetz et al., 1978; U.S. EPA, 1984, 1986, 1990
1,1,2,3,3-Pentachloropropene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1983
n-Pentane				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
Phenanthrene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984, 1987
Phenol subchronic (RfD _s)	NA; 60 mg/kg/day by gavage during organo- genesis	NA	rat	NA; reduced fetal body weight	ND	6E-1 ^{bb}	NA	100	U.S. EPA, 1984/ Research Triangle Institute, 1983, U.S. EPA, 1990
chronic (RfD)	NA; 60 mg/kg/day by gavage during organo- genesis	NA	rat	NA; reduced fetal body weight	ND	6E-1 ^{a,1,bb}	NA	100	U.S. EPA, 1984/ Research Triangle Institute, 1983; U.S. EPA, 1990
Phenylenediamines (o-, p-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (Cancer: see Table B)					U.S. EPA, 1985

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SYNCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure Inhalation, Oral	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
m-Phenylenediamine subchronic (RfD ₅)	NA; 6.0 mg/kg/day for 90 days	NA	rat	NA, liver lesions	ND	6E-2	NA	100	U.S. EPA, 1985/ Hofer and Hruby, 1982; U.S. EPA, 1990
chronic (RfD)	NA; 6.0 mg/kg/day for 90 days	NA	rat	NA; liver lesions	ND	6E-3 ^a	NA	1000	U.S. EPA, 1985/ Hofer and Hruby, 1982, U.S. EPA, 1990
Phosgene	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U.S. EPA, 1984
Phosphine subchronic (RfD ₅)	1 ppm (1.4 mg/m ³) 34 hours/week for 24 weeks; 0.026 mg/kg/day in the diet for 2 years	rat	rat	renal effects, no effect	3E-4	3E-4	1	100	Klimmer, 1969; U.S. EPA, 1989/ Hackenberg, 1972, U.S. EPA, 1989
chronic (RfD)	1 ppm (1.4 mg/m ³) 34 hours/week for 24 weeks; 0.026 mg/kg/day in the diet for 2 years	rat	rat	renal effects; no effect	3E-5	3E-4	10	100	Klimmer, 1969; U.S. EPA, 1989/ Hackenberg, 1972; U.S. EPA, 1989
Phthalic acid esters, selected (see Table B)	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U.S. EPA, 1986
Phthalic acids (o-, m-)	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U.S. EPA, 1986
p-Phthalic acid subchronic (RfD ₅)	NA; 142 mg/kg/day in diet for 2 years	NA	rat	NA, hyperplasia of bladder uro- thelium	ND	1E+0	NA	100	U.S. EPA, 1986/ Citt, 1983; Gross, 1974, U.S. EPA, 1986
chronic (RfD)	NA; 142 mg/kg/day in diet for 2 years	NA	rat	NA, hyperplasia of bladder uro- thelium	ND	1E+0	NA	100	U.S. EPA, 1986/ Citt, 1983, Gross, 1974, U.S. EPA, 1986

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Phthalic anhydride subchronic (RfD ₅)	NA; 12,019 ppm (1562 mg/kg/day) in diet for 104 weeks	NA	mouse	NA; lung and kidney histopathology	ND	2E+0	NA	1000	U.S. EPA, 1986/ NCI, 1979, U.S. EPA, 1990
chronic (RfD)	NA; 12,019 ppm (1562 mg/kg/day) in diet for 104 weeks	NA	mouse	NA; lung and kidney histopathology (also see Table B)	ND	2E+0 ^a	NA	1000	U.S. EPA, 1986/ NCI, 1979, U.S. EPA, 1990
Polybrominated biphenyls subchronic (RfD ₅)	NA; Firemaster FF-1 0.1 mg/kg by gavage, 5 days/week for 25 weeks (0.01 mg/kg/day)	NA	rat	NA; elevated liver weight and liver lesions	ND	7E-5	NA	1000	U.S. EPA, 1989/ NTP, 1983, U.S. EPA, 1989
chronic (RfD)	NA; Firemaster FF-1 0.1 mg/kg by gavage, 5 days/week for 25 weeks (0.01 mg/kg/day)	NA	rat	NA; elevated liver weight and liver lesions (also see Table B)	ND	7E-6	NA	10,000	U.S. EPA, 1989/ NTP, 1983; U.S. EPA, 1989
Profluralin subchronic (RfD ₅)	NA; subchronic feeding study; no details provided	NA	rat	NA; NA	ND	6E-3	NA	NA	U.S. EPA, 1984/ U.S. EPA, 1984
chronic (RfD)	NA; subchronic feeding study; no details provided	NA	rat	NA; NA	ND	6E-3	NA	NA	U.S. EPA, 1984/ U.S. EPA, 1984
Propachlor subchronic (RfD ₅)	NA; 13.3 mg/kg/day in the diet for 90 days	NA	rat	NA; decreased body weight gain	ND	1.3E-1	NA	100	U.S. EPA, 1984/ Monsanto, 1964, U.S. EPA, 1984, 1990
chronic (RfD)	NA; 13.3 mg/kg/day in the diet for 90 days	NA	rat	NA; decreased body weight gain	ND	1.3E-2 ^a	NA	1000	U.S. EPA, 1984/ Monsanto, 1964, U.S. EPA, 1984, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Propazine subchronic (RfD ₅)	NA; 100 ppm in the diet for 2 years (5 mg/kg/day)	NA	rat	NA; decreased body weight gain	ND	2E 2	NA	300	U.S. EPA, 1990/Geigy, 1980, U.S. EPA, 1984, 1990
chronic (RfD)	NA; 100 ppm in the diet for 2 years (5 mg/kg/day)	NA	rat	NA; decreased body weight gain (also see Table B)	ND	2E 2 ^d	NA	300	U.S. EPA, 1990/Geigy, 1980, U.S. EPA, 1984, 1990
2 Propenoic acid (see Acrylic acid)									
Propionitrile				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
n Propyl alcohol				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
Propylene glycol subchronic (RfD ₅)	170-350 mg/m ³ (mean: 260 mg/m ³) continuously for 18 months (166 mg/kg/day); 6% in diet for 20 weeks (3 g/kg/day)	rat	rat	none observed; renal lesions	6E+0 (2E+0)	3E+1	100	100	Robertson, 1947, U.S. EPA, 1987//Guerrant et al., 1947, U.S. EPA, 1987
chronic (RfD)	170-350 mg/m ³ (mean: 260 mg/m ³) continuously for 18 months (166 mg/kg/day); 50,000 ppm in diet for 2 years (2.1 g/kg/day)	rat	dog	none observed; decrease in RBC, hematocrit, hemoglobin in dogs	6E+0 (2E+0)	2E+1	100	100	Robertson, 1947, U.S. EPA, 1987//Gaunt et al., 1972, U.S. EPA, 1987
Propylene glycol monoethyl ether subchronic (RfD ₅)	NA; 30-day drinking water (680 mg/kg/day)	NA	rat	NA, reduced weight gain	ND	7E+0	NA	100	U.S. EPA, 1984//Smyth and Carpenter, 1948, U.S. EPA, 1984
chronic (RfD)	NA; 30-day drinking water (680 mg/kg/day)	NA	rat	NA; reduced weight gain	ND	7E 1	NA	1000	U.S. EPA, 1984//Smyth and Carpenter, 1948, U.S. EPA, 1984

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)

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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
Propylene glycol monomethyl ether subchronic (RfD _S)	1000 ppm (3685 mg/m ³) 6 hours/day, 5 days/ week for 13 weeks (489 mg/kg/day); 947 mg/kg, 5 days/week for 35 days (676 mg/ kg/day) by gavage	rat	rat	liver histo- pathology; liver and kidney histo- pathology	2E+1 (5E+0)	7E+0	100	100	Miller et al., 1984; U.S. EPA, 1984/Rowe et al., 1954; U.S. EPA, 1984
chronic (RfD)	1000 ppm (3685 mg/m ³) 6 hours/day, 5 days/ week for 13 weeks (489 mg/kg/day); 947 mg/kg, 5 days/week for 35 days (676 mg/kg/day) by gavage	rat	rat	liver histo- pathology; liver and kidney histo- pathology	2E+0 (5E-1) ¹	7E-1	1000	1000	Miller et al., 1984; U.S. EPA, 1984/Rowe et al., 1954; U.S. EPA, 1984
Pyrene subchronic (RfD _S)	NA; 75 mg/kg/day by gavage for 13 weeks	NA	mouse	NA; renal effects	ND	3E-1	NA	300	U.S. EPA, 1984 U.S. EPA, 1989
chronic (RfD)	NA; 75 mg/kg/day by gavage for 13 weeks	NA	mouse	NA; renal effects	ND	3E-2 ¹	NA	3000	U.S. EPA, 1989
Pyridine subchronic (RfD _S)	NA; 1 mg/kg/day by gavage for 90 days	NA	rat	NA; increased liver weight	ND	1E-2	NA	100	U.S. EPA, 1990/ U.S. EPA, 1986a,b, 1990
chronic (RfD)	NA; 1 mg/kg/day by gavage for 90 days	NA	rat	NA; increased liver weight	ND	1E-3 ^a	NA	1000	U.S. EPA, 1990/ U.S. EPA, 1986a,b, 1990
RDX (Cyclonite) subchronic (RfD _S)	NA; 0.3 mg/kg/day for 105 weeks	NA	rat	NA; prostate inflam- mation, hemosiderosis	ND	3E-3	NA	100	U.S. EPA, 1989/ Levine et al., 1984; U.S. EPA, 1989, 1990
chronic (RfD)	NA; 0.3 mg/kg/day for 105 weeks	NA	rat	NA; prostate inflam- mation, hemosiderosis	ND	3E-3 ^a	NA	100	U.S. EPA, 1989/ Levine et al., 1984; U.S. EPA, 1989, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation, Oral	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Ronnol subchronic (RfD ₅)	NA; 5 mg/kg/day in the diet for 2 years	NA	rat	NA, liver and effects	ND	5E-2	NA	100	U S EPA, 1984/ McCollister et al, 1959, U S EPA, 1984
	chronic (RfD)	NA	rat	NA, liver and effects	ND	5E-29	NA	100	U S EPA, 1984/ McCollister et al, 1959, U S EPA, 1984
Selenium subchronic (RfD ₅)	NA; 3.2 mg/day from diet of seleniferous foodstuffs (0.046 mg/kg/day)	NA	human	ND; hair and nail loss, dermatitis	ND	3E-3	NA	15	U S EPA, 1989/ Yang et al, 1983, U S EPA, 1989, 1990
	chronic (RfD)	NA	human	ND, hair and nail loss, dermatitis	ND	3E-34.9	NA	15	U S EPA, 1989/ Yang et al, 1983, U S EPA, 1989, 1990
Simazine subchronic (RfD ₅)	NA; 0.52 mg/kg/day in in the diet for 2 years	NA	rat	NA, decreased weight gain, hematological effects	ND	2E-3	NA	300	U S EPA, 1984/ Ciba Geigy Corp, 1988, U S EPA, 1984, 1990
	chronic (RfD)	NA	rat	NA; decreased weight gain, hematological effects	ND	2E-33	NA	300	U S EPA, 1984/ Ciba Geigy Corp, 1988, U S EPA, 1984, 1990
Sodium cyanide subchronic (RfD ₅)	NA, 10.8 mg CN/kg/day from diet containing HCN (equivalent to NaCN at 20.4 mg/kg/day)	NA	rat	NA, CNS	ND	4E-2	NA	500	U S EPA, 1984/ Howard and Harrel, 1955, U S EPA, 1984

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
Chronic (RfD)	NA; 10.0 mg CN/kg/day from diet containing HCN (equivalent to NaCN at 20.4 mg/kg/day)	NA	rat	NA, CNS	ND	4E 2 ^d	NA	500	U.S. EPA, 1984/ Howard and Marzai, 1955, U.S. EPA, 1984, 1990
Sodium diethyldithio- carbamate subchronic (RfD ₅)	NA; 30 mg/kg/day for 90 days	NA	rat	NA, decreased body weight gain, renal and hemotological effects	ND	3E 1	NA	100	U.S. EPA, 1988/ Sunderman et al., 1967, U.S. EPA, 1988
Chronic (RfD)	NA; 30 mg/kg/day for 90 days	NA	rat	NA; cataracts and reduced body weight in chronic study (Cancer. see Table B)	ND	3E 2 ^d	NA	1000	U.S. EPA, 1988/ Sunderman et al., 1967, U.S. EPA, 1988 1990
Sodium metavanadate subchronic (RfD ₅)	NA; 10 ppm sodium metavanadate in drink- ing water for 3 months (1.32 mg sodium meta- vanadate/kg/day)	NA	rat	NA; impaired kidney function	ND	1E 2	NA	100	U.S. EPA, 1987/ Domingo et al., 1985, U.S. EPA, 1987
Chronic (RfD)	NA; 10 ppm sodium metavanadate in drink- ing water for 3 months (1.32 mg sodium meta- vanadate/kg/day)	NA	rat	NA; impaired kidney function	ND	1E -3	NA	1000	U.S. EPA, 1987/ Domingo et al., 1985, U.S. EPA, 1987
Styrene subchronic (RfD ₅)	NA; 200 mg/kg/day by gavage for 19 months	NA	dog	NA, red blood cell and liver effects	ND	2E 0	NA	100	U.S. EPA, 1990/ Quast et al., 1979; U.S. EPA, 1984, 1989, 1990
Chronic (RfD)	NA; 200 mg/kg/day by gavage for 19 months	NA	dog	NA, red blood cell and liver effects (also see Table B)	ND	2E 1 ^d	NA	1000	U.S. EPA, 1990/ Quast et al., 1979, U.S. EPA, 1984, 1989, 1990

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference	
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral		
Stirophos (see tetrachlorvinphos)										
Succinonitrile				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT						U S. EPA, 1987
Sulfuric acid subchronic (RfD ₅)	0.066-0.098 mg/m ³ occupational; NA	human	NA	respiratory; NA	ND ^a	ND	NA	NA	Carson et al., 1981, U S. EPA, 1984/NA	
chronic (RfD)	0.066-0.098 mg/m ³ occupational, NA	human	NA	respiratory, NA	ND ^a	ND	NA	NA	Carson et al., 1981, U S. EPA, 1984/NA	
Temephos subchronic (RfD ₅)	NA; 200 ppm in the diet for 99 days (11-24 mg/kg/day)	NA	rats	NA, no effect	ND	2E-1	NA	100	U S. EPA, 1984/ Gaines et al., 1967, U S. EPA, 1984	
chronic (RfD)	NA; 200 ppm in the diet for 99 days (11-24 mg/kg/day)	NA	rats	NA; no effect	ND	2E-2	NA	1000	U.S. EPA, 1984/ Gaines et al., 1967, U S. EPA, 1984	
Terbufos subchronic (RfD ₅)	NA; 0.01 mg/kg/day in the diet for 6 months	NA	dog	NA; no effect	ND	1E-49	NA	100	U S. EPA, 1984/ U S. EPA, 1984	
chronic (RfD)	NA; 0.01 mg/kg/day in the diet for 6 months	NA	dog	NA; no effect	ND	1E-49	NA	100	U S. EPA, 1984/ U S. EPA, 1984	
Terephthalic acid				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT						U S. EPA, 1984
tetrachloroazobenzene (TCAB)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT						U S. EPA, 1985
tetrachloroazoxybenzene (TCAOB)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT						U S. EPA, 1985
Tetrachlorocyclopentadiene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT						U.S. EPA, 1988

