



Health Effects Assessment Summary Tables

Annual
FY-1991



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HEALTH EFFECTS ASSESSMENT

SUMMARY TABLES

FY-1991 Annual

Office of Research and Development
Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, DC 20460

DISCLAIMER

This report is intended for internal U.S. Environmental Protection Agency distribution only. The information contained herein has been taken from final documents prepared by the Office of Health and Environmental Assessment for the Office of Solid Waste and Emergency Response, Washington, DC and the Office of Air Quality Planning and Standards, Research Triangle Park, NC. These documents were reviewed in accordance with Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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INTRODUCTION

This document is the FY 91 annual update of the Health Effects Assessment Summary Tables (HEAST) prepared by EPA's Environmental Criteria and Assessment Office for use at both Superfund and RCRA sites. This edition of the HEAST completely replaces the previous edition of this document. Beginning with the FY 91 edition, the HEAST will no longer be issued in separate quarterly editions, with each issue replacing the previous issue. Instead, in January of each year, an annual or "main" edition will be issued. Quarterly supplements to the January edition will be issued in April (second quarter supplement), July (third quarter supplement) and October (fourth quarter supplement). Each supplement will incorporate the information in the previous supplement and thus replace the previous supplement. For example, to be current through the third quarter FY 91, the user would have to have the annual edition, plus the third quarter supplement. The second quarter supplement may be discarded because information in the second quarter supplement will be found in the third quarter supplement.

Contributors

Beginning with the third quarter of FY 1990, the document also includes chemicals commonly found at RCRA sites as identified by the Office of Solid Waste's Technical Assessment Branch. By including chemicals identified by OSW, the Agency conserves resources, enhances the completeness of HEAST tables and assists in promoting consistency within the Office of Solid Waste and Emergency Response. Also acknowledged are the contributions from

the Office of Radiation Programs, which provides data on radionuclides for Table C of the HEAST.

Chemicals Listed

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 risk assessments for many chemicals of interest to the Superfund program.

Caution

It is important to remember that the numbers in these tables alone tell very little about the adverse effects of a chemical or the quality of evidence on which risk assessments are based. Original assessment documents must be consulted by users of this document in order 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 and RCRA sites. The HEAST is structured to point the user to these sources.

Hierarchy of Sources

We recognize that at any point in 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.
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.

References

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). Carcinogen Assessment Group (CAG) Profiles cited in Table B are available through RCRA docket (202/475-9327).

Questions

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.

Ordering Information

Limited copies of the HEAST are available for EPA Superfund staff, States Superfund programs and other Federal agencies working on Superfund sites and EPA contractors working for the EPA Superfund program. If you fall into one of these groups you can call the Toxics Integration Branch (202) 475-9490 to be put on the mailing list.

EPA's Office of Solid Waste (OSW) requests that their users (i.e. OSW staff, contractors, State solid waste programs) call Steve Kroner of the Office of Solid Waste at (202) 382-5219 to obtain copies of the HEAST. Regional OSW staff are reminded that copies are sent to all EPA Regional libraries.

Users of the HEAST in EPA's Office of Air and Radiation and state air programs should call Fred Hauchman of EPA's Office of Air Quality Planning and Standards at (919) 541-5339. All others must purchase the document from:

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

Starting in FY91, the HEAST is being produced as an annual publication with quarterly supplements. This NTIS order is PB91921100. For ordering information, call NTIS Subscriptions Department at (703) 487-4630. NTIS normally ships 4th class United States mail. You may wish to consult with NTIS concerning the use of an overnight delivery service.

WHAT'S NEW IN THE ANNUAL FY91 HEAST

Annual Publication

This document is the FY 91 annual update of the Health Effects Assessment Summary Tables (HEAST) prepared by EPA's Environmental Criteria and Assessment Office for use at both Superfund and RCRA sites. This edition of the HEAST completely replaces the previous edition of this document. Beginning with the FY 91 edition, the HEAST will no longer be issued in separate quarterly editions, with each issue replacing the previous issue. Instead, in January of each year, an annual or "main" edition will be issued. Quarterly supplements to the January edition will be issued in April (second quarter supplement), July (third quarter supplement) and October (fourth quarter supplement). (For further information consult the Introduction of this document.)

GENERIC ISSUES:

Recent activity by the RfC/RfD and CRAVE Work Groups has changed the status (usually from "under review" to "verified" or from "verified" to "available on IRIS") of several chemicals in Tables A and B. Each change of status is not detailed in the list of chemical-specific changes below. New additions to Tables A and B, as well as amendments to the values found in Tables A and B are described below.

On 01/01/91 the inhalation slope factors were removed from the quantitative cancer risk assessments available on IRIS. The CRAVE Work Group felt that calculation of an inhalation slope factor from the unit risk may be a misleading use of the data because of the

need to introduce assumptions regarding inhalation rate and body weight. This change in IRIS is not reflected in this update of the HEAST. The Superfund Office is currently evaluating the impact of the removal of inhalation slope factors on Superfund cancer risk assessments and on future updates of the HEAST.

RfC/RfD and CRAVE Work Group status reports dated 01/01/91 were used in this update of Tables A and B.

CHEMICAL-SPECIFIC CHANGES TO TABLE A: OTHER THAN CARCINOGENICITY

Allyl chloride

Allyl chloride was the subject of a HEEP (U.S. EPA, 1983) in which risk assessment values based on systemic toxicity were not derived due to the known carcinogenicity of this chemical. The RfD/RfC Work Group recently verified an RfC for allyl chloride; data regarding inhalation exposure and corresponding references have been entered into Table A. The oral RfD reported in Table A is an interim value, calculated based on extrapolation from the inhalation study that serves as the basis of the inhalation RfC.

Aniline

Aniline was the subject of a HEEP (U.S. EPA, 1985) in which risk assessment values based on systemic toxicity were not derived due to the known carcinogenicity of this chemical. The RfD/RfC Work Group recently verified an RfC for aniline; data regarding inhalation exposure and corresponding references have been entered into Table A.

Ethylbenzene

A recently verified inhalation RfC was added to Table A.

Ethyl chloride

A recently verified inhalation RfC was added to Table A.

Fluorene

The footnote is changed to indicate that the oral RfD is now on IRIS.