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral	
	Inhalation; Oral	Inhalation	Oral		Inhalation	Oral	Inhalation	Oral		
					[mg/m ³	(mg/kg/day)]	(mg/kg/day)			
Tetrachloroethylene (perchloroethylene) subchronic (RfD _S)	NA; 20 mg/kg 5 days/week for 6 weeks (14 mg/kg/day)	NA	mouse	NA; hepatotoxicity	ND		1E-1	NA	100	U S. EPA, 1988/ Buben and O'Flaherty, 1985, U.S. EPA, 1990
chronic (RfD)	NA; 20 mg/kg 5 days/week for 6 weeks (14 mg/kg/day)	NA	mouse	NA; hepatotoxicity (Cancer: see Table B)	ND		1E-2 ^a	NA	1000	U S. EPA, 1988/ Buben and O'Flaherty, 1985, U S. EPA, 1990
Tetrachlorohydrazobenzene (TCHB)			DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT							U S. EPA, 1985
2,3,4,6-Tetrachlorophenol subchronic (RfD _S)	NA; 25 mg/kg/day for 90 days	NA	rat	NA; increased liver weights and centri- lobular hypertrophy	ND		3E-1	NA	100	U.S. EPA, 1987/ U S. EPA, 1986, 1990
chronic (RfD)	NA; 25 mg/kg/day for 90 days	NA	rat	NA; increased liver weights and centri- lobular hypertrophy	ND		3E-2 ^a	NA	1000	U.S. EPA, 1987/ U.S. EPA, 1986, 1990
Tetrachlorophenol, 2,3,4,5-, 2,3,5,6-			DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT							U.S. EPA, 1987
1,1,2,3-Tetrachloropropene			DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT							U S. EPA, 1983
Tetrachlorovinphos (Stirofos) subchronic (RfD _S)	NA; 125 ppm in the diet for 2 years (3.1 mg/kg/day)	NA	dog	NA; increased liver and kidney weights, reduced body weight gain	ND		3E-2	NA	100	U.S. EPA, 1990/ Shell Chem. Co., 1968; U S EPA, 1984, 1990
chronic (RfD)	NA; 125 ppm in the diet for 2 years (3.1 mg/kg/day)	NA	dog	NA; increased liver and kidney weights, reduced body weight gain (Cancer: see Table B)	ND		3E-2 ^a	NA	100	U S. EPA, 1990/ Shell Chem Co., 1968, U S EPA, 1984, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
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Thallic oxide (Thallium(III) oxide) subchronic (RfD _s)	NA; 0.02 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	7E-4	NA	300	U S EPA, 1988/ MRI, 1986; U S EPA, 1986
chronic (RfD)	NA; 0.02 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	7E-5 ^a	NA	3000	U S EPA, 1988/ MRI, 1986, U S EPA, 1986
Thallium (in soluble salts) subchronic RfD _s)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	7E-4	NA	300	U S EPA, 1988/ MRI, 1986, U S EPA, 1986
chronic (RfD)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	7E-5	NA	3000	U S EPA, 1988/ MRI, 1986, U S EPA, 1986
Thallium(I) acetate subchronic (RfD _s)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	9E-4	NA	300	U S EPA, 1988/ MRI, 1986, U S EPA, 1986, 1990
chronic (RfD)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	9E-5 ^a	NA	3000	U S EPA, 1988/ MRI, 1986, U.S. EPA, 1986, 1990
Thallium(I) carbonate subchronic (RfD _s)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	8E-4	NA	300	U S EPA, 1988/ MRI, 1986, U S EPA, 1986, 1990
chronic (RfD)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	8E-5 ^a	NA	3000	U S EPA, 1988/ MRI, 1986, U S EPA, 1986, 1990
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HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
Thallium(I) chloride subchronic (RfD _s)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	8E-4	NA	300	U S EPA, 1988/ MRI, 1986, U S EPA, 1986, 1990
	chronic (RfD)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	8E-5 ^a	3000	U S EPA, 1988/ MRI, 1986, U S EPA, 1986, 1990
Thallium(I) nitrate subchronic (RfD _s)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	9E-4	NA	300	U S EPA, 1988/ MRI, 1986, U S EPA, 1986, 1990
	chronic (RfD)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	9E-5 ^a	3000	U S EPA, 1988/ MRI, 1986; U S EPA, 1986, 1990
Thallium selenite (Tl ₂ Se) subchronic (RfD _s)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	9E-4	NA	300	U S EPA, 1988/ MRI, 1986, U S EPA, 1986, 1990
	chronic (RfD)	NA; 0.20 mg thallium/kg/ day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	9E-5 ^a	3000	U S EPA, 1988/ MRI, 1986, U S EPA, 1986, 1990
Thallium(I) sulfate subchronic (RfD _s)	NA; 0.25 mg/kg/day for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia	ND	8E-4	NA	300	U S EPA, 1988/ MRI, 1986, U S EPA, 1986, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation, Oral	Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 0.25 mg/kg/day for 90 days	NA	rat	NA, increased SGOT and serum IDH levels, alopecia	ND	8E-5 ^a	NA	3000	U.S. EPA, 1988/MRI, 1986, U.S. EPA, 1986, 1990
2 (Thiocyanomethylthio)-benzothiazole (TCMTB) subchronic (RfD ₅)	NA; 333 ppm in the diet diet, subchronic (25 mg/kg/day)	NA	rats	NA; stomach lesions	ND	3E-1	NA	100	U.S. EPA, 1984/U.S. EPA, 1984
chronic (RfD)	NA; 333 ppm in the diet diet, subchronic (25 mg/kg/day)	NA	rats lesions	NA; stomach lesions	ND	3E-2	NA	1000	U.S. EPA, 1984/U.S. EPA, 1984
Thiofanox subchronic (RfD ₅)	NA; 0.025 mg/kg/day for 8 days	NA	dog	NA; cholinesterase inhibition	ND	3E-4	NA	100	U.S. EPA, 1989/U.S. EPA, 1989
chronic (RfD)	NA; 0.025 mg/kg/day for 8 days	NA	dog	NA; cholinesterase inhibition	ND	3E-4 ^b	NA	100	U.S. EPA, 1989/U.S. EPA, 1989
Thiram subchronic (RfD ₅)	NA; 0.61 mg/kg/day for 24 weeks	NA	ferret	NA; impaired reproduction	ND	6E-3	NA	100	U.S. EPA, 1989/Hornshaw et al., 1987, U.S. EPA, 1989, 1990
chronic (RfD)	NA; 0.61 mg/kg/day for 24 weeks	NA	ferret	NA, impaired reproduction	ND	6E-3 ^a	NA	100	U.S. EPA, 1989/Hornshaw et al., 1987, U.S. EPA, 1989, 1990
tin and Compounds subchronic (RfD ₅)	NA; 2000 ppm stannous chloride in diet for 2 years (62 mg Sn/kg/day)	NA	rat	NA, liver and kidney lesions	ND	6E-1	NA	100	U.S. EPA, 1987/NTP, 1982, U.S. EPA, 1987
chronic (RfD)	NA; 2000 ppm stannous chloride in diet for 2 years (62 mg Sn/kg/day)	NA	rat	NA, liver and kidney lesions	ND	6E-1	NA	100	U.S. EPA, 1987/NTP, 1982, U.S. EPA, 1987

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Compound	Exposure Inhalation, Oral	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
Toluene									
subchronic (RfD ₅)	40 ppm for 6 hours (151 mg/m ³); 590 mg/day 5 days/week for 138 doses (42 mg/ kg/day) by gavage	human	rat	CNS effects, eyes and nose irritation, CNS effects	2E+0	4E-1	100	100	Andersen et al., 1983; CIII, 1980; U.S. EPA, 1984/ Wolf et al., 1956
chronic (RfD)	40 ppm for 6 hours (151 mg/m ³); 300 ppm (1130 mg/m ³) 6 hours/day, 5 days/ week for 24 months (29 mg/kg/day) ^b	human	rat	CNS effects, eyes and nose irritation, CNS effects ¹	2E+0 ¹	3E-1 ^{b,2}	100	100	Andersen et al., 1983; CIII, 1980; U.S. EPA, 1984/ CIII, 1980 U.S. EPA, 1984, 1985, 1990
Toluenediamine (2,3-, 3,4-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Toluene-2,5-diamine									
subchronic (RfD ₅)	NA; 2000 ppm of the sulfate salt in the diet for 78 weeks (56 mg/kg/day)	NA	rat	NA; no effect	ND	6E-1	NA	100	U.S. EPA, 1984/ NCI, 1978; U.S. EPA, 1984
chronic (RfD)	NA; 2000 ppm of the sulfate salt in the diet for 78 weeks (56 mg/kg/day)	NA	rat	NA; no effect	ND	6E-1	NA	100	U.S. EPA, 1984/ NCI, 1978; U.S. EPA, 1984
Toluene-2,6-diamine									
subchronic (RfD ₅)	NA; 500 ppm of the dihydrochloride in the diet for 2 years (16 mg/kg/day)	NA	rat	NA; no effect	ND	2E-1	NA	100	U.S. EPA, 1984/ NCI, 1980; U.S. EPA, 1980
chronic (RfD)	NA; 500 ppm of the dihydrochloride in the diet for 2 years (16 mg/kg/day)	NA	rat	NA; no effect	ND	2E-1	NA	100	U.S. EPA, 1984/ NCI, 1980; U.S. EPA, 1980
m-Toluidine				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Triallate									
subchronic (RfD ₅)	NA; 1.3 mg/kg/day in the diet for 24 months	NA	dog	NA, spleen and liver	ND	1.3E-2	NA	100	U.S. EPA, 1990/Monsanto Co., 1979, U.S. EPA, 1990
chronic (RfD)	NA; 1.3 mg/kg/day in the diet for 24 months	NA	dog	NA, spleen and liver	ND	1.3E-2 ^{ad}	NA	100	U.S. EPA, 1990/Monsanto Co., 1979, U.S. EPA, 1990
1,2,4 Tribromobenzene									
subchronic (RfD ₅)	NA; 5 mg/kg/day in the diet for 45 or 90 days	NA	rat	NA, liver weight and enzyme induction	ND	5E-2	NA	100	U.S. EPA, 1990/Carlson and Tardiff, 1977, U.S. EPA, 1984, 1990
chronic (RfD)	NA; 5 mg/kg/day in the diet for 45 or 90 days	NA	rat	NA, liver weight and enzyme induction	ND	5E-3 ^d	NA	1000	U.S. EPA, 1990/Carlson and Tardiff, 1977; U.S. EPA, 1984, 1990
Tribromomethane (see Bromoform)									
1,2,4-Trichlorobenzene									
subchronic (RfD ₅)	3 ppm (22 mg/m ³) 6 hours/day, 5 days/week for 3 months (2.5 mg/kg/day); 20 mg/kg/day by gavage for 90 days	rat	rat	Increased uroporphyrin; increased liver-to-body weight ratio	9E-2 (3E-2)	2E-1	100	100	Watanabe et al., 1978, U.S. EPA, 1987/Carlson and Tardiff, 1976, U.S. EPA, 1987
chronic (RfD)	3 ppm (22 mg/m ³) 6 hours/day, 5 days/week for 3 months (2.5 mg/kg/day), 20 mg/kg/day by gavage for 90 days	rat	rat	Increased uroporphyrin, increased liver to body weight ratio	9E-3 (3E-3)	2E-2 ^y	1000	1000	Watanabe et al., 1978, U.S. EPA, 1987/Carlson and Tardiff, 1976, U.S. EPA, 1987
Trichlorocyclopentadiene									U.S. EPA, 1988
DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT									

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A. SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure Inhalation, Oral	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
1,1,1-Trichloroethane subchronic (RfD ₅)	500 ppm (2730 mg/m ³) 7 hours/day, 5 days/ week for 6 months (304 mg/kg/day); 500 ppm (2730 mg/m ³) 7 hours/day for 6 months (90 mg/kg/day) ^b	guinea pig	guinea pig	hepatotoxicity; hepatotoxicity	1E+1 (3E+0) ^s	9E-1 ^b	100	100	Torkelson et al., 1958; U.S. EPA, 1990/ Torkelson et al., 1958; U.S. EPA, 1990
chronic (RfD)	500 ppm (2730 mg/m ³) 7 hours/day, 5 days/ week for 6 months (304 mg/kg/day); 500 ppm (2730 mg/m ³) 7 hours/day for 6 months (90 mg/kg/day) ^b	guinea pig	guinea pig	hepatotoxicity; hepatotoxicity ¹	1E+0 (3E-1) ^s	9E-2 ^{a,b}	1000	1000	Torkelson et al., 1958; U.S. EPA, 1990/ Torkelson et al., 1958; U.S. EPA, 1990
1,1,2-Trichloroethane subchronic (RfD ₅)	NA; 3.9 mg/kg/day by drinking water for 90 days	NA	mouse	NA; clinical chemistry altera- tions	NO	4E-2	NA	100	U.S. EPA, 1984/ White et al., 1985; Sanders et al., 1985, U.S. EPA, 1990
chronic (RfD)	NA; 3.9 mg/kg/day by drinking water for 90 days	NA	mouse	NA; clinical chemistry altera- tions (Cancer. see Table B)	NO	4E-3 ^a	NA	1000	U.S. EPA, 1984/ White et al., 1985; Sanders et al., 1985, U.S. EPA, 1990
Trichlorofluoromethane (F-11) subchronic (RfD ₅)	5600 mg/m ³ contin- uously for 90 days (1940 mg/kg/day); 1000 mg/kg/day, 5 days/week for 6 weeks (714.3 mg/kg/day)	dog	rat	elevated RUN, lung lesions; mortality	7E+0 (2E+0)	7E-1	1000	1000	Jenkins et al., 1970; U.S. EPA, 1981/NCI, 1978, U.S. EPA, 1981

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	5600 mg/m ³ continuously for 90 days (1940 mg/kg/day); 488 mg/kg/day, 5 days/week for 66 weeks (348.6 mg/kg/day)	dog	rat	elevated BUN, lung lesions; mortality	1E-1 (2E-1)	3E-1 ^d	10,000	1000	Jenkins et al., 1970, U.S. EPA, 1987/MCI, 1978, U.S. EPA, 1987, 1990
2,4,4'-Trichloro-2'-hydroxydiphenyl ether subchronic (RfD _S)	NA; 500 mg/kg, 6 days/week for 4 weeks (429 mg/kg/day)	NA	rat	ND; ND	ND	4E+0	NA	100	U.S. EPA, 1987// Lyman and Furia, 1969, U.S. EPA, 1987
chronic (RfD)	NA; NA	NA	NA	ND; ND	ND	ND	NA	NA	U.S. EPA, 1987// U.S. EPA, 1987
Trichloromethane (see Chloroform)									
Trichlorophenol, 2,3,4-, 2,3,5-, 2,3,6-, and 3,4,5-				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
2,4,5-Trichlorophenol subchronic (RfD _S)	NA; 1000 ppm of diet for 98 days (100 mg/kg/day)	NA	rat	NA; hepatotoxicity, kidney effects	ND	1E+0	NA	100	U.S. EPA, 1984, 1987/McCollister et al., 1961, U.S. EPA, 1984, 1987
chronic (RfD)	NA; 1000 ppm of diet for 98 days (100 mg/kg/day)	NA	rat	NA; hepatotoxicity, kidney effects	ND	1E-1 ^d	NA	1000	U.S. EPA, 1984, 1987/McCollister et al., 1961; U.S. EPA, 1984, 1987, 1990
2,4,6-Trichlorophenol - see Table B									
2,4,5-Trichlorophenoxyacetic acid subchronic (RfD _S)	NA; 10 mg/kg/day for 90 days	NA	rat	NA; liver and kidney weights	ND	1.0E-1	NA	100	U.S. EPA, 1989// Gehring and Britso, 1978, U.S. EPA, 1989

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 3 mg/kg/day 3-generation study	NA	rat	NA; decreased survival	ND	1.0E-2 ^a	NA	300	U.S. EPA, 1989/ Kociba et al., 1979, U.S. EPA, 1989, 1990
1,1,1 Trichloropropane				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987/ U.S. EPA, 1987
1,2,2-Trichloropropane				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987/ U.S. EPA, 1987
1,1,2-Trichloropropane subchronic (RfD ₅)	NA; 100 mg/l in drinking water for 13 weeks (15 mg/kg/day)	NA	rat	histopathological lesions in liver, kidney and thyroid	ND	5E-2	NA	300	U.S. EPA, 1987/ Villeneuve et al., 1985, U.S. EPA, 1990
chronic (RfD)	NA; 100 mg/l in drinking water for 13 weeks (15 mg/kg/day)	NA	rat	histopathological lesions in liver, kidney and thyroid	ND	5E-3 ^a	NA	3000	U.S. EPA, 1987/ Villeneuve et al., 1985, U.S. EPA, 1990
1,2,3 Trichloropropane subchronic (RfD ₅)	NA; 8 mg/kg 5 days/week for 120 days (5.7 mg/kg/day)	NA	rat	NA; transient clinical signs, liver and kidney lesions, decrease in RBC, hematocrit and hemoglobin	ND	6E-2	NA	100	U.S. EPA, 1987/ NTP, 1983, U.S. EPA, 1987
chronic (RfD)	NA; 8 mg/kg 5 days/week for 120 days (5.7 mg/kg/day)	NA	rat	NA; transient clinical signs, liver and kidney lesions, decrease in RBC, hematocrit and hemoglobin	ND	6E-3 ^a	NA	1000	U.S. EPA, 1987/ NTP, 1983, U.S. EPA, 1987, 1990
1,2,3-Trichloropropene subchronic (RfD ₅)	3 ppm (18 mg/m ³), 6 hours/day, 5 days/week for 66 weeks; NA	duys	NA	eye irritation; NA	ND	5E-3 ^b	NA	100	U.S. EPA, 1983/ McKenna et al., 1978, U.S. EPA, 1983

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A SURCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation, Oral	Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
chronic	3 ppm (18 mg/m ³), 6 hours/day, 5 days/week for 66 weeks, NA	days	NA	eye irritation, NA	ND	SE 3 ^b	NA	100	U S EPA, 1987/ McKenna et al., 1978, U S EPA, 1983
2,3,6 Trichlorotoluene subchronic (RID ₅)	NA, 0.5 ppm in diet (0.05 mg/kg/day) for 28 days	NA	rat	NA, liver kidney, thyroid lesions	ND	SE-5	NA	1000	U S EPA, 1987/ Chu et al., 1984, U S EPA, 1987
chronic (RID)	NA, NA	NA	NA	NA, NA	ND	ND	NA	NA	U S EPA, 1987/ U S EPA, 1987
2,4,6 Trichloro toluene subchronic (RID ₅)	NA, 0.5 ppm in diet (0.05 mg/kg/day) for 28 days	NA	rat	NA, liver, kidney, thyroid lesions	ND	SE-5	NA	1000	U S EPA, 1987/ Chu et al., 1984, U S EPA, 1987
chronic (RID)	NA, NA	NA	NA	NA, NA	ND	ND	NA	NA	U S EPA, 1987/ U S EPA, 1987
1,1,2 Trichloro-1,2,2- trifluoroethane subchronic (RID ₅)	5358 mg/m ³ occupational for 2 1/2 years (2/3 mg/kg/day), NA	human	NA	psychomotor impair- ment, NA	ND	3E+1	NA	10	Imbus and Adkins, 1972, U S EPA, 1983, 1985/Imbus and Adkins, 1972, U S EPA, 1983, 1990
chronic (RID)	5338 mg/m ³ occupational for 2 1/2 years (2/3 mg/kg/day), NA	human	NA	psychomotor impair ment, NA	ND	3E+1 ^{b,2}	NA	10	Imbus and Adkins, 1972, U S EPA, 1983, 1985/Imbus and Adkins, 1972, U S EPA, 1983, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure Inhalation; Oral	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference
		Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
Trifluralin subchronic (RfD _s)	NA; 30 ppm in the diet for 12 months (0.75 mg/kg/day)	NA	dog	NA; increased liver weight, methemo- globlinemia	ND	7.5E-3	NA	100	U.S. EPA, 1990/ Hoechst, 1984; U.S. EPA, 1984, 1990
chronic (RfD)	NA; 30 ppm in the diet for 12 months (0.75 mg/kg/day)	NA	dog	NA; increased liver weight, methemo- globlinemia (Cancer: see Table B)	ND	7.5E-3 ^a	NA	100	U.S. EPA, 1990/ Hoechst, 1984; U.S. EPA, 1984, 1990
Trimethylbenzenes				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
1,3,5-Trinitrobenzene subchronic (RfD _s)	NA; 3 ppm 1,3-dinitro- benzene in drinking water for 16 weeks (0.4 mg/kg/ day equivalent to 0.51 mg/kg/day 1,3,5-trinitro- benzene)	NA	rat	NA; increased spleen weight	ND	5E-4	NA	1000	U.S. EPA, 1989/ Cody et al., 1981; U.S. EPA, 1989, 1990
chronic (RfD)	NA; 3 ppm 1,3-dinitro- benzene in drinking water for 16 weeks (0.4 mg/kg/ day equivalent to 0.51 mg/kg/day 1,3,5-trinitro- benzene)	NA	rat	NA; increased spleen weight	ND	5E-5 ^a	NA	10,000	U.S. EPA, 1989/ Cody et al., 1981; U.S. EPA, 1989, 1990
Trinitrophenols				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Vanadium subchronic (RfD _s)	NA; 5 ppm vanadium from vanadyl sulfate in drinking water for lifetime (0.7 mg/kg/day)	NA	rat	NA; none observed	ND	7E-3	NA	100	U.S. EPA, 1987/ Schroeder et al., 1970; U.S. EPA, 1987
chronic (RfD)	NA; 5 ppm vanadium from vanadyl sulfate in drinking water for lifetime (0.7 mg/kg/day)	NA	rat	NA; none observed	ND	7E-3 ^B	NA	100	U.S. EPA, 1987/ Schroeder et al., 1970; U.S. EPA, 1987, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure Inhalation, Oral	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
		Inhalation	Oral		Inhalation {mg/m ³ (mg/kg/day)}	Oral (mg/kg/day)	Inhalation	Oral	
Vanadium pentoxide subchronic (RfD ₅)	NA; 10 ppm vanadium in diet from vanadium pentoxide for lifetime (0.9 mg vanadium pent- oxide/kg/day)	NA	rat	NA; none observed	ND	9E-3	NA	100	U.S. EPA, 1987/ Stokinger et al., 1953; U.S. EPA, 1987
chronic (RfD)	NA; 10 ppm vanadium in diet from vanadium pentoxide for lifetime (0.9 mg vanadium pent oxide/kg/day)	NA	rat	NA; none observed	ND	9E-3 ^a	NA	100	U.S. EPA, 1987/ Stokinger et al., 1953, U.S. EPA, 1987, 1990
Vanadyl sulfate subchronic (RfD ₅)	NA; 5 ppm vanadium from vanadyl sulfate in drinking water for life- time (2.24 mg vanadyl sulfate/kg/day)	NA	rat	NA; none observed	ND	2E-2	NA	100	U.S. EPA, 1987/ Schroeder et al., 1970, U.S. EPA, 1987
chronic (RfD)	NA; 5 ppm vanadium from vanadyl sulfate in drinking water for life- time (2.24 mg vanadyl sulfate/kg/day)	NA	rat	NA; none observed	ND	2E-2	NA	100	U.S. EPA, 1987/ Schroeder et al., 1970, U.S. EPA, 1987
Vernolate (Vernam) subchronic (RfD ₅)	NA; 20 ppm in the diet (1 mg/kg/day) reproduc- tive	NA	rat	NA; decreased body weight	ND	1E-2	NA	100	U.S. EPA, 1983/ Stauffer Chem Co., 1983, U.S. EPA, 1983, 1990
chronic (RfD)	NA; 20 ppm in the diet (1 mg/kg/day) reproduc- tive	NA	rat	NA, decreased body weight	ND	1E-3 ^a	NA	1000	U.S. EPA, 1983/ Stauffer Chem Co., 1983, U.S. EPA, 1983, 1990
4 Vinyl-1-cyclohexene	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								U.S. EPA, 1983

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update, March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference
	Inhalation, Oral	Inhalation	Oral		Inhalation (mg/m ³)	Oral (mg/kg/day)	Inhalation	Oral	
m-Xylene subchronic (RfD ₅)	4750 mg/m ³ , 8 hours/ day, 7 days/week for 1 year (1009 mg/kg/ day) ^W ; 500 mg/kg mixed xylenes 5 days/week for 103 weeks (357 mg mixed xylenes/kg/day)	rat	rat	hepatomegaly, none observed	4E+0 (1E+0)	4E+0	1000	100	Tatrai et al., 1981; U.S. EPA, 1989/NTP, 1986
chronic (RfD)	4750 mg/m ³ , 8 hours/ day, 7 days/week for 1 year (1009 mg/kg/day) ^W , 250 mg/kg mixed xylenes 5 days/week for 103 weeks (179 mg mixed xylenes/kg/day)	rat	rat	hepatomegaly, hyper- activity, decreased body weight, in- creased mortality at higher dosage	7E-1 (2E-1)	2E+0	5000	100	Tatrai et al., 1981, U.S. EPA, 1989/NTP, 1986; U.S. EPA, 1986
o-Xylene subchronic (RfD ₅)	150 mg/m ³ continuous on days 7-14 of gesta- tion (95.6 mg/kg/day); 500 mg/kg mixed xylenes 5 days/week by gavage for 13 weeks (357 mg mixed xylenes/kg/day)	rat	rat	fetotoxicity; none observed	3E+0 (1E+0) ^{bb}	4E+0	100	100	Ungvary et al., 1980, U.S. EPA, 1989/NTP, 1986
chronic (RfD)	4750 mg/m ³ , 8 hours/ day, 7 days/week for 1 year (1009 mg/kg/day), 250 mg/kg mixed xylenes 5 days/week for 103 weeks (179 mg mixed xylenes/kg/day)	rat	rat	hepatomegaly; hyper- activity, decreased body weight, in- creased mortality at higher dosage	7E-1 (2E-1)	2E+0	5000	100	Tatrai et al., 1981; U.S. EPA, 1989/NTP, 1986, U.S. EPA, 1986
p-Xylene subchronic (RfD ₅)	20 ppm 7.5 hours/day for 5 days (27 mg/m ³); NA	human	rat	CNS effects, nose and throat irrita- tion, NA	3E-1	ND	100	NA	Wake et al., 1981; U.S. EPA, 1989/ U.S. EPA, 1989
chronic (RfD)	20 ppm 7.5 hours/day for 5 days (27 mg/m ³), NA	human	NA	CNS effects, nose and throat irrita- tion, NA	3E-1	ND	100	NA	U.S. EPA, 1989/ U.S. EPA, 1989

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation; Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
Xylenes, mixed subchronic (RfDs)	20 ppm 7.5 hours/day for 5 days (27 mg/m ³); 500 mg/kg mixed xylenes 5 days/week by gavage for 13 weeks (357 mg mixed xylenes/kg/day)	human	rat	CNS effects, nose and throat irrita- tion; none observed	3E-1	4E+0	100	100	Hake et al., 1981; Litton Bio- netics, 1978; U.S. EPA, 1989/ NTP, 1986; U.S. EPA, 1990
chronic (RfD)	20 ppm 7.5 hours/day for 5 days (27 mg/m ³); 250 mg/kg mixed xylenes 5 days/week for 103 weeks (179 mg mixed xylenes/kg/day)	human	rat	CNS effects, nose and throat irrita- tion; hyperactivity, decreased body weight and increased mortality at higher dosage ¹	3E-1 ¹	2E+0 ^a	100	100	Hake et al., 1981; Carpenter et al. 1975; U.S. EPA, 1989/NTP, 1986; U.S. EPA, 1989, 1990
Zinc subchronic (RfDs)	NA; 2.14 mg/kg/day therapeutic dosage	NA	human	NA; anemia	ND	2E-1	NA	10	U.S. EPA, 1984/ Pories et al., 1967; Prasad et al., 1975; U.S. EPA, 1984
chronic (RfD)	NA; 2.14 mg/kg/day therapeutic dosage	NA	human	NA; anemia	ND	2E-1 ⁹	NA	10	U.S. EPA, 1984/ Pories et al., 1967; Prasad et al., 1975; U.S. EPA, 1984, 1990
Zinc subchronic (RfDs)	NA; 500 ppm in the diet for 2 years (25 mg/kg/ day)	NA	rat	NA; thyroid hyperplasia	ND	5E-2	NA	500	U.S. EPA, 1984/ Blackwell-Smith et al., 1953; U.S. EPA, 1984, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)

Update March, 1990

Compound	Exposure	Species		Effect of Concern Inhalation, Oral	Reference Dose		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral	Inhalation	Oral		Inhalation [mg/m ³ (mg/kg/day)]	Oral (mg/kg/day)	Inhalation	Oral	
chronic (RfD)	NA; 500 ppm in the diet for 2 years (25 mg/kg/ day)	NA	rat	NA; thyroid hyperplasia	ND	SE 2 ^d	NA	500	U.S. EPA, 1984/ Blackwell Smith et al., 1957; U.S. EPA, 1984, 1990

^aVerified, available on IRIS

^bBased on route-to-route extrapolation

^cSpecifically related to organoleptic threshold and potential for respiratory tract irritation, not to systemic toxicity.

^dSpecifically related to organoleptic threshold; safe concentration may be higher but data are inadequate to assess.

^eInhalation study with antimony trioxide in rats (Watt, 1980, 1981, 1983; ASARCO, Inc., 1980) provides qualitative evidence of lung cancer; cancer potency not estimated.

^fCalculated by analogy to antimony by correcting for differences in molecular weight.

^gUnder review by RfD Work Group

^hBecause of background dietary exposure, an RfD₅₀ was not estimated.

ⁱVerified 2 separate RfD₅, 1E-3 for food and 5E-4 for water

^jVerified, Workgroup concurrence on final data base file, and IRIS input pending

^kCurrent drinking water standard of 1.3 mg/l; Drinking Water Criteria Document concluded toxicity data were inadequate for calculation of an RfD for copper.

^lCRAVE-verified as a CAG Group D substance

^mThese values differ from those in the HEED (U.S. EPA, 1987a) because the uncertainty factor for deriving the inhalation RfD values presented herein were changed to correspond to those used by IRIS (U.S. EPA, 1987b) for generating the oral RfD from the same (inhalation) study.

ⁿCalculated by analogy to free cyanide by correcting for differences in molecular weight.

^oThese values differ from those in the HEA (U.S. EPA, 1984) because the study chosen as the basis for the inhalation RfD values was changed to conform to the inhalation study chosen as the basis of the oral RfD derived in a more recent HEED (U.S. EPA, 1986).

^pFinal Draft of Air Quality Criteria Document (600/8-83-028f) declines to derive an air quality criterion for lead.

QNot verified and further discussion not scheduled

RBased on RfD for methyl mercury

SThese values differ from those in the HEA (U.S. EPA, 1984) because the study chosen as the basis for the inhalation RfD values was changed to conform to the inhalation study chosen as the basis of the oral RfD derived on IRIS.

AA minor calculation error in estimation of transformed dose in 1986 HEEP is corrected here.

UVerified as a Group C carcinogen; no quantitative estimate available.

VReported effects occurred at portal of entry; estimates of mg/day reference doses are inappropriate because effects at portal of entry depend on concentration in air. An acceptable air concentration of 0.07 mg/m³ was estimated by Carson et al. (1981) from available data.

WExperiment performed with o-xylene.

XFrom toxicity data on tetraethyl lead.

YWithdrawn from IRIS.

ZThe oral RfD, while still available on IRIS, is being reconsidered by the RfD Workgroup.

aaThe verified RfD appears on IRIS as 1.3E-3 because of a typographical error.

bbDevelopmental effects have been used as the basis of calculation.

ccBased on arsenic equivalents.

NA = Not applicable or not available; ND = not determined

Notes: To estimate acceptable water concentrations from oral RfD_s/RfD, multiply by 70 and divide by 2 g.

If exposure occurs by both oral and inhalation routes, the route-specific RfD_s/RfD must be proportionally reduced.