2-Methoxyethanol

Inhalation RfC was changed to correspond to a recently verified value; oral RfD reported is an interim value, calculated on extrapolation from the study that serves as the basis of the inhalation RfC.

4,4'-Methylenediphenyl isocyanate

A recently verified inhalation RfC was added to Table A. Calculation of an oral RfD based on route-to-route extrapolation is inappropriate because portal-of-entry effects were observed in the inhalation study.

Naphthalene

The footnote is added to indicate that this chemical has been verified by CRAVE as an EPA weight-of-evidence Group D substance.

2-Nitropropane

2-Nitropropane was the subject of a HEEP (U.S. EPA, 1985) in which risk assessment values based on systemic toxicity were not derived due to the known carcinogenicity of this chemical. The RfD/RfC Work Group recently verified an RfC for 2-nitropropane; data regarding inhalation exposure and corresponding references have been entered into Table A.

Propylene oxide

Propylene oxide was the subject of a HEEP (U.S. EPA, 1985) in which risk assessment values based on systemic toxicity were not derived due to the known carcinogenicity of this chemical. The RfD/RfC Work Group recently verified an RfC for propylene oxide; data regarding inhalation exposure and corresponding references have been entered into Table A.

Trinitrophenyl Methyl nitramine

This is a new entry from a recently finalized HEED. Risk assessment information has now been incorporated in this entry. The appropriate citations have also been added to "References for Table A".

Vinyl Acetate

A footnote is added to indicate that the inhalation RfC is now on IRIS.

CHEMICAL-SPECIFIC CHANGES TO TABLE B: CARCINOGENICITY

Atrazine

Recently verified oral slope factor and unit risk have been added to Table B.

Benz[a]anthracene

The footnote is changed to indicate that the classification is now on IRIS.

Benzo[a]pyrene

A new footnote is added to indicate that the classification is verified and on IRIS. Quantitative estimates, derived in a HEA document (U.S. EPA, 1984), have not been verified.

Benzo[b]fluoranthene

The footnote is changed to indicate that the classification is now on IRIS.

Benzo[k]fluoranthene

The footnote is changed to indicate that the classification is now on IRIS.

Chlorothalonil

The footnote was changed to indicate that newly verified oral slope factor and unit risk have been added to Table B.

Dibenz[a,h]anthracene

The footnote is changed to indicate that the classification is now on IRIS.

Indeno[1,2,3-cd]pyrene

The footnote is changed to indicate that the classification is now on IRIS.

Methylene chloride

A footnote was added to indicate that only the inhalation unit risk, which has been corrected, is verified and available on IRIS. IRIS notes that calculation of a slope factor is inappropriate when pharmacokinetic models are used.

Propylene oxide

A footnote was added to indicate that only the inhalation unit risk is verified and available on IRIS. IRIS did not provide an explanation as to why an inhalation slope factor was not derived.

Tetrachloroethylene

A footnote was added to indicate that the weight-of-evidence was recently verified (12/06/90). However, quantitative estimates were not calculated by the CRAVE Work Group. Numbers presented in Table B should only be viewed as interim, pending further notice.

CHEMICAL-SPECIFIC CHANGES TO TABLE C: RADIONUCLIDE CARCINOGENICITY

To HEAST Table C on Radionuclide Carcinogenicity, cancer slope factors have been added for Rn-222 plus decay products, for Po-218, and for soluble forms of Pu-239, Pu-240 and Pu-242. Pathway-specific risk values have also been calculated and included in Table C for each of these radionuclides.

USER'S GUIDE: CHEMICAL TOXICITY

The Health Effects Assessment Summary Tables A & B summarize reference concentrations (RfCs) and 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 drafts 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). Also included in the HEAST are chemicals commonly found at RCRA sites as identified by the Office of Solid Waste Technical Assessment Branch. The information in HEA Summary Tables A and B is excerpted from the original documents and is 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 RfC/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 RfC, 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/RfC or CRAVE work groups. 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 RfC or 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 RfC or RfD (designated "subchronic" in Table A and formerly called AIS), or during the lifetime, in the case of a chronic RfC or RfD (designated "chronic" in Table A and formerly called AIC). The RfC and RfD values are listed in Table A in columns with headings "Inhalation RfC" and "Oral RfD." The RfC or 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):

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

In Table A, the NOAEL or LOAEL that is the basis for the RfC or 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 for oral and inhalation studies assessed by the older method is given in parentheses. An inhaled mg/kg/day dose is not calculated for studies assessed by the newer Interim Methods. 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 necessarily 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 RfC or RfD reflects scientific judgment regarding the various types of data used to estimate RfC or 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 or long-term 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 to expand from subchronic to chronic

exposure. 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 RfC or RfD is usually derived, if not previously derived in health effects documents that originally addressed the chemical, for chemicals for which a chronic RfC or RfD is presented in Table A. The subchronic RfC or 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 RfC or RfD, the subchronic RfC or RfD is derived from the same benchmark concentration or dose without application of the uncertainty factor to expand from subchronic to chronic exposure. If, however, the chronic RfC or RfD was derived without use of an uncertainty factor to expand from subchronic to chronic exposure, the chronic RfC or RfD is adopted as the subchronic RfC or 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 oral RfD for bromomethane reflects an uncertainty factor of 100 and a modifying factor of 1.

RfC and 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 RfCs 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 considered in 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 RfC 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 assumed human inhalation rate).

Inhalation 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. These 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 $\text{mg}/\text{kg}/\text{day}$) in the column "Inhalation RfC."

RfD values for oral exposure are reported as mg/kg/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 RfC or RfD is used as a reference point for gauging the potential effects of other exposures. Usually, exposures that are less than the RfD or RfD are not likely to be associated with health risks. As the frequency of exposures exceeding the RfC or 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 exposures below the RfC or RfD as "acceptable" (risk-free) and all exposures in excess of the RfC or RfD as "unacceptable" (causing adverse effects) cannot be made. In addition, RfC and 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 RfC or 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. RfC and 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 ($2 \text{ l}/\text{day}$), respectively, for risk associated with unit concentration in air or water. Hence,

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

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

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:

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

SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Updated: December 1990

Compound	Exposure	Species	Effect of Concern	Inhalation RfC		Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
				mg/m ³	mg/kg/day		Inhalation	Oral	
Acetophenone	subchronic NA; 175 mg/kg/day gavage for 90 days	NA	NA	ND	ND	1E-1	NA	300	U.S. EPA, 1987/ 1989, 1990
	subchronic NA; 175 mg/kg/day gavage for 90 days	NA	NA; hepatotoxicity	ND	ND	1E-2	NA	3000	U.S. EPA, 1987/ 1989, 1990
Data inadequate for quantitative risk assessment									
subchronic	NA; 2 ppm in the diet mg/kg/day	NA	rat	NA; inhibition of brain AcHase	ND	ND	NA	NA	U.S. EPA, 1987; U.S. EPA, 1989, 1990
subchronic	NA; 2 ppm in the diet for 13 weeks (0.125 mg/kg/day)	NA	rat	NA; inhibition of brain (also see Table B)	ND	4E-3 ^a	NA	30	U.S. EPA, 1987; U.S. EPA, 1989
subchronic	NA; 100 mg/kg/day gavage	NA	rat	NA; increased liver and kidney weights, hepatic toxicity	ND	1E-1	NA	NA	U.S. EPA, 1986,
chronic	NA; 100 mg/kg/day gavage	NA	rat	NA; increased liver and kidney weights, hepatic toxicity	ND	1E-1	NA	NA	U.S. EPA, 1986.
Acetone cyanohydrin									
	6 hours/day, 5 days/week 10.8 mg CN/kg/day for 104 weeks from diet treated with HCN	NA	rat	CNS signs; body weight, thyroid and CNS effects	1E-1 (4E-2)	7E-2 ^b	100	500	Blank and Thake, 1988; U.S. EPA, 1988/Howard and Howard, 1990; U.S. EPA, 1990a,b, 1990c
chronic	6 hours/day, 5 days/week 10.8 mg CN/kg/day treated with HCN	NA	rat	thyroid and CNS effects	1E-1	7E-2	100	500	Blank and Thake, 1988/Howard and U.S. EPA,

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

Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Acetonitrile									
subchronic	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 ^b	300	300	Coate, 1983; U.S. EPA, 1987/ Coate, 1983; U.S. EPA, 1987, 1990
chronic	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 hematocrit and hepatic lesions; decreased RBC counts and hematocrit and hepatic lesions	5E-2 (1E-2) ^g	6E-3 ^{b,y}	3000	3000	Coate, 1983; U.S. EPA, 1987/ Coate, 1983; U.S. EPA, 1987, 1990
Acetophenone									
subchronic	0.007 mg/m ³ continuously 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	0.007 mg/m ³ continuously 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 ¹	2E-5 (5E-6) ^{ff}	1E-1 ^a	1000	3000	Imasheva, 1966; U.S. EPA, 1987/ Hagan et al., 1967; U.S. EPA, 1990
Acrolein									
subchronic	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; Kutzman, et al., 1985; U.S. EPA, 1987/ U.S. EPA, 1987
chronic	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 ^j	ND ^p	3000	NA	Costa et al., 1986; Kutzman, 1981; Kutzman, et al., 1985; U.S. EPA, 1987, 1990/U.S. EPA, 1987

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

Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Acrylamide									
subchronic	NA; 0.2 mg/kg/day in the drinking water for 90 days	NA	rat	NA; nerve damage	ND	2E-3	NA	100	NA/Burek et al., 1980; U.S. EPA, 1985; U.S. EPA, 1990
chronic	NA; 0.2 mg/kg/day in the drinking water for 90 days	NA	rat	NA; nerve damage (also see Table B)	ND ^{ff}	2E-4 ^a	NA	1000	NA/Burek et al., 1980; U.S. EPA, 1985; U.S. EPA, 1990
Acrylic acid									
subchronic	0.5 ppm (14.94 mg/m ³) 6 hours/day, 5 days/week, LOAEL _{HEC} =0.33mg/m ³ ; 83 mg/kg/day in the water for 3 months	mouse	rat	lesions of the nasal mucosa; reduced body weight, altered organ weights	3E-3	8E-1	100	100	Miller et al., 1981; U.S. EPA, 1990/DePass et al., 1983; U.S. EPA, 1984, 1990
chronic	0.5 ppm (14.94 mg/m ³) 6 hours/day, 5 days/week, LOAEL _{HEC} =0.33mg/m ³ ; 83 mg/kg/day in the water for 3 months	mouse	rat	lesions of the nasal mucosa; reduced body weight, altered organ weights	3E-4 ^a	8E-2 ^a	1000	1000	Miller et al., 1981; U.S. EPA, 1990/DePass et al., 1983; U.S. EPA, 1984, 1990
Adiponitrile				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹					U.S. EPA, 1987
Alachlor									
subchronic	NA; 1 mg/kg/day by gavage for 1 year	NA	dog	NA; hemolytic anemia, hemosiderosis	ND	1E-2	NA	100	NA/Monsanto Company, 1984; U.S. EPA, 1984; U.S. EPA, 1990
chronic	NA; 1 mg/kg/day by gavage for 1 year	NA	dog	NA; hemolytic anemia, hemosiderosis (also see Table B)	ND	1E-2 ^a	NA	100	NA/Monsanto Company, 1984; U.S. EPA, 1984; U.S. EPA, 1990
Aldicarb									
subchronic	NA; 1 ppm diet for 1 year (0.02 mg/kg/day)	NA	dog	NA; plasma cholinesterase inhibition	ND	7E-5	NA	300	NA/Hazeltan Labs. America, Inc., 1988
chronic	NA; 1 ppm diet for aldicarb sulfoxide in diet for 3-6 months	NA	dog	NA; plasma cholinesterase inhibition ¹	ND	7E-5 ^j	NA	300	NA/Hazeltan Labs. America, Inc., 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 RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Aldrin										
subchronic	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, 1987, 1990
chronic	NA; 0.5 ppm in diet for 2 years (0.025 mg/kg/day)	NA	rat		NA; liver lesions (also see Table B)	ND	3E-5 ^a	NA	1000	NA/Fitzhugh et al., 1964; U.S. EPA, 1987, 1990
Allidochlor					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Allyl alcohol										
subchronic	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	NA/Carpanini et al., 1978; U.S. EPA, 1985, 1990
chronic	NA; 50 ppm in the drinking water for 15 weeks (4.8 mg/kg/day)	NA	rat		NA; liver and kidney	ND	5E-3 ^a	NA	1000	NA/Carpanini et al., 1978; U.S. EPA, 1985, 1990
Allyl chloride (3-chloropropene)										
subchronic	17 mg/m ³ 6 hours/day, 6 days/week for 5 months, NOAELHEC=3.6mg/m ³ ; 17 mg/m ³ 6 hours/day, 6 days/week for 5 months (1.5 mg/kg/day)	rabbit	rabbit		peripheral neurotoxicity; peripheral neurotoxicity	1E-2	5E-3 ^b	300	300	Boquin et al. 1982/Boquin et al., 1982
chronic	17 mg/m ³ 6 hours/day, 6 days/week for 5 months, NOAELHEC=3.6mg/m ³ ; 17 mg/m ³ 6 hours/day, 6 days/week for 5 months (1.5 mg/kg/day)	rabbit	rabbit		peripheral neurotoxicity; peripheral neurotoxicity	1E-3 ^j	5E-2 ^b	3000	3000	Boquin et al. 1982; U.S. EPA, 1990/Boquin et al., 1982
Aluminum					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
Aluminum phosphide										
subchronic	NA; 0.51 mg phosphine/kg fumigated chow for 2 years (0.25 mg phosphine/kg/day) (0.043 mg aluminum phosphine/kg/day)	NA	rat		NA; body weight and clinical parameters	NA	4E-4	NA	100	NA/Hackenburg 1972; 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 0.51 mg phosphine/kg fumigated chow for 2 years (0.25 mg phosphine/kg/day) (0.043 mg aluminum phosphine/kg/day)	NA	rat	NA; body weight and clinical parameters	NA	4E-4 ^a	NA	100	NA/Hackenburg 1972; U.S. EPA, 1990
Ametryn									
subchronic	NA; 10 mg/kg/day, 6 days/week for 13 weeks by gavage	NA	rat	NA; liver	ND	9E-2	NA	100	NA/Ciba-Geigy, 1961; U.S. EPA, 1984, 1990
chronic	NA; 10 mg/kg/day, 6 days/week for 13 weeks by gavage	NA	rat	NA; liver	ND	9E-3 ^a	NA	1000	NA/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	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	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	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
chronic	NA; 3 ppm in diet for 90 days (0.15 mg/kg/day)	NA	rat	NA; increased liver (males) and brain weight (females) ¹	ND	2E-5 ^b	NA	10,000	U.S. EPA, 1989/ Kohn, 1968; U.S. EPA, 1980, 1989
Ammonia									
subchronic	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