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Compound	Exposure Inhalation; Oral	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference Inhalation/Oral
		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
						$(\mu\text{g}/\text{m}^3)^{-1}$ [(mg/kg/day) $^{-1}$]	$(\mu\text{g}/\text{L})^{-1}$ [(mg/kg/day) $^{-1}$]	
Acephate	NA; 2-year dietary	NA	mice	NA (also see Table A)	liver	ND	C/2.5E-7 [8.7E-3] ^a	U.S. EPA, 1990/ Chevron Chemical Company, 1982; U.S. EPA, 1984; U.S. EPA, 1990 U.S. EPA, 1988/ 1990
Acrolein	NA; NA	NA	NA	NA (also see Table A)	NA	C/ND ^a	C/ND ^a	U.S. EPA, 1987, 1990/U.S. EPA, 1987, 1990
Acrylamide	NA; 2-year drinking water	NA	rat	NA (also see Table A)	CNS, mammary and thyroid glands, uterus, oral cavity	B2/1.3E-3 [4.5E+0] ^{a,b}	B2/1.3E-4 [4.5E+0] ^a	U.S. EPA, 1990/ Johnson et al., 1986; U.S. EPA, 1985; U.S. EPA, 1990
Acrylonitrile	occupational; three drinking water studies	human	rat	lung	multiple	B1/6.8E-5 [2.4E-1] ^a	B1/1.5E-5 [5.4E-1] ^a	O'Berg, 1980; U.S. EPA, 1983, 1987a,b/Quast et al., 1980; Bio/dynamics, Inc., 1980a,b; U.S. EPA, 1983, 1987, 1990
Alachlor	NA; NA	NA	NA (also see Table A)	NA	NA	B2/ND ^f	B2/2.3E-6 [8.1E-2] ^f	U.S. EPA, 1984, 1988
Aldrin	three dietary studies; three dietary studies	mouse	mouse	liver (also see Table A)	liver	B2/4.9E-3 [1.7E+1] ^{a,b}	B2/4.9E-4 [1.7E+1] ^a	NCI, 1977; Davis and Fitzhugh, 1962; Epstein, 1975; Davis, 1965; U.S. EPA, 1986, 1987b/ NCI, 1977; Davis and Fitzhugh, 1962; Epstein, 1975; Davis, 1965; U.S. EPA, 1986, 1987, 1990

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
	Inhalation, Oral					$\frac{(\mu\text{g}/\text{m}^3)^{-1}}{[(\text{mg}/\text{kg}/\text{day})^{-1}]}$	$\frac{(\mu\text{g}/\text{g})^{-1}}{[(\text{mg}/\text{kg}/\text{day})^{-1}]}$	Inhalation/Oral
Allyl chloride	NA; NA	NA	NA	NA (also see Table A)	NA	C/ND ^f	C/ND ^f	U.S. EPA, 1983, 1989/U.S. EPA, 1983, 1989
Aniline	NA; 2-year dietary	NA	rat	NA	spleen	ND	B2/1.6E-7 [5.7E-3] ^d	U.S. EPA, 1987/ CIIT, 1982;
Aramite	NA; 400 ppm in diet for 104 weeks (20 mg/kg/day)	NA	rat	increased incidence of liver tumors (also see Table A)	increased incidence of liver tumors	B2/7.1E-6 [2.5E-2] ^b	B2/7.1E-6 [2.5E-2]	U.S. EPA, 1985, 1990 U.S. EPA, 1989/ U.S. EPA, 1989; Popper et al., 1960; Oser and Oser, 1962
Arsenic	100-5000 $\mu\text{g}/\text{m}^3$ continuous; 0.01-1.8 mg/l in drinking water	human	human	respiratory tract (also see Table A)	skin	A/4.3E-3 [5.0E+1] ^{a,p}	A/NA ^k	Brown and Chu, 1983a,b,c; Lee- feldstein, 1983; Higgins, 1982; Enterline and Marsh, 1982; U.S. EPA, 1984a,b, 1990/U.S. EPA, 1990
Asbestos	occupational; dietary	human	rat	lung and mesothelioma	large intestine	A/2.3E-1 (fibers/m) ⁻¹ =	A/ND	U.S. EPA, 1986, 1987/NTP, 1985; U.S. EPA, 1985, 1990
Azobenzene	NA; 2-year dietary	NA	rat	NA	abdominal cavity	B2/3.1E-5 [1.1E-1] ^{a,b}	B2/3.1E-6 [1.1E-1] ^a	U.S. EPA, 1990/ NCI, 1979; U.S. EPA, 1986, 1990

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
		Inhalation	Oral	Inhalation	Oral	Inhalation ($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	Oral ($\mu\text{g}/\text{kg}$) ⁻¹ [(mg/kg/day) ⁻¹]	
	Inhalation; Oral							Inhalation/Oral
Benzene	occupational; occupational	human	human	leukemia	leukemia	A/8.3E-6 [2.9E-2] ^a	A/8.3E-7 [2.9E-2] ^{a,b}	Ott et al., 1978; Rinsky et al., 1981, Wong et al., 1983, U.S. EPA, 1985, 1987a, 1989/Ott et al., 1978; Rinsky et al., 1981; Wong et al., 1983; U.S. EPA, 1985, 1987a, 1989, 1990
Benzidine	occupational; occupational	human	human	urinary bladder (also see Table A)	urinary bladder	A/6.7E-2 [2.3E+2] ^a	A/6.7E-3 [2.3E+2] ^{a,b}	Zavon et al., 1973; U.S. EPA, 1990/ Zavon et al., 1973; U.S. EPA, 1980, 1986, 1987, 1990
Benzo(a)anthracene	NA; NA	NA	NA	NA	NA	B2/NA ^f	B2/ND ^f	U.S. EPA, 1990
Benzo(a)pyrene	2.2-9.5 mg/m ³ , 4.5 hours/day for \leq 96.4 weeks; 1-250 ppm diet for \approx 110 days	hamster	mouse	respiratory tract	stomach	B2/ND ^a	B2/ND ^a	Thyssen et al., 1990; U.S. EPA, 1987/Neal and Rigdon, 1967; U.S. EPA, 1980, 1990
Benzo(b)fluoranthene	NA; NA	NA	NA	NA	NA	B2/ND ^f	B2/ND ^f	U.S. EPA, 1990
Benzo(k)fluoranthene	NA; NA	NA	NA	NA	NA	B2/ND ^f	B2/ND ^f	U.S. EPA, 1987
Benzotrichloride	0.94E-3 mg/kg/day, 0.5 hrs/day, 2 days/wk for 1 yr; 0.26 mg/kg/day, 2 days/week by gavage for 25 weeks	mice	mice	lung	lungs	B2 ^f /8.6E-1 [3.0+3] ^g	B2 ^f /3.6E-4 [1.3E+1] ^{f,g}	Yoshimura et al., 1986/Fukuda et al., 1978; U.S. EPA, 1986, 1989
Benzyl chloride	NA; 0, 15, 30 mg/kg, 3 days/week by gavage for 104 weeks	NA	rat	NA	thyroid	ND	B2/4.9E-6 [1.7E-1] ^a	U.S. EPA, 1990/ Lijinski, 1986, U.S. EPA, 1986, 1990

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	Inhalation/Oral
						($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	($\mu\text{g}/\text{L}$) ⁻¹ [(mg/kg/day) ⁻¹]	
Beryllium	occupational; 5 ppm in drinking water for lifetime	human	rat	lung (also see Table A)	total tumors	B2/2.4E-3 [8.4E+0] ^a	B2/1.2E-4 [4.3E+0] ^a	Wagoner et al., 1980; U.S. EPA, 1987, 1990/ Schroeder and Mitchener, 1975a; U.S. EPA, 1986, 1990
Bis(2-chloroethyl) ether	560-day oral study; 560-day oral study	mouse	mouse	liver	liver	B2/3.3E-4 [1.1E+0] ^{a,b}	B2/3.3E-5 [1.1E+0] ^a	Innes et al., 1969; U.S. EPA, 1980, 1990;/Innes et al., 1969; U.S. EPA, 1980 1987, 1990
Bis(chloromethyl)- ether	inhalation 10-100 days; inhalation 10-100 days	rat	rat	respiratory tract	ND	A/6.2E-2 [2.2E+2] ^a	A/6.2E-3 [2.2E+2] ^{a,b}	Kuschner et al., 1975; U.S. EPA, 1990/U.S. EPA, 1990
Bis(2-chloro-1-methyl- ethyl)ether	2-year gavage study ^b ; 2-year gavage study	mouse	mouse	liver, lung	liver, lung	C/2E-5 [7E-2] ^b	C/2E-6 [7E-2]	NTP, 1982; U.S. EPA, 1987/ NTP 1982; U.S. EPA, 1987
Bis(2-ethylhexyl) phthalate	NA; 103-week dietary study	NA	mouse	NA (also see Table A)	liver	B2/ND ^a	B2/4E-7 [1.4E-2] ^a	U.S. EPA, 1987/ NTP, 1982, U.S. EPA, 1986, 1988, 1990
Bromodichloromethane	NA; 102-week gavage study	NA	mouse	NA (also see Table A)	liver	B2/ND ^f	B2/3.7E-6 [1.3E-1] ^f	U.S. EPA, 1987, 1989, 1990/NTP, 1986; U.S. EPA, 1987, 1990
Bromoethene (vinyl bromide)	2-year inhalation study; NA	rat	NA	liver	NA	B2/3.2E-5 [1.1-1]	B2/ND	Benya et al., 1982; U.S. EPA, 1984/ U.S. EPA, 1984

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
						($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	($\mu\text{g}/\text{kg}$) ⁻¹ [(mg/kg/day) ⁻¹]	
Bromoform	NA; 103 week gavage study	NA	rat	NA	adenomatous polyps or adenocarcinomas in the large intestine (also see Table A)	B2/1.1E-6 [3.9E-3] ^f	B2/2.2E-7 [7.9E-3] ^f	U.S. EPA, 1989, 1990/ NTP, 1988/ U.S. EPA, 1989, 1990
1,3-Butadiene	two inhalation studies; NA	mouse, rat	NA	hematopoietic system, Leydig cell, thyroid	NA	B2/2.8E-4 [1.8E+0] ^{a,1}	ND	Hazellton Labs, 1981; U.S. EPA, 1985, 1987, 1989; U.S EPA, 1989, 1990
Butyl benzyl phthalate	NA; NA	NA	NA	NA (also see Table A)	NA	NA	C/ND ^a	U.S. EPA, 1987, 1990/U.S. EPA, 1987, 1990
Cadmium	occupational; NA	human	NA	respiratory tract (also see Table A)	NA	B1/1.8E-3 [6.1E+0] ^a	ND/ND ^c	Thun et al., 1985; U.S. EPA, 1985, 1990/U.S. EPA, 1984, 1988
Captafol	NA; dietary study (CBI)	NA	mice	NA (also see Table A)	lymphosarcoma	C/ND	C/2.4E-7 [8.6E-3]	U.S. EPA, 1984/ U.S. EPA, 1984
Captan	NA; NA	NA	NA	NA (also see Table A)	NA	B2/ND ^f	B2/1.0E-7 [3.5E-3] ^f	U.S. EPA, 1984, 1988/U.S. EPA, 1984, 1988
Carbazole	NA; 96-week dietary study	NA	mice	NA	liver	B2/ND	B2/2.8E-7 [2E-2]	U.S. EPA, 1986/ Tsuda et al., 1982; U.S. EPA, 1986

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	Inhalation/Oral
						$\frac{(\mu\text{g}/\text{m}^3)^{-1}}{[(\text{mg}/\text{kg}/\text{day})^{-1}]}$	$\frac{(\mu\text{g}/\text{g})^{-1}}{[(\text{mg}/\text{kg}/\text{day})^{-1}]}$	
Carbon tetrachloride	several gavage studies; several gavage studies	several	several	liver (also see Table A)	liver	B2/1.5E-5 ^d [1.3E-1] ^{a,b}	B2/3.7E-6 [1.3E-1] ^a	Della Porta et al., 1961; Edwards et al., 1942; NCI, 1976; U.S. EPA, 1984a,b, 1990/ Della Porta et al., 1961; Edwards et al., 1942; NCI, 1976; U.S. EPA, 1984, 1990
Chloranil	NA; 82-week oral study	NA	mice	NA	liver and lung	C/ND	C/1.1E-5 [4.03E-1]	U.S. EPA, 1986/ BRL, 1968; U.S. EPA, 1986
Chlordane	two dietary bioassays; two dietary bioassays	mouse	mouse	liver (also see Table A)	liver	B2/3.7E-4 [1.3E+0] ^{a,b}	B2/3.7E-5 [1.3E+0] ^a	IRDC, 1973; NCI, 1977; U.S. EPA, 1986, 1990/IRDC, 1973; NCI, 1977; U.S. EPA, 1986, 1988, 1990
Chlorodibromoethane	NA; 105-week gavage study	NA	mouse	NA (also see Table A)	liver	B2/ND	B2/2.4E-6 [8.4E-2]	U.S. EPA, 1987/ NTP, 1985; U.S. EPA, 1987
Chloroethene (see vinyl chloride)								

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
	Inhalation; Oral					$\frac{(\mu\text{g}/\text{m}^3)^{-1}}{[(\text{mg}/\text{kg}/\text{day})^{-1}]}$	$\frac{(\mu\text{g}/\text{L})^{-1}}{[(\text{mg}/\text{kg}/\text{day})^{-1}]}$	Inhalation/Oral
Chloroform	138-477 mg/kg/day; 200-188 ppm in drinking water for 104 weeks	mouse	rat	liver (also see Table A)	kidney	B2/2.3E-5 [8.1E-2] ^a	B2/1.7E-7 [6.1E-3] ^a	NCI, 1976; U.S. EPA, 1985, 1988, 1990/ Jorgenson et al., 1985; U.S. EPA, 1988, 1990
Chloromethane	24-month inhalation study; 24-month inhalation study	mouse	mouse	kidney	kidney	C/1.8E-6 [6.3E-3]	C/3.7E-7 [1.3E-2] ^b	CIIT, 1983; NIOSH, 1984; U.S. EPA, 1987/CIIT, 1983; NIOSH, 1984; U.S. EPA, 1986, 1987
4-Chloro-2-methyl- aniline	NA; 0-4000 ppm in the diet for 18 months	NA	mice	NA	vascular hemangiomas and hemangio- sarcomas	B2/ND	B2/1.6E-4 [5.8E-1] ^c	U.S. EPA, 1986/ U.S. EPA, 1986; Weisburger et al., 1978
4-Chloro-2,2-methyl- aniline hydrochloride	NA; 9-4000 ppm in the diet for 18 months	NA	mice	NA	vascular hemangiomas and hemangio- sarcomas	B2/ND	B2/1.3E-5 [4.6E-1]	U.S. EPA, 1986/ U.S. EPA, 1986; Weisburger et al., 1978
Chloromethyl methyl ether	NA; NA	human	NA	lung	NA	A/ND ^a	A/ND ^a	U.S. EPA, 1987, 1990/U.S. EPA, 1990
o-Chloronitrobenzene	NA; 18-month dietary study	NA	mice	NA	liver	B2/ND	B2/3.5E-7 [2.5E-2]	U.S. EPA, 1985/ U.S. EPA, 1985; Weisburger et al., 1978
p-Chloronitrobenzene	NA; 0-6000 ppm in the diet for 18 months	NA	mice	NA	vascular tumors	B2/ND	B2/5.1E-7 [1.8E-2]	U.S. EPA, 1985/ U.S. EPA, 1985; Weisburger et al., 1978

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation	Oral	Inhalation ($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	Oral ($\mu\text{g}/\text{L}$) ⁻¹ [(mg/kg/day) ⁻¹]	Inhalation/Oral
Chlorthalonil	NA, 80-week dietary study	NA	rat	NA (also see Table A)	kidney	B2/ND	B2/8.2E-8 [2.9E-3] ^f	U.S. EPA, 1984/ NCI, 1978; U.S. EPA, 1984
Chromium (VI)	occupational; NA	human	NA	lung (also see Table A)	NA	A/1.2E-2 [4.1E+1] ^d	ND/ND ^c	Mancuso, 1975; U.S. EPA, 1984a,b, 1990/NA
Chrysene	NA; NA	NA	NA	NA (also see Table A)	NA	B2/ND ^f	B2/NA ^f	U.S. EPA, 1990
Coal tars	occupational; NA	human	NA	lung	NA	ND/6.2E-4 [2.2E+0] ^e	ND/ND	Redmond et al., 1979; Mazumdar et al., 1975; U.S. EPA, 1984/NA
Creosol, o-, m- and p-	NA; NA	NA	NA	NA (also see Table A)	NA	C/ND ^f	C/ND ^f	U.S. EPA, 1984, 1985, 1990/U.S. EPA, 1984, 1985, 1990
Creosote	NA; NA	NA	NA	NA	NA	B1/ND ^a	B1/ND ^a	U.S. EPA, 1990/ U.S. EPA, 1990
Crotonaldehyde	113-week drinking water study; 113-week drinking water study	rat	rat	liver	liver	C/5.4E-4 [1.9E+0] ^b	C/5.4E-5 [1.9E+0]	U.S. EPA, 1989/ Chung et al., 1986; U.S. EPA, 1989
DDT	NA; several dietary studies	mouse, rat	mouse, rat	liver (also see Table A)	liver	B2/9.7E-5 [3.4E-1] ^{a,b}	B2/9.7E-6 [3.4E-1] ^a	U.S. EPA, 1986, 1990/U.S. EPA, 1984, 1986, 1990
Decabromodiphenyl oxide (Decabromo- diphenyl ether)	NA; NA	NA	NA	NA (also see Table A)	NA	C/ND ^f	C/ND ^f	U.S. EPA, 1984, 1987, 1990/U.S. EPA, 1984, 1987 1990