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

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	0.36 mg/m ³ continuous; 34 mg/l in drinking water	human	human	odor threshold; taste threshold	0.36 ^{c,8}	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
Aniline subchronic	5 ppm (19 mg/m ³) 6 hours/day 5 days/ week for 20-26 weeks, NOAELHEC=3.4mg/m ³ ; NA	rat, guinea pig, mouse	NA	spleen toxicity; NA	1E-2	ND	300	NA	Oberst et al. 1956; U.S. EPA, 1985, 1990/ U.S. EPA, 1985 1990
chronic	5 ppm (19 mg/m ³) 6 hours/day 5 days/ week for 20-26 weeks, NOAELHEC=3.4mg/m ³ ; NA	rat, guinea pig, mouse	NA	spleen toxicity; NA (see also Table B)	1E-3 ^a	ND	3000	NA	Oberst et al. 1956; U.S. EPA, 1985, 1990/ U.S. EPA, 1985 1990
Anthracene subchronic	NA; 1000 mg/kg/day by gavage for 90 days	NA	mouse	NA; No effects	ND	3E+0	NA	300	NA/U.S. EPA, 1989, 1990
chronic	NA; 1000 mg/kg/day by gavage for 90 days	NA	mouse	NA; No effects ¹	ND	3E-1 ^a	NA	3000	NA/U.S. EPA, 1989, 1990
Antimony subchronic	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day)	NA	rat	cancer ^e ; reduced lifespan, altered blood chemistries	ND	4E-4	NA	1000	U.S. EPA, 1987/ Schroeder et al., 1970; U.S. EPA, 1990
chronic	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day)	NA	rat	cancer ^e ; reduced lifespan, altered blood chemistries	ND	4E-4 ^a	NA	1000	U.S. EPA, 1987/ Schroeder et al., 1970; U.S. EPA, 1985, 1990
Antimony pentoxide subchronic	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 ^e ; reduced lifespan, altered blood chemistries	ND	5E-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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	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 ^e ; reduced lifespan, altered blood chemistries	ND	5E-4 ^f	NA	1000	U.S. EPA, 1987/Schroeder et al., 1970; U.S. EPA, 1985, 1987, 1990
Antimony potassium tartrate									
subchronic	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 ^e ; reduced lifespan, altered blood chemistries	ND	9E-4 ^f	NA	1000	U.S. EPA, 1987/Schroeder et al., 1970; U.S. EPA, 1990
chronic	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 ^e ; reduced lifespan, altered blood chemistries	ND	9E-4 ^f	NA	1000	U.S. EPA, 1987/Schroeder et al., 1970; U.S. EPA, 1987, 1990
Antimony tetroxide									
subchronic	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day, 0.44 mg Sb ₂ O ₄ /kg/day)	NA	rat	cancer ^e ; reduced lifespan, altered blood chemistries	ND	4E-4 ^f	NA	1000	U.S. EPA, 1987/Schroeder et al., 1970; U.S. EPA, 1990
chronic	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day, 0.44 mg Sb ₂ O ₄ /kg/day)	NA	rat	cancer ^e ; reduced lifespan, altered blood chemistries	ND	4E-4 ^f	NA	1000	U.S. EPA, 1987/Schroeder et al., 1970; U.S. EPA, 1985, 1987, 1990
Antimony trioxide									
subchronic	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 ^e ; reduced lifespan, altered blood chemistries	ND	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 RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
chronic	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 ^e ; reduced lifespan, altered blood chemistries	ND	4E-4 ^f	NA	1000	U.S. EPA, 1987/Schroeder et al., 1970; U.S. EPA, 1985, 1987, 1990
Aramite subchronic	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	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 ^g	NA	100	U.S. EPA, 1989/Popper et al., 1960; Oser and Oser, 1962
Arsenic subchronic	NA; 1 µg/kg/day		NA	human	NA; keratosis and hyperpigmentation	ND	1E-3	NA	1	U.S. EPA, 1984/Tseng, 1977
chronic	NA; 1 µg/kg/day		NA	human	NA; keratosis and hyperpigmentation (also see Table B)	ND	1E-3 ^g	NA	1	U.S. EPA, 1984/Tseng, 1977
Atrazine subchronic	NA; 10 ppm in the diet, 2-generation study (0.5 mg/kg/day)		NA	rat	NA; decreased body weight of pups	ND	5E-3	NA	100	NA/Ciba-Geigy, 1987; U.S. EPA, 1984, 1990
chronic	NA; 10 ppm in the diet, 2-generation study (0.5 mg/kg/day)		NA	rat	NA; decreased body weight of pups	ND	5E-3 ^a	NA	100	NA/Ciba-Geigy, 1987; U.S. EPA, 1984, 1990
Barium subchronic	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-3 (1E-3) ^{aa}	5E-2	100	100	Tarasenko et al., 1977; U.S. EPA, 1984/Perry et al., 1983; 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	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) ^{aa}	5E-2 ^{ee}	1000	100	Tarasenko et al., 1977; U.S. EPA, 1984/ Perry et al., 1983; U.S. EPA, 1984, 1985, 1990
Barium cyanide subchronic	NA; 10 ppm barium in drinking water for up to 16 months, equivalent to barium cyanide at 7 mg/kg/day	NA	rat	NA; hypertension	ND	7E-2	NA	100	NA/Perry et al., 1983; U.S. EPA, 1990
chronic	NA; 10 ppm barium in drinking water for up to 16 months, equivalent to barium cyanide at 7 mg/kg/day	NA	rat	NA; hypertension	ND	7E-2 ^y	NA	100	NA/Perry et al., 1983; U.S. EPA, 1990
Benefin subchronic	NA; 25 mg/kg/day in the diet for 1 year	NA	dog	NA; hematological effects	ND	3E-1	NA	100	NA/Eli Lilly Co., 1972; U.S. EPA, 1984, 1990
chronic	NA; 25 mg/kg/day in the diet for 1 year	NA	dog	NA; hematological effects	ND	3E-1 ^a	NA	100	NA/Eli Lilly Co., 1972; U.S. EPA, 1984, 1990
Benzal chloride				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
Benzaldehyde subchronic	NA; 200 mg/kg/day by gavage 5 days/week for 13 weeks	NA	rat	NA; kidney, forestomach	ND	1E+0	NA	100	NA/Kluwe et al., 1983; U.S. EPA, 1985, 1990
chronic	NA; 200 mg/kg/day by gavage 5 days/week for 13 weeks	NA	rat	NA; kidney, forestomach	ND	1E-1 ^a	NA	1000	NA/Kluwe et al., 1983; U.S. EPA, 1985, 1990
Benzaldehyde cyanohydrin				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1988