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	Inhalation/Oral
						$\frac{(\mu\text{g}/\text{m}^3)^{-1}}{[(\text{mg}/\text{kg}/\text{day})^{-1}]}$	$\frac{(\mu\text{g}/\text{g})^{-1}}{[(\text{mg}/\text{kg}/\text{day})^{-1}]}$	
Diallate	NA; 19-month oral study	NA	mice	NA (also see Table A)	liver	B2/ND	B2/1.7E-6 [6.1E-2]	U.S. EPA, 1983/ BRL, 1968; Innes et al., 1969; U.S. EPA, 1983
Dibenzo(a,h) anthracene	NA; NA	NA	NA	NA	NA	B2/ND ^f	B2/ND ^f	U.S. EPA, 1990
Dibromochloromethane	NA; 105-week gavage study	NA	mouse	NA (also see Table A)	hepatocellular adenomas or carcinomas	C/ND ^f	C/2.4E-6 [8.4E-2] ^f	U.S. EPA, 1989/ NTP, 1985; U.S. EPA, 1987, 1989a,b
1,2-Dibromoethane (ethylene dibromide)	88-103 week inhala- tion study; 49-week gavage study	rat	rat	nasal cavity	forestomach	B2/2.2E-4 [7.6E-1] ^a	B2/2.5E-3 [8.5E+1] ^a	NTP, 1982; U.S. EPA, 1984, 1990/NCI, 1978; U.S. EPA, 1984, 1987, 1990
1,4-Dichlorobenzene (p-dichlorobenzene)	NA; 103-week gavage study	NA	mouse	NA (also see Table A)	liver	B2/ND	B2/6.8E-7 [2.4E-2] ^g	U.S. EPA, 1987/ NTP, 1986; U.S. EPA, 1987
3,3'-Dichlorobenzidine	NA; lifetime dietary study	NA	rat	NA	mammary	B2/ND ^f	B2/1.3E-5 [4.5E-1] ^f	U.S. EPA, 1988/ Stula et al., 1975; U.S. EPA, 1988
1,4-Dichloro-2-butene	90-day inhalation study; NA	rat	NA	nasal passages (also see Table A)	NA	B2/2.6E-3 [9.3E+0]	B2/ND	EI Dupont de Nemours, 1986; U.S. EPA, 1987/ U.S. EPA, 1987
1,1-Dichloroethane	NA; gavage	NA	rat	NA (also see Table A)	hemangio- sarcoma	C/ND ^f	C/2.6E-6 [9.1E-2] ^f	U.S. EPA, 1984, 1990/NCI, 1978; U.S. EPA, 1985, 1989

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	Inhalation/Oral
						($\mu\text{g}/\text{m}^3$) ⁻¹ [($\text{mg}/\text{kg}/\text{day}$) ⁻¹]	($\mu\text{g}/\text{g}$) ⁻¹ [($\text{mg}/\text{kg}/\text{day}$) ⁻¹]	
1,2-Dichloroethane (ethylene chloride)	gavage; gavage	rat	rat	circulatory system	circulatory system	B2/2.6E-5 [9.1E-2] ^{a,b}	B2/2.6E-6 [9.1E-2] ^a	NCI, 1978; U.S. EPA, 1985, 1990/NCI, 1978; U.S. EPA, 1985, 1990
1,1-Dichloroethylene (vinylidene chloride)	10 and 25 ppm for 12 months; gavage	mouse	rat	kidney (also see Table A)	adrenal	C/5E-5 [1.2E+0] ^{a,1}	C/1.7E-5 [6E-1] ^a	Maltoni et al., 1985; U.S. EPA, 1985, 1990/ NTP, 1982; U.S. EPA, 1985, 1988, 1990
1,2-Dichloropropane	NA; gavage	NA	mouse	NA (also see Table A)	liver	B2/ND	B2/1.9E-6 [6.8E-2] ⁹	U.S. EPA, 1987/ NTP, 1986; U.S. EPA, 1987
1,3-Dichloropropene	2-year inhalation bioassay; 104-week gavage study	mouse	rat	benign lung tumors (also see Table A)	forestomach, liver, adrenal, thyroid	B2/3.7E-5 [1.3E-1]	B2/5.1E-6 [1.8E-1]	Lomax et al., 1989; U.S. EPA, 1989/ NTP, 1985; U.S. EPA, 1985, 1989
Dieldrin	several dietary studies; several dietary studies	mouse	mouse	liver (also see Table A)	liver	B2/4.6E-3 [1.6E+1] ^{a,b}	B2/4.6E-4 [1.6E+1] ^a	Thorpe and Walker, 1973; Davis, 1965; Walker et al., 1972; Tennekes et al., 1981; Meterhenrey et al., 1983; NCI, 1978; U.S. EPA, 1990/ Thorpe and Walker, 1973; Davis, 1965; Walker et al., 1972; Tennekes et al., 1981; Meterhenrey et al., 1983; NCI, 1978; U.S. EPA, 1987, 1990

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	Inhalation/Oral
						($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	($\mu\text{g}/\text{L}$) ⁻¹ [(mg/kg/day) ⁻¹]	
3,3'-Dimethoxybenzidine	NA; lifetime dietary study	NA	hamster	NA	forestomach	B2/ND	B2/4E-7 [1.4E-2]	U.S. EPA, 1987/ Sellakumar et al., 1969; OSHA/NIOSH, 1980; U.S. EPA, 1987
2,4-Dimethylaniline	NA; 18-month dietary study with the HCl salt	NA	mouse	NA	lung	C/ND	C/2.1E-5 [7.5E-1]	U.S. EPA, 1987/ Weisberger et al., 1978; U.S. EPA, 1987
2,4-Dimethylaniline hydrochloride	NA; 18-month dietary study	NA	mouse	NA	lung	C/ND	C/1.7E-5 [5.8E-1]	U.S. EPA, 1987/ Weisberger et al., 1978; U.S. EPA, 1987
3,3'-Dimethylbenzidine	NA; 30-day gavage study	NA	rat	NA	mammary	B2/ND	B2/2.6E-4 [9.2E+0]	U.S. EPA, 1987/ Griswold et al., 1968; U.S. EPA, 1987
1,1-Dimethylhydrazine	NA; lifetime drinking water study	NA	mouse	NA	vascular system	C/ND	C/2.5E-4 [8.7E+0] ^g	U.S. EPA, 1984/Toth, 1972, 1973; U.S. EPA, 1984
1,2-Dimethylhydrazine	NA; 73-week drinking water study	NA	mouse	NA	vascular system	B1/ND	B1/4.0E-2 [1.4E+3] ^g	U.S. EPA, 1984/Toth and Wilson, 1971; U.S. EPA, 1984
Dimethyl sulfate	NA; NA	NA	NA	NA	NA	B2 ^a /ND	B2 ^a /ND	U.S. EPA, 1985, 1990/U.S. EPA, 1985, 1990
2,4-Dinitrotoluene	NA; 2-year dietary study	NA	rat	NA	liver, mammary gland	B2/ND ^f	B2/1.9E-5 [6.8E-1] ^{f,n}	U.S. EPA, 1987, 1990/Ellis et al., 1979; U.S. EPA, 1987, 1990
2,6-Dinitrotoluene	NA; NA	NA	NA	NA	NA	B2/ND ^f	B2/1.9E-5 [6.8E-1] ^{f,n}	U.S. EPA, 1987, 1990/U.S. EPA, 1987, 1990

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Compound	Exposure		Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation; Oral		Inhalation Oral		Inhalation Oral		Inhalation	Oral	Inhalation/Oral
							($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	($\mu\text{g}/\text{L}$) ⁻¹ [(mg/kg/day) ⁻¹]	
1,2-Diphenylhydrazine	2-year dietary study ^b ; 2-year dietary study	rat	rat	liver	liver	B2/2.2E-4 [8.0E-1] ^{a,b}	B2/2.2E-5 [8.0E-1] ^a	NCI, 1978; U.S. EPA, 1980, 1990/NCI, 1978; U.S. EPA, 1980, 1987, 1988, 1990	
Direct Black 38	NA; 190-1500 ppm in diet for 93 days	NA	rat	NA	liver	A/ND	A/2.4E-4 [8.7E+0]	U.S. EPA, 1987/ NCI, 1978; U.S. EPA, 1987	
Direct Blue 6	NA; 190-1500 ppm in diet for 91 days	NA	rat	NA	liver	A/ND	A/2.3E-4 [8.7E+0]	U.S. EPA, 1987/ NCI, 1978; U.S. EPA, 1987	
Direct Brown 95	NA; 190-1500 ppm in diet for 91 days	NA	rat	NA	liver	A/ND	A/2.6E-4 [9.3E+0]	U.S. EPA, 1987/ NCI, 1978; U.S. EPA, 1987	
Direct Sky Blue 6B	NA; NA	NA	NA	NA	NA	B2/ND	B2/ND	U.S. EPA, 1987/ U.S. EPA, 1987	
Epichlorohydrin	inhalation exposure for 30 days, observed for lifespan; 81-week drinking water study	rat	rat	respiratory tract (also see Table A)	forestomach	B2/1.2E-6 [4.2E-3] ^a	B2/2.8E-7 [9.9E-3] ^a	Laskin et al., 1980; U.S. EPA, 1984, 1985, 1990/ Komishi et al., 1980; U.S. EPA, 1984, 1985, 1990	
Ethyl acrylate	NA; 104-week gavage study	NA	rat	NA	forestomach	B2/ND	B2/1.4E-6 [4.8E-2] ⁹	U.S. EPA, 1987/ NTP, 1986; U.S. EPA, 1987	
Ethylene dibromide (see 1,2-Dibromoethane)									

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
		Inhalation	Oral	Inhalation	Oral	Inhalation ($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	Oral ($\mu\text{g}/\text{kg}$) ⁻¹ [(mg/kg/day) ⁻¹]	
Ethylene oxide	2-year inhalation study; NA	rat	NA	blood cells, brain	NA	B1/1E-4 [3.5E-1] ⁹	ND	Snellings et al., 1981; U.S. EPA, 1985/U.S. EPA, 1985
Ethylene thiourea	NA; 5-500 ppm in diet for 2 years	NA	rat	NA	thyroid	B2/ND	B2/1E-6 [3.6E-2] ⁹	U.S. EPA, 1984/ U.S. EPA, 1984
Folpet	NA; 112-113-week dietary study	NA	mice	NA	digestive tract	B2/ND	B2/1E-7 [3.5E-3] ^a	U.S. EPA, 1990/ Chevron Chemical Company, 1982; U.S. EPA, 1984, 1990
Formaldehyde	24-month inhalation study; NA	rat	NA	nasal cavity	NA	B1/1.3E-5 [4.5E-2] ^a	B1/ND	U.S. EPA, 1985, 1990/ U.S. EPA, 1990
Furazolidone	NA; 45-week dietary study	NA	rat	NA	mammary	B2/ND	B2/1E-4 [3.8E+0]	U.S. EPA, 1987/ U.S. DHEW, 1976a,b; U.S. EPA, 1987
Furium	NA; 28-week dietary study	NA	mouse	NA	leukemia	B2/ND	B2/7.1E-4 [5.0E+1]	U.S. EPA, 1987/ Cohen et al., 1970; U.S. EPA, 1987
Glycidaldehyde	NA; 70-week study (gastric intubation)	NA	rats	NA	NA	B2/ND	B2/ND	U.S. EPA, 1989/ U.S. EPA, 1989
Heptachlor	dietary studies; dietary studies	mouse	mouse	liver (also see Table A)	liver	B2/1.3E-3 [4.5E+0] ^{a,b}	B2/1.3E-4 [4.5E+0] ^a	Davis, 1965; Epstein, 1976; NCI, 1977; Reuber, 1977; U.S. EPA, 1986, 1990/Davis, 1965; Epstein, 1976; NCI, 1977; Reuber, 1977; U.S. EPA, 1986 1987, 1990

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope factor]		Reference
		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
	Inhalation; Oral					($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	($\mu\text{g}/\text{L}$) ⁻¹ [(mg/kg/day) ⁻¹]	Inhalation/Oral
Hexachlorobenzene	diet; diet	hamster	hamster	liver (also see Table A)	liver	B2/4.9E-4 [1.7E+0] ^{b,f}	B2/4.9E-5 [1.7E+0] ^f	Cabral et al., 1977; U.S. EPA, 1984, 1989/Cabral et al., 1977; U.S. EPA, 1984, 1985
Hexachlorobutadiene	diet; diet	rat	rat	kidney (also see Table A)	kidney	C/2.2E-5 [7.8E-2] ^{a,b}	C/2.2E-6 [7.8E-2] ^a	Kociba et al., 1977; U.S. EPA, 1990/Kociba et al., et al., 1977; U.S. EPA, 1980, 1984, 1990
Hexachlorocyclohexane- alpha	NA; 24-week dietary study	NA	mice	NA	liver	B2/1.8E-3 [6.3E+0] ^{a,b}	B2/1.8E-4 [6.3E+0] ^a	U.S. EPA, 1990/Ito et al., 1973; U.S. EPA, 1987, 1990
Hexachlorocyclohexane- beta	NA; 110-week dietary study	NA	mice	NA	liver	C/5.3E-4 [1.8E+0] ^{a,b}	C/5.3E-5 [1.8E+0] ^a	U.S. EPA, 1990/ Thorpe and Walker, 1973; U.S. EPA, 1987, 1990
Hexachlorocyclohexane- delta	NA; 24-week dietary study	NA	mice, rat	NA	liver	D/ND	D/ND ^a	U.S. EPA, 1990/ Ito et al., 1973, 1975; Nagasaki et al., 1972; U.S. EPA, 1987, 1990
Hexachlorocyclohexane- gamma (Lindane)	NA; diet	NA	mouse	NA (also see Table A)	liver	B2-C/ND	B2-C/3.7E-5 [1.3E+0] ^g	U.S. EPA, 1984/ Thorpe and Walker, 1973; U.S. EPA, 1984, 1990
Hexachlorocyclohexane- epsilon	NA; mixture of delta and epsilon in the diet for 26 weeks	NA	mice	NA	liver	D/ND	D/ND ^a	U.S. EPA, 1986/ Goto et al., 1972; U.S. EPA, 1987, 1990

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation	Oral	Inhalation ($\mu\text{g}/\text{m}^3$) ⁻¹ [($\text{mg}/\text{kg}/\text{day}$) ⁻¹]	Oral ($\mu\text{g}/\text{L}$) ⁻¹ [($\text{mg}/\text{kg}/\text{day}$) ⁻¹]	Inhalation/Oral
Hexachlorocyclohexane-technical	NA; 6-20-month dietary study	NA	mice	NA	liver	B2/5.1E-4 [1.8E+0] ^{a,b}	B2/5.1E-5 [1.8E+0] ^a	U.S. EPA, 1990/ Munir et al., 1983; U.S. EPA, 1987, 1990
Hexachloroethane	90-week gavage study; 90-week gavage study	mouse	mouse	liver (also see Table A)	liver	C/4.0E-6 [1.4E-2] ^{a,b}	C/4.0E-7 [1.4E-2] ^a	NCI, 1978; U.S. EPA, 1990, 1989/NCI, 1978; U.S. EPA, 1980a, 1987, 1989, 1990
Hydrazine/hydrazine sulfate	hydrazine vapor inhalation for 1 year; 25-week exposure by gavage to hydrazine sulfate	rat	mouse	nasal cavity	liver	B2/4.9E-3 [17.1E+0] ^a	B2/8.5E-5 [3.0E+0] ^a	MacEwen et al., 1981; U.S. EPA, 1984, 1990/ Blancifiori, 1970; U.S. EPA, 1984, 1990
Indeno (1,2,3-c,d) pyrene	NA; NA	NA	NA	NA	NA	B2/ND ^f	B2/ND ^f	U.S. EPA, 1990
Isophorone	NA; 2-year gavage study	NA	rat	NA	kidney, preputial gland (also see Table A)	C/ND ^f	C/1.1E-7 [3.9E-3] ^g	U.S. EPA, 1987, 1989/ NTP, 1986; U.S. EPA, 1986, 1987, 1989
Lead	NA; NA	NA	NA	NA	NA (also see Table A)	B2/ND ^a	B2/ND ^a	U.S. EPA, 1984, 1990/U.S. EPA, 1984, 1990
2-Methoxy-5-nitro-aniline	NA; 0.4%, 0.8% in diet for 104 weeks	NA	rat	NA	skin	B2/ND	B2/1.3E-6 [4.6E-2]	U.S. EPA, 1987/NCI, 1978; U.S. EPA, 1987
2-Methylaniline	NA; 2-methylaniline-hydrochloride in diet for 93 weeks	NA	rat	NA	skin	B2/ND	B2/6.9E-6 [2.4E-1]	U.S. EPA, 1987/ Hecht et al., 1982; U.S. EPA, 1987
2-Methylaniline hydrochloride	NA; 93-week dietary study	NA	rat	NA	skin	B2/ND	B2/6.0E-6 [1.8E-1]	U.S. EPA, 1987/ Hecht et al., 1982; U.S. EPA, 1987

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
						($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	($\mu\text{g}/\text{g}$) ⁻¹ [(mg/kg/day) ⁻¹]	
Methyl chloride	2-year inhalation study	mouse	NA	kidney	NA	C/3.7E-6 [1.3E-2]	C/ND	CIIT, 1983; U.S. EPA, 1986/ U.S. EPA, 1986
4,4-Methylenebis benzylamine	NA; 2-year drinking water	NA	rat	NA	liver	ND	ND/7.1E-6 [2.5E-1]	NA/NTP, 1983; U.S. EPA, 1984
4,4'-Methylene bis(N,N'-dimethyl) aniline	NA; in diet for 59 weeks	NA	rat	NA	thyroid	B2 ^a /ND	B2 ^a /1.3E-6 [4.6E-2] ^a	U.S. EPA, 1985/ NCI, 1979; U.S. EPA, 1990
Methylene chloride (dichloromethane)	Inhalation study; inhalation and drinking water studies	mouse	mouse	lung, liver (also see Table A)	liver	B2/4.1E-6 [1.4E-2] ^m	B2/2.1E-7 [7.5E-3] ^m	NTP, 1986; U.S. EPA, 1984, 1990/NTP, 1986; NCA, 1983; U.S. EPA, 1985, 1990
Methyl Ethyl Ketone	NA; NA	NA	NA	NA (also see Table A)	NA	D/ND ^f	D/ND ^f	U.S. EPA, 1985, 1988/ U.S. EPA, 1985, 1988
Methylhydrazine	NA; lifetime oral study	NA	hamster	NA	liver	NA/ND	NA/3.1E-5 [1.1E+0]	U.S. EPA, 1984/Toh and Shimizu, 1973; U.S. EPA, 1984
2-Methyl-5-Nitroaniline	NA; in diet for 98 weeks	NA	mouse	NA	liver	C/ND	C/9.4E-7 [3.3E-2]	U.S. EPA, 1987/NCI, 1978; U.S. EPA, 1987
Mirex	NA; 2-year dietary study	NA	rat	NA (also see Table A)	liver, adrenal	B2/ND	B2/5.1E-5 [1.8E+0]	U.S. EPA, 1987/ NTP, 1987; U.S. EPA, 1987
Niagara Blue 4B	NA; NA	NA	NA	NA	NA	B2/ND	B2/ND	U.S. EPA, 1987/ U.S. EPA, 1987

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
		Inhalation	Oral	Inhalation	Oral	Inhalation ($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	Oral ($\mu\text{g}/\text{kg}$) ⁻¹ [(mg/kg/day) ⁻¹]	
	Inhalation; Oral	Inhalation	Oral	Inhalation	Oral	Inhalation ($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	Oral ($\mu\text{g}/\text{kg}$) ⁻¹ [(mg/kg/day) ⁻¹]	Inhalation/Oral
Nickel	occupational; NA	human	NA	respiratory tract (also see Table A)	NA	nickel refinery dust: A/ 2.4E-4 [8.4E-1] ^a nickel subsulfide: A/4.8E-4 [1.7E+0] ^a	ND/ND ^c	U.S. EPA, 1986; Chovil et al., 1981; Enterline and Marsh, 1982; Magnus et al., 1982; Peto et al., 1984; U.S. EPA, 1984/ U.S. EPA, 1990
Nitrofurazone	NA; 46-week dietary study	NA	rat	NA	mammary	B2/ND	B2/4.3E-5 [1.5E+0]	U.S. EPA, 1987/ Erturk et al., 1970; U.S. EPA, 1987
2-Nitropropane	22-month inhalation study; NA	rat	NA	liver	NA	B2/2.7E-3 [9.4E+0] ⁹	B2/ND ⁹	Lewis et al., 1979; U.S. EPA, 1985/ U.S. EPA, 1985
N-Nitrosodi-n-butyl- amine	drinking water for life; drinking water for life	mouse	mouse	bladder esophagus	bladder esophagus	B2/1.6E-3 [5.4E+0] ^{a,b}	B2/1.6E-4 [5.4E+0] ^a	Bertram and Craig, 1970; U.S. EPA, 1986, 1990/Bertram and Craig, 1970; U.S. EPA, 1986, 1990
Nitrosodiethanol- amine	NA; 28 or 64 ppm in drinking water for 100 weeks	NA	rat	NA	liver	B2 ^a /ND	B2/8.0E-5 [2.8E+0] ^a	U.S. EPA, 1986, 1990/ Lijinsky and Kovatch, 1985; U.S. EPA, 1986, 1990
N-Nitrosodiethyl- amine	drinking water 6 or 12 months; drinking water for 6 or 12 months	rat	rat	liver	liver	B2/4.3E-2 [1.5E+2] ^{a,b}	B2/4.3E-3 [1.5E+2] ^a	Peto et al., 1984; U.S. EPA, 1986, 1990/ Peto et al., 1984; U.S. EPA, 1986, 1990
N-Nitrosodimethyl- amine	drinking water; drinking water;	rat	rat	liver	liver	B2/1.4E-2 [5.1E+1] ^{a,b}	B2/1.4E-3 [5.1E+1] ^a	Peto et al., 1984; U.S. EPA, 1986, 1990/ Peto et al., 1984; U.S. EPA, 1986, 1990

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Compound	Exposure	Species		Tumor Site -		EPA Group/Unit Risk [Slope factor]		Reference
		Inhalation	Oral	Inhalation	Oral	Inhalation ($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	Oral ($\mu\text{g}/\text{kg}$) ⁻¹ [(mg/kg/day) ⁻¹]	
N-Nitrosodiphenylamine	NA; 700-day dietary study	NA	rat	NA	urinary bladder	B2/ND ^a	B2/1.4E-7 [4.9E-3] ^a	U.S. EPA, 1987/ NCI, 1979; U.S. EPA, 1980, 1986, 1987, 1990
N-Nitrosodi-n-propylamine	NA; lifetime drinking water	NA	rat	NA	liver	B2 ^a /ND	B2/2.0E-4 [7.0E+0] ^a	U.S. EPA, 1986, 1990/ Druckrey, 1967; Druckrey et al., 1967; U.S. EPA, 1986, 1990
N-Nitrosomethyl-ethylamine	NA; in drinking drinking water for lifetime	NA	rat	NA	liver	B2 ^a /ND	B2/6.3E-4 [2.2E+1] ^a	U.S. EPA, 1986, 1990/ Druckrey et al., 1967; Druckrey, 1967; U.S. EPA, 1986, 1990
N-Nitrosomethyl-vinylamine	NA; NA	NA	NA	NA	NA	B2/ND	B2/ND	U.S. EPA, 1986/ U.S. EPA, 1986
Parathion	NA; NA	NA	NA	NA	NA (also see Table A)	C/ND ^a	C/ND ^a	U.S. EPA, 1987, 1990/ U.S. EPA, 1987, 1990
PCBs (see Polychlorinated biphenyls)								
1,2,3,4,5-Penta-bromo-6-chloro-cyclohexane	NA; 0-70 mg/kg/day in the diet for 2 years	NA	rat	NA	large intestine	C/ND	C/6.6E-7 [2.3E-2] ⁹	U.S. EPA, 1985/ Blair, 1981; U.S. EPA, 1985
Pentachloronitrobenzene	NA; 72-week oral study	NA	mouse	NA	liver (also see Table A)	C/ND	C/7.4E-6 [2.6E-1] ⁹	U.S. EPA, 1986/ Innes et al., 1969; U.S. EPA, 1986
o-Phenylenediamine	NA; o-phenylenediamine dihydrochloride in diet for 548 days	NA	rat	NA	liver	B2/ND	B2/1.3E-6 [4.7E-2]	U.S. EPA, 1985/ U.S. EPA, 1985; Weisburger et al., 1978

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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
		Inhalation	Oral	Inhalation	Oral	Inhalation ($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	Oral ($\mu\text{g}/\text{kg}/\text{day}$) ⁻¹ [(mg/kg/day) ⁻¹]	
2-Phenylphenol	NA; 2-phenyl-phenol sodium salt in diet for 637 days	NA	rat	NA	urinary bladder	C/ND	C/5.5E-8 [1.9E-3]	U.S. EPA, 1984/ Hiraga and Fujii, 1981; U.S. EPA, 1984
Polyaromatic hydrocarbons (PAH)	Inhalation study with benzo(a)pyrene; dietary study with benzo(a)pyrene	hamster	mouse	respiratory tract	stomach	B2/ND ^a	B2/ND ^a	Thyssen et al., 1981; U.S. EPA, 1990/Neal and Rigdon, 1967; U.S. EPA, 1980, 1984, 1990
Polybrominated biphenyls	NA; Firemaster FF-1 by gavage for 25 weeks followed by 23-month observation	NA	rat	NA	hepato-cellular carcinoma and neo-plastic nodules (also see Table A)	B2/ND	B2/2.5E-4 [8.9E+0]	U.S. EPA, 1989/ NTP, 1983; U.S. EPA, 1989
Polychlorinated biphenyls	NA; Aroclor 1260 in diet	NA	rat	NA	liver	B2/ND	B2/2.2E-4 [7.7E+0] ^a	U.S. EPA, 1984, 1990/Norback and Weltman, 1985; U.S. EPA, 1987, 1990
Propylene oxide	2-year inhalation study; 150-week gavage study	mouse	rat	nasal cavity	forestomach	B2/3.7E-6 [1.3E-2] ^f	B2/6.9E-6 [2.4E-1] ^f	NTP, 1985; Renne et al., 1986; U.S. EPA, 1985, 1990/ Dunkelberg, 1982; U.S. EPA, 1985, 1990
RDX (Cyclonite)	NA; 2-year diet study	NA	mouse	NA	liver hepato-cellular carcinomas and adenomas (also see Table A)	C/ND ^f	C/3.1E-6 [1.1E-1]	U.S. EPA, 1988, 1989/Lish et al., 1984; U.S. EPA, 1988, 1989

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		Inhalation	Oral	Inhalation	Oral	Inhalation ($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	Oral ($\mu\text{g}/\text{g}$) ⁻¹ [(mg/kg/day) ⁻¹]	
Quinoline	NA; 20-40-week dietary study	NA	rat	NA	liver	C/ND	C/3.5E-4 [1.2E+1]	U.S. EPA, 1985/ Hirao et al., 1976; U.S. EPA, 1985
Selenium sulfide	NA; 2-year oral study	NA	rats, mice	NA	liver, lung	B2/ND	B2/ND	U.S. EPA, 1989/ NCI/NTP, 1980; U.S. EPA, 1989
Simazine	NA; NA	NA	NA	NA	NA	C/ND ^f	C/3.4E-6 [1.2E-1] ^f	U.S. EPA, 1984, 1988/U.S. EPA, 1984, 1987
Sodium diethyldithio- carbamate	NA; diet	NA	mouse	NA (also see Table A)	hepatoma	C/ND	C/7.7E-6 [2.7E-1]	U.S. EPA, 1988/ BRL, 1968; U.S. EPA, 1988
Styrene	20-month inhalation study; gavage study	rat	mice	leukemia (also see Table A)	lung and bronchi	B2/5.7E-7 [2.0E-3] ^f	B2/8.6E-7 [3.0E-2]	Jersey et al., 1978; U.S. EPA, 1989/NCI, 1979; U.S. EPA, 1989a,b
2,3,7,8-TCDD	diet; diet	rat	rat	several	several	B2/3.3E-5 ^s (pg/m^3) ⁻¹ [1.5E+5] ^{b,f}	B2/4.5E+0 [1.5E+5] ^f	Kociba et al., 1978; U.S. EPA, 1984/Kociba et al., 1978; U.S. EPA, 1984 1985a,b
1,1,2,2-Tetrachloro- ethane	gavage; gavage	mouse	mouse	liver	liver	C/5.8E-5 [2.0E-1] ^{a,b}	C/5.8E-6 [2.0E-1] ^a	NCI, 1978; U.S. EPA, 1980, 1986/NCI, 1978; U.S. EPA, 1980, 1990
Tetrachloroethy- lene (perchloro- ethylene)	Inhalation; gavage	rat, mouse	mouse	leukemia, liver (also see Table A)	liver	B2/9.5E-7 [3.3E-3]	B2/1.5E-6 [5.1E-2] ^g	NTP, 1986; U.S. EPA 1986, 1988/NCI, 1977; U.S. EPA, 1985, 1988

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		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
	Inhalation; Oral	Inhalation	Oral	Inhalation	Oral	$\frac{(\mu\text{g}/\text{m}^3)^{-1}}{[(\text{mg}/\text{kg}/\text{day})^{-1}]}$	$\frac{(\mu\text{g}/\text{g})^{-1}}{[(\text{mg}/\text{kg}/\text{day})^{-1}]}$	Inhalation/Oral
p,p',o,o'-Tetra-chlorotoluene	gavage study; gavage study	mouse	mouse	lung	lung	B2	B2/5.7E-4 [2.0E+1]	Fukada et al., 1979; U.S. EPA, 1987/ Fukada et al., 1979; U.S. EPA, 1987
Tetrachlorovinphos (stirofos)	NA; 560-day dietary study	NA	mice	NA (also see Table A)	liver	C/ND	C/6.9E-7 [2.4E-2]	U.S. EPA, 1984/ NCI, 1978; U.S. EPA, 1984
2,4-Toluenediamine	NA; in the diet for 103 weeks	NA	rat	NA	mammary gland	B2/ND	B2/9.1E-5 [3.2E+0]	U.S. EPA, 1986/ NCI, 1979; U.S. EPA, 1986
o-Toluidine	NA; 511-day dietary study with HCl salt	NA	rat	NA	skin fibroma	B2/ND	B2/6.9E-6 [2.4E-1]	U.S. EPA, 1984/ Hecht et al., 1982; U.S. EPA, 1984
p-Toluidine	NA; 6-12 month dietary study with the HCl salt	NA	mice	NA	liver	C/ND	C/2.6E-5 [1.9E-1]	U.S. EPA, 1984/ Weisburger et al., 1978; U.S. EPA, 1984
Toxaphene	735-day dietary study; 735-day dietary study	mouse	mouse	liver	liver	B2/3.2E-4 [1.1E+0] ^{a,b}	B2/3.2E-5 [1.1E+0] ^a	Litton Bionetics, Inc., 1978; U.S. EPA, 1990/ Litton Bionetics, Inc., 1978; U.S. EPA, 1980, 1987, 1990
2,4,6-Trichloroaniline	NA; diet, HCl salt	NA	mouse	NA	unspecified tumors of the vascular system	C/ND	C/1.0E-6 [3.4E-2]	U.S. EPA, 1987/ Weisburger et al., 1978; U.S. EPA, 1987
2,4,6-Trichloroaniline hydrochloride	NA; diet	NA	mouse	NA	unspecified tumors of the vascular system	C/ND	C/8.2E-7 [2.9E-2]	U.S. EPA, 1987/ Weisburger et al., 1978; U.S. EPA, 1987

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE B: CARCINOGENICITY
Update: March, 1990

Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope factor]		Reference
		Inhalation	Oral	Inhalation	Oral	Inhalation ($\mu\text{g}/\text{m}^3$) ⁻¹ [(mg/kg/day) ⁻¹]	Oral ($\mu\text{g}/\text{L}$) ⁻¹ [(mg/kg/day) ⁻¹]	
1,1,2-Trichloroethane	gavage; gavage	mouse	mouse	liver (also see Table A)	liver	C/1.6E-5 [5.7E-2] ^{a,b}	C/1.6E-6 [5.7E-2] ^a	NCI, 1978; U.S. EPA, 1980, 1990/NCI, 1978; U.S. EPA, 1980, 1984, 1990
Trichloroethylene	two inhalation studies; two gavage studies	mouse	mouse	lung	liver	B2/1.7E-6 [1.7E-2] ^{h,1}	B2/3.1E-7 [1.1E-2] ^{h,1}	Maltoni et al., 1986; Fukuda et. al., 1983/ NCI, 1976; NTP, 1983; U.S. EPA, 1985, 1987, 1988
2,4,6-Trichlorophenol	diet; diet	mouse	mouse	liver	liver	B2/5.7E-6 [2E-2] ^{b,h}	B2/5.7E-7 [2E-2] ^h	NCI, 1979; U.S. EPA, 1980, 1990, 1987/NCI, 1979; U.S. EPA, 1980, 1984, 1987, 1990
Trifluralin	NA; in the diet for 2 years	NA	rat	NA (see also Table A)	kidney, bladder and thyroid	C/ND	C/2.2E-7 [7.7E-3] ^a	U.S. EPA, 1990/ Emmerson et al., 1980; U.S. EPA, 1984, 1990
Trimethyl phosphate	NA; 10-week gavage study	NA	mice	NA	uterus	B2/ND	B2/1.1E-6 [3.7E-2]	U.S. EPA, 1985/ NCI, 1978; U.S. EPA, 1985
Vinyl bromide (see bromoethene)								
Vinyl chloride	1-year inhalation study; 10-50 ppm diet	rat	rat	liver	lung	A/4.2E-5 [2.95E-1] ^{1,9}	A/6.5E-5 [2.3E+0] ⁹	Maltoni et al., 1980, 1981; U.S. EPA, 1985b; ATSDR, 1988/Feron et al., 1981; U.S. EPA, 1984, 1985a

^dVerified, on IRIS

^bBased upon route to route extrapolation

^cThere is inadequate evidence for carcinogenicity of this compound by the oral route

^dIncorporates an absorption factor of 0.4

^eBased on occupational data for coke-oven workers

^fVerified, Workgroup concurrence on final data base file, and IRIS input pending

^gUnder review by CRAVI

^hValues removed from IRIS pending further review. New verified values are pending input into IRIS.