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Benzidine									
subchronic	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	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	NA; per capita daily dietary intake of benzoic acid equivalent 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	NA; per capita daily dietary intake of benzoic acid equivalent to 312 mg/day	NA	human	NA; irritation, malaise ¹	ND	4E+0 ^a	NA	1	U.S. EPA, 1987/ FASEB, 1973; U.S. EPA, 1987, 1990
Benzyl Alcohol									
subchronic	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
chronic	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	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	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

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
1,1'-Biphenyl									
subchronic	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	NA; 0.1% in the diet for 700 days (50 mg/kg/day)	NA	rat	NA; kidney damage	ND ^{ff}	5E-2 ^a	NA	1000	NA/Ambrose et al., 1960; U.S. EPA, 1984, 1990
Bis(2-chloroisopropyl) ether									
subchronic	NA; 400 ppm in diet for up to 104 weeks (35.8 mg/kg/day)	NA	mouse	NA; decrease in hemoglobin and possible erythrocyte destruction	ND	4E-2	NA	1000	NA/Mitsumori et al., 1979; U.S. EPA, 1990
chronic	NA; 400 ppm in diet for up to 104 weeks (35.8 mg/kg/day)	NA	mouse	NA; decrease in hemoglobin and possible erythrocyte destruction	ND	4E-2 ^a	NA	1000	NA/Mitsumori et al., 1979; U.S. EPA, 1990
Bis(2-ethylhexyl) phthalate									
subchronic	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	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	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
chronic	NA; 0, 1000, 2000 ppm in diet for 103 weeks (1000 ppm=50 mg/kg/day)	NA	rat	NA; reduced body weight	ND	5E-2 ^a	NA	1000	U.S. EPA, 1988/ NTP, 1982; U.S. EPA, 1988, 1990
Boron									
subchronic	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, 1990