ⁱBased on metabolized dose

^jB2 classification is for 2,3,7,8-TCDD alone. Mixtures consisting of phenoxy herbicides and/or chlorophenols with 2,3,7,8-TCDD as a contaminant are classified as B1 carcinogens

^kA unit risk of $5\text{E-}5 \text{ (}\mu\text{g/L)}^{-1}$ has been proposed by the Risk Assessment Forum and this recommendation has been scheduled for SAB review

^lSlope factor is for internal dose, ambient concentration was calculated by assuming an absorption factor of 54%.

^mVerified and on IRIS, but under review

ⁿThis value applies to the mixture of 2,4- and 2,6-dinitrotoluene isomers

^oBased on results with 4-chloro-2-methylaniline hydrochloride

^pAn absorption factor of 30% is used in calculation of the unit risk from the Unit Risk.

^qBased on results with the alpha isomer

^sAn absorption factor of 75% is used in calculation of the unit risk from the slope factor.

NA - Not applicable, ND - not determined

USER'S GUIDE: RADIONUCLIDE CARCINOGENICITY

The Health Effects Assessment Summary Table C summarizes the cancer slope factors and unit risk values for selected radionuclides of potential concern at Superfund sites contaminated with radioactive materials. These values were calculated by the Office of Radiation Programs (ORP) and are intended for use by EPA risk assessors during human health risk assessments conducted as part of the Superfund remedial investigation/feasibility study (RI/FS) process. HEAST users should apply these values as specified by the radiation risk assessment guidance provided in this section and in Chapter 10 of the Risk Assessment Guidance for Superfund; Volume I, Human Health Evaluation Manual, Part A (EPA/540/1-89/002), which is available from the Center for Environmental Research Information at (513) 569-7562. As risk assessment methodologies are refined, slope factors and unit risk values will be revised and updated in Table C.

EPA classifies all radionuclides as Group A carcinogens based on their property of emitting ionizing radiation and on the extensive weight of evidence provided by epidemiological studies of radiation-induced cancers in humans. Data derived from both human studies and animal experiments are used by EPA to construct mathematical models of exposure, dose, and risk to estimate radionuclide slope factor values. These models consider pathways of exposure, the distinct metabolic behavior of each element by compound and the radiological characteristics of each nuclide of

concern, the time and duration of exposure, the radiosensitivity of each target organ in the body, the latency period for cancer expression in these organs, and the age and sex of individuals in the exposed population.

Similar to chemical risk models, radiation models extrapolate cancer risks due to low dose exposures from risks observed at higher doses using linear dose-response relationships. Because of the radiation risk models employed, slope factors for radionuclides are characterized as best estimates (i.e., maximum likelihood estimates) of the age-averaged total lifetime excess cancer risk per unit intake or exposure. HEAST users should consult Volume I of the Background Information Document for the Draft Environmental Impact Statement for Proposed NESHAPs for Radionuclides (EPA 520/1-89-005) for a more detailed discussion of EPA's current radiation risk assessment methodology.

Quantitative carcinogenic estimates listed in Table C^{*} include the following:

slope factor = risk per unit intake or exposure = risk per pCi inhaled or ingested or as risk per pCi/m² per year due to external exposure.

* Slope factors and risk estimates are reported in Table C in units of activity, both in the customary units of picocuries (1 pCi = 10⁻¹² curies (Ci) = 3.7x10⁻² nuclear transformations per second) for consistency with the system used for radionuclides in the IRIS database, and in the International System (SI) units of becquerels (1 Bq = 1 nuclear transformation per second; approximately 27 pCi). Users can calculate cancer risks using slope factors expressed in either customary units or SI units with equivalent results, provided that they also use air, water and soil concentration values in the same system units. For simplicity, examples presented in text are shown in picocuries only.

pathway-specific unit risk = risk per unit concentration in air, drinking water or soil (external exposure) = risk per pCi/m³ (air), risk per pCi/L (water), risk per pCi/g (external exposure), or risk pCi/g (soil ingestion).

Unit risk estimates for air, drinking water, and soil ingestion pathways provided in Table C were calculated by multiplying the appropriate inhalation and ingestion slope factors by the inhalation rate (20 m³/day), the water consumption rate (2 L/day), or the soil ingestion rate*, respectively, and by multiplying all values by the total number of days in 70 years (i.e., by the lifetime exposure = 365 days/yr x 70 yrs = 25,550 days). Hence,

$$\begin{aligned}\text{risk per pCi/m}^3 \text{ (air)} &= \text{slope factor (risk per pCi inhaled)} \times 20 \text{ m}^3/\text{day} \times 25,550 \text{ days} \\ \text{risk per pCi/L (water)} &= \text{slope factor (risk per pCi ingested)} \times 2 \text{ L/day} \times 25,550 \text{ days} \\ \text{risk per pCi/g (soil)} &= \text{slope factor (risk per pCi ingested)} \times [(0.2 \text{ g/day} \times 1,825 \text{ days}) + (0.1 \text{ g/day} \times 23,360 \text{ days})] \\ \text{(soil ingestion)} &\end{aligned}$$

The designations "D", "W", and "Y" presented under the heading "ICRP Lung Class" in Table C refer to the lung clearance times for

* Soil ingestion rates of 0.2 gram per day for children aged 1 year through 6 years and 0.1 gram per day for older age groups were taken from EPA's Interim Final Guidance for Soil Ingestion Rates (OSWER Directive 9850.4; January 27, 1989), available from the Office of Waste Enforcement Programs at (202) 382-4814. Accordingly, for lifetime exposures, an individual would be expected to consume 365 grams of soil starting at age 1 to age 6 (i.e., 0.2 g/day x 365 days/year x 5 years), plus 2,336 grams after age 6 to age 70 (i.e., 0.1 g/day x 365 days x 64 years) for a total of approximately 2,700 grams.

inhaled particulate radionuclides expressed as days (D), weeks (W), or years (Y), as recommended by the International Commission on Radiological Protection (ICRP). Gaseous radionuclides, e.g., Rn-222, are assigned to class "g". "GI Absorption Factors, f_1 ," are the fractional amounts of each radionuclide that may be absorbed from the gastrointestinal (GI) tract into blood following an oral intake. The ICRP lung clearance rates and GI absorption factors provided in Table C are default values used by the EPA to calculate radionuclide slope factors for inhalation and ingestion exposures, respectively. Application of values other than those specified in Table C will result in slope factors and unit risk estimates different from those provided in the table. At this time, EPA recommends that risk assessors should not replace or substitute for the default values listed.

Values listed in Table C for external exposure are best estimates of the lifetime cancer risk due to the irradiation of an individual exposed to gamma-emitting radionuclides uniformly mixed in soil. Unit risk estimates for this pathway were calculated by multiplying the appropriate ground surface slope factors by the effective surface density of soil (i.e., $143 \text{ kg/m}^2 = 0.10 \text{ m (soil depth)} \times 1.43 \times 10^3 \text{ kg/m}^3 \text{ (soil density)}$), and by multiplying all values by 70 years (i.e., by the lifetime exposure). Hence,

$$\text{risk per pCi/g (soil)} = \text{slope factor (risk per pCi/m}^2 \text{ per year)} \times 143 \text{ kg/m}^2 \times 10^3 \text{ (g/kg)} \times 70 \text{ years}$$

External exposure factors do not include contributions from decay products, i.e., any radionuclides formed during radioactive decay. In some cases, these contributions can be substantial and should be factored into the risk calculations. For example, to estimate the total lifetime excess cancer risk due to continuous, lifetime external exposure to soil contaminated with Cs-137 at a level of 1 pCi/g, risk values must be calculated for Cs-137 and Ba-137m in equilibrium concentrations of 1 pCi/g each (assuming a uniformly mixed source in soil and using the values listed under "External Exposure" in Table C as follows;

$$\begin{aligned}
 \text{Total risk} &= \text{Risk from Cs-137} + \text{Risk from Ba-137m} \\
 &= (\text{pCi/g Cs-137} \times \text{Risk per pCi/g Cs-137}) \\
 &\quad + (\text{pCi/g Ba-137m} \times \text{Risk per pCi/g Ba-137m}) \\
 &= (1 \text{ pCi/g} \times 0.0\text{E}+00 \text{ risk per pCi/g Cs-137}) \\
 &\quad + (1 \text{ pCi/g} \times 3.4\text{E}-04 \text{ risk per pCi/g Ba-137m}) \\
 &= 3.4 \times 10^{-4} \text{ total lifetime excess cancer risk}
 \end{aligned}$$

This calculation must be performed in this manner because the external exposure risk from Cs-137 is due to the photon radiation emitted by Ba-137m, its immediate short-lived decay product. In the same manner, the total lifetime excess cancer risk due to continuous external exposure to soil contaminated with Ra-226 and progeny (assuming secular equilibrium) should be calculated as the summation of the risks contributed by Ra-226 and each decay product that emits photon radiation, such as Pb-214 and Bi-214.

To estimate risk-specific concentrations in air from the unit risk in air as presented in Table C, the specified level of risk is divided by the unit risk for air. Hence, the air concentration (in pCi/m³) corresponding to a best estimate of the increased lifetime cancer risk of 1x10⁻⁵ is calculated as follows:

$$\text{pCi/m}^3 \text{ in air} = \frac{1 \times 10^{-5}}{\text{unit risk in (pCi/m}^3)^{-1}}$$

Similarly, to estimate risk-specific concentrations in water and in soil (ingestion exposure), the specified level of risk is divided by the unit risk for drinking water or soil ingestion. Hence, the water concentration (in pCi/L) corresponding to a best estimate of the increased lifetime cancer risk of 1x10⁻⁵ is calculated as follows:

$$\text{pCi/L in water} = \frac{1 \times 10^{-5}}{\text{unit risk in (pCi/L)}^{-1}}$$

and the soil concentration (in pCi/g) corresponding to a best estimate of the increased lifetime cancer risk of 1x10⁻⁵ is calculated as follows:

$$\begin{array}{l} \text{pCi/g in soil} \\ \text{(ingestion exposure)} \end{array} = \frac{1 \times 10^{-5}}{\begin{array}{l} \text{unit risk in (pCi/g)}^{-1} \\ \text{(soil ingestion)} \end{array}}$$

To estimate risk-specific concentrations in soil from the unit risk from external exposure as presented in Table C, the specified level of risk is divided by the unit risk for soil. Hence, the soil concentration (in pCi/g) corresponding to a best estimate of the increased lifetime cancer risk of 1×10^{-5} is calculated as follows:

$$\begin{array}{l} \text{pCi/g in soil} \\ \text{(external exposure)} \end{array} = \frac{1 \times 10^{-5}}{\begin{array}{l} \text{unit risk in (pCi/g)}^{-1} \\ \text{(external exposure)} \end{array}}$$

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE C: RADIONUCLIDE CARCINOGENICITY (Expressed in picocuries (pCi))

Nuclide	ICRP ^{aa} Lung Class	GI ^{aaa} Absorption Factor (f ₁)	Slope Factor			Pathway-Specific Unit Risk			
			Age-averaged lifetime excess total cancer risk per unit intake or exposure			Age-averaged lifetime excess total cancer risk per unit daily intake or exposure for 70 years			
			Inhalation (pCi) ⁻¹	Ingestion (pCi) ⁻¹	Ground Surface (pCi/m ² /yr) ⁻¹	Air (pCi/m ³) ⁻¹	Drinking Water (pCi/L) ⁻¹	External Exposure (pCi/g) ⁻¹	Soil Ingestion (pCi/g) ⁻¹
Am-241	W	1.0E-03	4.0E-08	3.1E-10	1.6E-12	2.1E-02	1.6E-05	1.6E-05	8.4E-07
Am-243	W	1.0E-03	4.0E-08	3.0E-10	3.6E-12	2.1E-02	1.5E-05	3.6E-05	8.1E-07
Ba-137m	D	1.0E-01	6.0E-16	2.4E-15	3.4E-11	3.0E-10	1.2E-10	3.4E-04	6.5E-12
Bi-214	W	5.0E-02	2.2E-12	1.4E-13	8.0E-11	1.1E-06	7.2E-09	8.0E-04	3.8E-10
C-14	g	9.5E-01	6.4E-15	9.1E-13	0.0E+00	3.2E-09	4.7E-08	0.0E+00	2.5E-09
Ce-144	Y	3.0E-04	3.4E-10	6.1E-12	1.2E-12	1.7E-04	3.0E-07	1.2E-05	1.6E-08
Cm-243	W	1.0E-03	3.1E-08	2.3E-10	8.2E-12	1.6E-02	1.2E-05	8.2E-05	6.2E-07
Cm-244	W	1.0E-03	2.7E-08	2.0E-10	5.8E-14	1.4E-02	1.0E-05	5.9E-07	5.4E-07
Co-60	Y	3.0E-01	1.6E-10	1.5E-11	1.3E-10	8.1E-05	7.8E-07	1.3E-03	4.1E-08
Cr-51	Y	1.0E-01	3.0E-13	4.2E-14	1.9E-12	1.5E-07	2.1E-09	1.9E-05	1.1E-10
Cs-134	D	9.5E-01	2.8E-11	4.2E-11	8.9E-11	1.4E-05	2.1E-06	8.9E-04	1.1E-07
Cs-135	D	9.5E-01	2.7E-12	4.0E-12	0.0E+00	1.4E-06	2.1E-07	0.0E+00	1.1E-08
Cs-137	D	9.5E-01	1.9E-11	2.8E-11	0.0E+00	9.6E-06	1.4E-06	0.0E+00	7.6E-08
Fe-59	W	1.0E-01	9.8E-12	2.8E-12	6.2E-11	4.9E-06	1.4E-07	6.3E-04	7.6E-09
H-3	g	9.5E-01	7.8E-14	5.5E-14	0.0E+00	4.0E-08	2.8E-09	0.0E+00	1.5E-10
I-129	D	9.5E-01	1.2E-10	1.9E-10	1.5E-12	6.1E-05	9.6E-06	1.5E-05	5.1E-07
I-131	D	9.5E-01	2.4E-11	3.6E-11	2.9E-11	1.2E-05	1.8E-06	2.9E-04	9.7E-08
K-40	D	9.5E-01	7.6E-12	1.1E-11	7.8E-12	4.0E-06	5.7E-07	7.8E-05	3.0E-08
Mn-54	W	1.0E-01	5.3E-12	1.1E-12	4.7E-11	2.6E-06	5.7E-08	4.8E-04	3.0E-09
Mo-99	Y	8.0E-01	2.6E-12	1.7E-12	9.0E-12	1.3E-06	8.7E-08	8.9E-05	4.6E-09