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 350 ppm in diet (8.75 mg/kg/day) for 2 years	NA	dog	NA; testicular lesions	ND	9E-2 ^a	NA	100	U.S. EPA, 1987/Weir and Fisher, 1972; U.S. EPA, 1987, 1990
Brominated dibenzo-p-dioxins and dibenzofurans				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹					U.S. EPA, 1985a,b, 1986
Bromoacetone				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986
Bromochloroethanes				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
Bromodichloromethane									
subchronic	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	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	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, 1989/NTP, 1988; U.S. EPA, 1989, 1990
chronic	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, 1989/NTP, 1988; U.S. EPA, 1989, 1990
Bromomethane									
subchronic	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	1.4E-2	300	100	Russo et al., 1984; U.S. EPA, 1990/Danse et al., 1984; U.S. EPA, 1987
chronic	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 ¹	6E-3 ^j	1.4E-3 ^a	3000	1000	Russo et al., 1984; U.S. EPA, 1990/Danse et al., 1984; U.S. EPA, 1986, 1987, 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
4-Bromophenyl phenyl ether				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹					U.S. EPA, 1986
Bromophos									
subchronic	NA; 5 mg/kg/day in the diet for 3 generations	NA	rat	NA; depression of plasma and liver cholinesterase	ND	5E-2	NA	100	NA/Leuschner et al., 1967; U.S. EPA, 1986
chronic	NA; 5 mg/kg/day in the diet for 3 generations	NA	rat	NA; depression of plasma and liver cholinesterase (also see Table B)	ND	5E-3	NA	1000	NA/Leuschner et al., 1967; U.S. EPA, 1986
Bromoxynil									
subchronic	NA; 100 ppm in the diet for 2 years (5 mg/kg/day)	NA	rat	NA; no adverse effects	ND	2E-2	NA	300	NA/Union Carbide, 1982; U.S. EPA, 1984, 1990
chronic	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	NA/Union Carbide, 1982; U.S. EPA, 1984, 1990
Bromoxynil octanoate									
subchronic	NA; 100 ppm in the diet for 2 years (5 mg/kg/day)	NA	rat	NA; no adverse effects	ND	2E-2	NA	300	NA/Union Carbide, 1982 U.S. EPA, 1984, 1990
chronic	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	NA/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 (n-Butanol)									
Subchronic	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	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Butylate									
subchronic	NA; 5 mg/kg/day by gavage for 12 months	NA	dog	NA; liver effects	ND	5E-2	NA	100	NA/Stauffer Chem. Co., 1987; U.S. EPA, 1984, 1990
chronic	NA; 5 mg/kg/day by gavage for 12 months	NA	dog	NA; liver effects	ND	5E-2 ^a	NA	100	NA/Stauffer Chem. Co., 1987; U.S. EPA, 1984, 1989, 1990
Butyl benzyl phthalate									
subchronic	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	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 ¹					U.S. EPA, 1988/
Butyrolactone, gamma				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1988 U.S. EPA, 1984/ U.S. EPA, 1984/
Cacodylic acid									
subchronic	NA; 184 mg/kg cacodylic acid in diet for 90 days (9.2 mg/kg/day)	NA	rat	NA; none	ND	3E-2 ^{bb}	NA	300	U.S. EPA, 1989/ Nees, 1968; U.S. EPA, 1989
chronic	NA; 184 mg/kg cacodylic acid in diet for 90 days (9.2 mg/kg/day)	NA	rat	NA; none	ND	3E-3 ^{g,bb}	NA	3000	U.S. EPA, 1989/ Nees, 1968; U.S. EPA, 1989
Cadmium									
subchronic	NA; NA	NA	NA	cancer; NA	ND	ND ^h	NA	NA	U.S. EPA, 1984/ U.S. EPA, 1984
chronic	NA; NA	NA	human	cancer (see Table B); renal damage	ND ^g	1E-3 (food) ^{a,i} 5E-4 (water)	NA	10	U.S. EPA, 1984/ U.S. EPA, 1980, 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Calcium cyanide									
subchronic	NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (19.1 mg calcium cyanide/kg/day)	NA	rat	NA; weight loss, thyroid effects and myelin degeneration	NA	4E-2 ⁿ	NA	500	NA/Howard and Hanzal, 1955; Philbrick et al., 1979; U.S. EPA, 1990
chronic	NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (19.1 mg calcium cyanide/kg/day)	NA	rat	NA; weight loss, thyroid effects and myelin degeneration	ND	4E-2 ^{a,n}	NA	500	NA/Howard and Hanzal, 1955; Philbrick et al., 1979; U.S. EPA, 1990
Caprolactam									
subchronic	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	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, 1988/ Serota et al., 1984; U.S. EPA, 1988, 1990
Captafol									
subchronic	NA; 2 mg/kg/day in capsules for 12 months	NA	dog	NA; kidney and bladder effects	ND	2E-3	NA	1000	NA/Ortho-Chevron Chemical Co., 1985; U.S. EPA, 1984, 1990
chronic	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	NA/Ortho-Chevron Chemical Co., 1985; U.S. EPA, 1984, 1990
Captan									
subchronic	NA; 12.5 mg/kg/day in the diet (multi-generation)	NA	rat	NA; decreased body weight	ND	1E-1	NA	100	NA/Stauffer Chem. Co., 1982; Chevron Chem. Co., 1982; U.S. EPA, 1984, 1990
chronic	NA; 12.5 mg/kg/day in the diet (multi-generation)	NA	rat	NA; decreased body weight (also see Table B)	ND	1E-1 ^a	NA	100	NA/Stauffer Chem. Co., 1982; Chevron Chem. Co., 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Carbaryl									
subchronic	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	NA/Carpenter et al., 1961; U.S. EPA, 1984, 1990
chronic	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	NA/Carpenter et al., 1961; U.S. EPA, 1984, 1990
Carbofuran									
subchronic	NA; 0.5 mg/kg/day in the diet for 1 year	NA	dog	NA; hematological, testicular and uterine effects	ND	5E-3	NA	100	NA/FMC Corp., 1983; U.S. EPA, 1984, 1990
chronic	NA; 0.5 mg/kg/day in the diet for 1 year	NA	dog	NA; hematological, testicular and uterine effects	ND	5E-3 ^a	NA	100	NA/FMC Corp., 1983; U.S. EPA, 1984, 1990
Carbon disulfide									
subchronic	10 mg/m ³ 8 hours/day during gestation (HEC=10 mg/m ³); 20 ppm (62.3 mg/m ³) during pregnancy and inhalation 6 hours/day before breeding (1.6 m ³ /day breathing rate and 0.5 absorption factor used to calculate dose of 11.0 mg/kg/day)	rat	rabbit	fetal toxicity; fetal toxicity; malformation	1E-2	1E-1	1000	100	Tabacova et al., 1978, 1983; U.S. EPA, 1986/Hardin et al., 1981; U.S.EPA, 1986, 1990
chronic	10 mg/m ³ 8 hours/day during gestation (HEC=10 mg/m ³); 20 ppm (62.3 mg/m ³) inhalation 6 hours/day during pregnancy and before breeding (1.6 m ³ /day breathing rate and 0.5 absorption factor used to calculate dose of 11.0 mg/kg/day)	rat	rabbit	fetal toxicity; fetal toxicity; malformation	1E-2 ^j	1E-1 ^{b,y}	1000	100	Tabacova et al., 1978, 1983; U.S. EPA, 1990/Hardin et al., 1981; 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	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Carbon tetrachloride										
subchronic	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	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	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	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	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
chronic	NA; 1 ppm in diet for 130 weeks (0.045 mg/kg/day)	NA	rat	NA; liver necrosis (also see Table B)	ND ^b	6E-5 ^a	NA	1000		U.S. EPA, 1988/ Velsicol Chemical Corp., 1983; U.S. EPA, 1990
Chlorine cyanide										
subchronic	NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (25.3 mg chlorine cyanide/kg/day)	NA	rat	NA; weight loss, thyroid effects and myelin degeneration	ND	5E-2	NA	500		NA/Howard and Hanzal, 1955; Philbrick et al., 1979; U.S. EPA, 1990
chronic	NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (25.3 mg chlorine cyanide/kg/day)	NA	rat	NA; weight loss, thyroid effects and myelin degeneration	ND	5E-2 ^{a,n}	NA	500		NA/Howard and Hanzal, 1955; Philbrick et al., 1979; 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Chloroacetaldehyde				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ^P					U.S. EPA, 1988
Chloroacetic acid									
subchronic	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	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					U.S. EPA, 1987
3-Chloroaniline				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
4-Chloroaniline (p-Chloroaniline)									
subchronic	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	NA; 250 ppm in diet for 78 weeks (12.5 mg/kg/day)	NA	rat	NA; proliferative lesions of the spleen	ND	4E-3 ^a	NA	3000	U.S. EPA, 1987/ NCI, 1979; U.S. EPA, 1990
Chlorobenzene									
subchronic	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	Dilley, 1977; U.S. EPA, 1989/ Monsanto, 1967; U.S. EPA, 1985, 1989, 1990
chronic	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 ¹	2E-2 (5E-3) ⁸	2E-2 ^a	10,000	1000	Dilley, 1977; U.S. EPA, 1989/ Monsanto, 1967; U.S. EPA, 1985, 1989, 1990
Chlorobenzilate									
subchronic	NA; 5 mg/kg/day in starch suspension by gastric intubation for 13 days during gestation period	NA	rabbit	NA; decreased stool quantity, food consumption and weight gain; hyperirritability	ND	2E-2	NA	300	NA/Ciba-Geigy Corp., 1984a; 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 5 mg/kg/day in starch suspension by gastric intubation for 13 days during gestation period	NA	rabbit	NA; decreased stool quantity, food consumption and weight gain; hyperirritability	ND	2E-2 ^a	NA	300	NA/Ciba-Geigy Corp., 1984a; U.S. EPA, 1990
p-Chlorobenzoic acid									
subchronic	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/ Kieckebusch et al., 1960; U.S. EPA, 1987
chronic	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/ Kieckebusch et al., 1960; U.S. EPA, 1987
4-Chlorobenzotrifluoride									
subchronic	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	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	10 ppm, 6 hours/day, 5 days/week for 2 years (4 mg/kg/day); NA	rat	NA	alopecia, retarded growth; NA	1E-1(4E-2)	2E-2 ^b	100	NA	Du Pont, 1985; U.S. EPA, 1989/ U.S. EPA, 1989
chronic	10 ppm, 6 hours/day, 5 days/week for 2 years (4 mg/kg/day); NA	rat	NA	alopecia, retarded growth; NA	1E-1(4E-2)	2E-2 ^b	100	NA	Du Pont, 1985; U.S. EPA, 1989/ U.S. EPA, 1989
1-Chlorobutane									
subchronic	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	NA; 60 mg/kg, 5 days/week for 103 weeks by gavage (43 mg/kg/day)	NA	rat	NA; mortality, CNS and hematologic effects ¹	ND	4E-1	NA	100	U.S. EPA, 1988/ NTP, 1986; 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
2-Chlorobutane					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹					U.S. EPA, 1988/ U.S. EPA, 1988
Chlorocyclopentadiene					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹					U.S. EPA, 1988
Chlorodibromomethane (see Dibromochloromethane)										
p-Chloro-m-cresol										
subchronic	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	NA; NA	NA	NA		NA; NA	ND	ND	NA	NA	U.S. EPA, 1988/ U.S. EPA, 1988
Chloroform										
subchronic	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	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 ^g	1E-2 ^a	NA	1000	U.S. EPA, 1988/ Heywood et al., 1979; U.S. EPA, 1990
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	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, 1990a,b
chronic	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, 1990a,b
Chloroprene (see 2-Chloro-1,3-butadiene)										