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE C: RADIONUCLIDE CARCINOGENICITY (Expressed in picocuries (pCi))

Nuclide	ICRP ^{xx} Lung Class	GI ^{xxx} Absorption Factor (f ₁)	Slope Factor			Pathway-Specific Unit Risk			
			Age-averaged lifetime excess total cancer risk per unit intake or exposure			Age-averaged lifetime excess total cancer risk per unit daily intake or exposure for 70 years			
			Inhalation (pCi) ⁻¹	Ingestion (pCi) ⁻¹	Ground Surface (pCi/m ² /yr) ⁻¹	Air (pCi/m ³) ⁻¹	Drinking Water (pCi/L) ⁻¹	External Exposure (pCi/g) ⁻¹	Soil Ingestion (pCi/g) ⁻¹
Nb-94	Y	1.0E-02	2.1E-10	2.1E-12	8.9E-11	1.1E-04	1.1E-07	8.9E-04	5.7E-09
Np-237	W	1.0E-03	3.6E-08	2.7E-10	1.8E-12	1.8E-02	1.4E-05	1.8E-05	7.3E-07
P-32	D	8.0E-01	3.0E-12	3.5E-12	0.0E+00	1.5E-06	1.8E-07	0.0E+00	9.5E-09
Pb-210	D	2.0E-01	1.7E-09	6.5E-10	1.8E-13	8.7E-04	3.4E-05	1.8E-06	1.8E-06
Pb-214	D	2.0E-01	2.9E-12	1.8E-13	1.5E-11	1.5E-06	9.2E-09	1.6E-04	4.9E-10
Po-210	W	1.0E-01	2.7E-09	2.6E-10	4.8E-16	1.4E-06	1.3E-05	4.8E-09	7.0E-07
Po-214	W	1.0E-01	2.8E-19	1.0E-20	4.7E-15	1.4E-13	5.1E-16	4.7E-08	2.7E-17
Pu-238	Y	1.0E-03	4.2E-08	2.8E-10	6.1E-14	2.1E-02	1.4E-05	5.9E-07	7.6E-07
Pu-239	Y	1.0E-04	4.1E-08	3.1E-11	2.6E-14	2.6E-02	1.6E-06	2.6E-07	8.4E-08
Pu-240	Y	1.0E-04	4.1E-08	3.1E-11	5.9E-14	2.1E-02	1.6E-06	5.9E-07	8.4E-08
Pu-241	Y	1.0E-03	2.9E-10	4.8E-12	0.0E+00	1.5E-04	2.5E-07	0.0E+00	1.3E-08
Pu-242	Y	1.0E-04	3.9E-08	3.0E-11	4.9E-14	2.1E-02	1.5E-06	4.8E-07	8.1E-08
Ra-226	W	2.0E-01	3.0E-09	1.2E-10	4.2E-13	1.5E-03	6.1E-06	4.1E-06	3.2E-07
Ra-228	W	2.0E-01	6.5E-10	1.0E-10	5.4E-20	3.4E-04	5.1E-06	5.6E-13	2.7E-07
Rn-222	g	--	7.2E-13	--	2.2E-14	3.7E-07	--	2.2E-07	--
Ru-106	Y	5.0E-02	4.4E-10	9.6E-12	0.0E+00	2.3E-04	4.9E-07	0.0E+00	2.6E-08
S-35	D	8.0E-01	1.9E-13	2.2E-13	0.0E+00	9.6E-08	1.1E-08	0.0E+00	5.9E-10
Sr-89	D	3.0E-01	2.9E-12	3.0E-12	7.8E-15	1.5E-06	1.5E-07	7.8E-08	8.1E-09
Sr-90	D	3.0E-01	5.6E-11	3.3E-11	0.0E+00	2.8E-05	1.7E-06	0.0E+00	8.9E-08
Tc-99	W	8.0E-01	8.3E-12	1.3E-12	3.4E-17	4.2E-06	6.6E-08	3.4E-10	3.5E-09

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE C: RADIONUCLIDE CARCINOGENICITY (Expressed in picocuries (pCi))

Nuclide	ICRP ^{**} Lung Class	GI ^{***} Absorption Factor (f ₁)	Slope Factor			Pathway-Specific Unit Risk			
			Age-averaged lifetime excess total cancer risk per unit intake or exposure			Age-averaged lifetime excess total cancer risk per unit daily intake or exposure for 70 years			
			Inhalation (pCi) ⁻¹	Ingestion (pCi) ⁻¹	Ground Surface (pCi/m ² /yr) ⁻¹	Air (pCi/m ³) ⁻¹	Drinking Water (pCi/L) ⁻¹	External Exposure (pCi/g) ⁻¹	Soil Ingestion (pCi/g) ⁻¹
Tc-99m	W	8.0E-01	2.7E-14	5.1E-14	8.1E-12	1.4E-08	2.6E-09	8.2E-05	1.4E-10
Th-230	Y	2.0E-04	3.1E-08	2.4E-11	5.9E-14	1.6E-02	1.2E-06	5.9E-07	6.5E-08
Th-232	Y	2.0E-04	3.1E-08	2.2E-11	4.6E-14	1.6E-02	1.1E-06	4.5E-07	5.9E-08
U-234	Y	2.0E-01	2.7E-08	1.4E-10	5.7E-14	1.4E-02	7.2E-06	5.6E-07	3.8E-07
U-235	Y	2.0E-01	2.5E-08	1.3E-10	9.6E-12	1.3E-02	6.6E-06	9.7E-05	3.5E-07
U-238	Y	2.0E-01	2.4E-08	1.3E-10	4.6E-14	1.2E-02	6.6E-06	4.5E-07	3.5E-07

* A picocurie is a unit of activity equal to 3.7E-02 nuclear transformations per second: 1 pCi = 1.0E-12 curies (Ci) = 3.7E-02 becquerels (Bq).

** Lung clearance classifications recommended by the International Commission on Radiological Protection (ICRP); "D" (days), "W" (weeks), "Y" (years), "g" (gas).

*** Gastrointestinal (GI) absorption factors, i.e, fractional uptake of a radionuclide from the gut into blood.

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE C: RADIONUCLIDE CARCINOGENICITY (Expressed in Becquerels (Bq))

Nuclide	ICRP ^{***} Lung Class	GI ^{***} Absorption Factor (f ₁)	Slope Factor			Pathway-Specific Unit Risk			
			Age-averaged lifetime excess total cancer risk per unit intake or exposure			Age-averaged lifetime excess total cancer risk per unit daily intake or exposure for 70 years			
			Inhalation (Bq) ⁻¹	Ingestion (Bq) ⁻¹	Ground Surface (Bq/m ² /yr) ⁻¹	Air (Bq/m ³) ⁻¹	Drinking Water (Bq/L) ⁻¹	External Exposure (Bq/g) ⁻¹	Soil Ingestion (Bq/g) ⁻¹
Am-241	W	1.0E-03	1.1E-06	8.4E-09	4.3E-11	5.6E-01	4.3E-04	4.3E-04	2.3E-05
Am-243	W	1.0E-03	1.1E-06	8.1E-09	9.7E-11	5.6E-01	4.1E-04	9.7E-04	2.2E-05
Ba-137m	D	1.0E-01	1.6E-14	6.5E-14	9.2E-10	8.2E-09	3.3E-09	9.2E-03	1.8E-10
Bi-214	W	5.0E-02	5.9E-11	3.8E-12	2.2E-09	3.3E-05	1.9E-07	2.2E-02	1.0E-08
C-14	g	9.5E-01	1.7E-13	2.5E-11	0.0E+00	8.7E-08	1.3E-06	0.0E+00	6.8E-08
Ce-144	Y	3.0E-04	9.2E-09	1.6E-10	3.2E-11	4.7E-03	8.2E-06	3.2E-04	4.3E-07
Cm-243	W	1.0E-03	8.4E-07	6.2E-09	2.2E-10	4.3E-01	3.2E-04	2.2E-03	1.7E-05
Cm-244	W	1.0E-03	7.3E-07	5.4E-09	1.6E-12	3.7E-01	2.8E-04	1.6E-05	1.5E-05
Co-60	Y	3.0E-01	4.3E-09	4.1E-10	3.5E-09	2.2E-03	2.1E-05	3.5E-02	1.1E-06
Cr-51	Y	1.0E-01	8.1E-12	1.1E-12	5.1E-11	4.1E-06	5.6E-08	5.1E-04	3.0E-09
Cs-134	D	9.5E-01	7.6E-10	1.1E-09	2.4E-09	3.9E-04	5.6E-05	2.4E-02	3.0E-06
Cs-135	D	9.5E-01	7.3E-11	1.1E-10	0.0E+00	3.7E-05	5.6E-06	0.0E+00	3.0E-07
Cs-137	D	9.5E-01	5.1E-10	7.6E-10	0.0E+00	2.6E-04	3.9E-05	0.0E+00	2.1E-06
Fe-59	W	1.0E-01	2.6E-10	7.6E-11	1.7E-09	1.3E-04	3.9E-06	1.7E-02	2.1E-07
H-3	g	9.5E-01	2.1E-12	1.5E-12	0.0E+00	1.1E-06	7.7E-08	0.0E+00	4.1E-09
I-129	D	9.5E-01	3.2E-09	5.1E-09	4.1E-11	1.6E-03	2.6E-04	4.1E-04	1.4E-05
I-131	D	9.5E-01	6.5E-10	9.7E-10	7.8E-10	3.3E-04	5.0E-05	7.8E-03	2.6E-06
K-40	D	9.5E-01	2.1E-10	3.0E-10	2.1E-10	1.1E-04	1.5E-05	2.1E-03	8.1E-07
Mn-54	W	1.0E-01	1.4E-10	3.0E-11	1.3E-09	7.2E-05	1.5E-06	1.3E-02	8.1E-08
Mo-99	Y	8.0E-01	7.0E-11	4.6E-11	2.4E-10	3.6E-05	2.4E-06	2.4E-03	1.2E-07

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE C: RADIONUCLIDE CARCINOGENICITY (Expressed in Becquerels (Bq))

Nuclide	ICRP ^{xx} Lung Class	GI ^{xxx} Absorption Factor (f_1)	Slope Factor			Pathway-Specific Unit Risk			
			Age-averaged lifetime excess total cancer risk per unit intake or exposure			Age-averaged lifetime excess total cancer risk per unit daily intake or exposure for 70 years			
			Inhalation (Bq) ⁻¹	Ingestion (Bq) ⁻¹	Ground Surface (Bq/m ² /yr) ⁻¹	Air (Bq/m ³) ⁻¹	Drinking Water (Bq/L) ⁻¹	External Exposure (Bq/g) ⁻¹	Soil Ingestion (Bq/g) ⁻¹
Nb-94	Y	1.0E-02	5.7E-09	5.7E-11	2.4E-09	2.9E-03	2.9E-06	2.4E-02	1.5E-07
Np-237	W	1.0E-03	9.7E-07	7.3E-09	4.9E-11	5.0E-01	3.7E-04	4.9E-04	2.0E-05
P-32	D	8.0E-01	8.1E-11	9.5E-11	0.0E+00	4.1E-05	4.9E-06	0.0E+00	2.6E-07
Pb-210	D	2.0E-01	4.6E-08	1.8E-08	4.9E-12	2.4E-02	9.2E-04	4.9E-05	4.9E-05
Pb-214	D	2.0E-01	7.8E-11	4.9E-12	4.2E-10	4.0E-05	2.5E-07	4.2E-03	1.3E-08
Po-210	W	1.0E-01	7.3E-11	7.0E-09	1.3E-14	3.7E-05	3.6E-04	1.3E-07	1.9E-05
Po-214	W	1.0E-01	7.6E-18	2.7E-19	1.3E-13	3.9E-12	1.4E-14	1.3E-06	7.3E-16
Pu-238	Y	1.0E-03	1.1E-06	7.6E-09	1.6E-12	5.6E-01	3.9E-04	1.6E-05	2.1E-05
Pu-239	Y	1.0E-04	1.1E-06	8.4E-10	7.0E-13	5.6E-01	4.3E-05	7.0E-06	2.3E-06
Pu-240	Y	1.0E-04	1.1E-06	8.4E-10	1.6E-12	5.6E-01	4.3E-05	1.6E-05	2.3E-06
Pu-241	Y	1.0E-03	7.8E-09	1.3E-10	0.0E+00	4.0E-03	6.6E-06	0.0E+00	3.5E-07
Pu-242	Y	1.0E-04	1.1E-06	8.1E-10	1.3E-12	5.6E-01	4.1E-05	1.3E-05	2.2E-06
Ra-226	W	2.0E-01	8.1E-08	3.2E-09	1.1E-11	4.1E-02	1.6E-04	1.1E-04	8.6E-06
Ra-228	W	2.0E-01	1.8E-08	2.7E-09	1.5E-18	9.2E-03	1.4E-04	1.5E-11	7.3E-06
Rn-222	g	--	1.9E-11	--	5.9E-13	9.9E-06	--	6.0E-06	--
Ru-106	Y	5.0E-02	1.2E-08	2.6E-10	0.0E+00	6.1E-03	1.3E-05	0.0E+00	7.0E-07
S-35	D	8.0E-01	5.1E-12	5.9E-12	0.0E+00	2.6E-06	3.0E-07	0.0E+00	1.6E-08
Sr-89	D	3.0E-01	7.8E-11	8.1E-11	2.1E-13	4.0E-05	4.1E-06	2.1E-06	2.2E-07
Sr-90	D	3.0E-01	1.5E-09	8.9E-10	0.0E+00	7.7E-04	4.5E-05	0.0E+00	2.4E-06
Tc-99	W	8.0E-01	2.2E-10	3.5E-11	9.2E-16	1.1E-04	1.8E-06	9.2E-09	9.5E-08

HEALTH EFFECTS ASSESSMENT SUMMARY TABLE C: RADIONUCLIDE CARCINOGENICITY (Expressed in Becquerels (Bq))

Nuclide	ICRP** Lung Class	GI*** Absorption Factor (f _g)	Slope Factor			Pathway-Specific Unit Risk			
			Age-averaged lifetime excess total cancer risk per unit intake or exposure			Age-averaged lifetime excess total cancer risk per unit daily intake or exposure for 70 years			
			Inhalation (Bq) ⁻¹	Ingestion (Bq) ⁻¹	Ground Surface (Bq/m ² /yr) ⁻¹	Air (Bq/m ³) ⁻¹	Drinking Water (Bq/L) ⁻¹	External Exposure (Bq/g) ⁻¹	Soil Ingestion (Bq/g) ⁻¹
Tc-99m	W	8.0E-01	7.3E-13	1.4E-12	2.2E-10	3.7E-07	7.2E-08	2.2E-03	3.8E-09
Th-230	Y	2.0E-04	8.4E-07	6.5E-10	1.6E-12	4.3E-01	3.3E-05	1.6E-05	1.8E-06
Th-232	Y	2.0E-04	8.4E-07	5.9E-10	1.2E-12	4.3E-01	3.0E-05	1.2E-05	1.6E-06
U-234	Y	2.0E-01	7.3E-07	3.8E-09	1.5E-12	3.7E-01	1.9E-04	1.5E-05	1.0E-05
U-235	Y	2.0E-01	6.8E-07	3.5E-09	2.6E-10	3.5E-01	1.8E-04	2.6E-03	9.5E-06
U-238	Y	2.0E-01	6.5E-07	3.5E-09	1.2E-12	3.3E-01	1.8E-04	1.2E-05	9.5E-06

* A Becquerel is a unit of activity equal to one nuclear transformation per second: 1 Bq = 2.7E-11 curies (Ci) = 27.027 picocuries (pCi).

** Lung clearance classifications recommended by the International Commission on Radiological Protection (ICRP); "D" (days), "W" (weeks), "Y" (years), "g" (gas).

*** Gastrointestinal (GI) absorption factors, i.e., fractional uptake of a radionuclide from the gut into blood.

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