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	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
2-Chloropropane										
subchronic	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	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	NA/Gibson et al., 1974; U.S. EPA, 1990
chronic	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	NA/Gibson et al., 1974; U.S. EPA, 1990
Chlorpyrifos										
subchronic	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	NA/Dow Chemical Co., 1972; U.S. EPA, 1984, 1990
chronic	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	NA/Dow Chemical Co., 1972; U.S. EPA, 1984, 1990
Chlorpyrifos-methyl										
subchronic	NA; 3-generation study in rats, 2-year study in dogs	NA	rat, dog		NA; reduced fertility in rats, liver effects in dogs	ND	1E-2	NA	100	NA/U.S. EPA, 1984
chronic	NA; 3-generation study in rats, 2-year study in dogs	NA	rat, dog		NA; reduced fertility in rats, liver effects in dogs	ND	1E-2 ^g	NA	100	NA/U.S. EPA, 1984
Chlorthalonil										
subchronic	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	NA/Diamond Shamrock Chem. Co., 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	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	NA/Diamond Shamrock Chem. Co., 1970; U.S. EPA, 1990
Chlorthiophos subchronic	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	NA/Worthing and Walker, 1983; U.S. EPA, 1986
chronic	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	NA/Worthing and Walker, 1983; U.S. EPA, 1986
Chromium (III) subchronic	LOAEL: 0.002 mg Cr(VI)/m ³ human (as chromic acid), LOAEL _{HEC} = 0.000714 mg/m ³ ; 5% Cr ₂ O ₃ in diet 5 days/week for 90 days (1400 mg Cr/kg/day)	human	rat	nasal mucosa atrophy; hepatotoxicity	2E-5	1E+1	30	100	Lindberg and Hedenstierna, 1983; U.S. EPA, 1984/Ivankovic and Preussman, 1975; U.S. EPA, 1984
chronic	LOAEL: 0.002 mg Cr(VI)/m ³ human (as chromic acid), LOAEL _{HEC} = 0.000714 mg/m ³ ; 5% Cr ₂ O ₃ in diet 5 days/week for 600 feedings (1468 mg Cr/kg/day)	human	rat	nasal mucosa atrophy; hepatotoxicity	2E-6 ^j	1E+0 ^a	300	1000	Lindberg and Hedenstierna, 1983; U.S. EPA, 1984/Ivankovic and Preussman, 1975; U.S. EPA, 1984, 1990
Chromium (VI) subchronic	LOAEL: 0.002 mg Cr(VI)/m ³ human (as chromic acid), LOAEL _{HEC} = 0.000714 mg/m ³ ; 25 ppm Cr VI in drinking water for 1 year (2.4 mg/kg/day)	human	rat	nasal mucosa atrophy; not defined	2E-5	2E-2	30	100	Lindberg and Hedenstierna, 1983; U.S. EPA, 1984/MacKenzie et al., 1958; U.S. EPA, 1984
chronic	LOAEL: 0.002 mg Cr(VI)/m ³ human (as chromic acid), LOAEL _{HEC} = 0.000714 mg/m ³ ; 25 ppm Cr VI in drinking water for 1 year (2.4 mg/kg/day)	human	rat	nasal mucosa atrophy; not defined	2E-6 ^j	5E-3 ^a	300	500	Lindberg and Hedenstierna, 1983; U.S. EPA, 1984/MacKenzie et al., 1958; 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Chrysene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (see Table B)					U.S. EPA, 1984
Copper									
subchronic	NA; 5.3 mg, single dose	NA	human	NA; local GI irritation	ND	1.3 mg/ℓ ^k	NA	NA	U.S. EPA, 1984/ U.S. EPA, 1987
chronic	NA; NA	NA	human	NA; local GI irritation ¹	ND	1.3 mg/ℓ ^k	NA	NA	U.S. EPA, 1984/ U.S. EPA, 1987
Copper cyanide									
subchronic	NA; 5 mg/kg/day by gavage for 90 days	NA	rat	NA; decreased body and organ weights, histopathologic alterations in liver and kidney	ND	5E-2	NA	100	NA/U.S. EPA, 1986, 1990
chronic	NA; 5 mg/kg/day by gavage for 90 days	NA	rat	NA; decreased body and organ weights, histopathologic alterations in liver and kidney	ND	5E-3 ^a	NA	1000	NA/U.S. EPA, 1986, 1990
m-Cresol									
subchronic	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neurotoxicity	ND	5E-1	NA	100	U.S. EPA, 1984/ Microbiological Associates, 1986; Toxicity Research Laboratories, 1987; U.S. EPA, 1985, 1990
chronic	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neurotoxicity (also see Table B)	ND	5E-2 ^a	NA	1000	U.S. EPA, 1984/ Microbiological Associates, 1986; Toxicity Research Laboratories, 1987; U.S. EPA, 1985, 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 RfC	Oral RfD	Uncertainty Factor		Reference	
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral	
o-Cresol	subchronic	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neurotoxicity	ND	5E-1	NA	100	U.S. EPA, 1984/ Microbiological Associates, 1986; Toxicity Research Laboratories, 1987; U.S. EPA, 1985, 1990
	chronic	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neurotoxicity (also see Table B)	ND	5E-2 ^a	NA	1000	U.S. EPA, 1984/ Microbiological Associates, 1986; Toxicity Research Laboratories, 1987; U.S. EPA, 1985, 1990
p-Cresol	subchronic	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neurotoxicity	ND	5E-1	NA	100	U.S. EPA, 1984/ Microbiological Associates, 1986; Toxicity Research Laboratories, 1987; U.S. EPA, 1985, 1990
	chronic	NA; 50 mg/kg/day for 90 days	NA	rat	NA; reduced body weight gain, neurotoxicity (also see Table B)	ND	5E-2 ^a	NA	1000	U.S. EPA, 1984/ Microbiological Associates, 1986; Toxicity Research Laboratories, 1987; U.S. EPA, 1985, 1990
Cumene	subchronic	105.1 ppm (517 mg/m ³) for 6 hrs/day, 5 days/week for 4 weeks, LOAEL _{HEC} =92mg/m ³ ; 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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	105.1 ppm (517 mg/m ³) for 6 hrs/day, 5 days/week for 4 weeks, LOAEL _{HEC} =92mg/m ³ ; 110 mg/kg for 194 days	rat	rat	CNS involvement, nasal irritation; renal	9E-3 ^j	4E-2 ^a	10,000	3000	Monsanto Company 1986; U.S. EPA, 1987, 1990/Wolfe et al., 1956; U.S. EPA, 1987, 1990
Cyanazine subchronic	NA; 25 ppm in the diet for 1 year (0.625 g/kg/day)	NA	dog	NA; body weight loss, hematologic and clinical chemistry parameters	ND	2E-3	NA	300	NA/Shell Chem. Co., 1986; U.S. EPA, 1984, 1990
chronic	NA; 25 ppm in the diet for 1 year (0.625 g/kg/day)	NA	dog	NA; body weight loss, hematologic and clinical chemistry parameters	ND	2E-3 ^a	NA	300	NA/Shell Chem. Co., 1986; U.S. EPA, 1984, 1990
Cyanide subchronic	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, 1990a,b
chronic	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, 1990a,b
Cyanogen subchronic	NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (21.6 mg Cyanogen/kg/day)	NA	rat	NA; weight loss, thyroid effects myelin degeneration	ND	4E-2 ⁿ	NA	500	NA/Howard and Hanzal, 1955; Philbrick et al., 1979; U.S. EPA, 1990
chronic	NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (21.6 mg Cyanogen/kg/day)	NA	rat	NA; weight loss, thyroid effects myelin degeneration	ND	4E-2 ^{a,n}	NA	500	NA/Howard and Hanzal, 1955; Philbrick et al., 1979; 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	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Cyanogen bromide										
subchronic	NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (4.4 mg Cyanogen bromide/kg/day)	NA	rat		NA; weight loss, thyroid effects myelin degeneration	ND	9E-2 ⁿ	NA	500	NA/Howard and Hanzal, 1955; Philbrick et al., 1979; U.S. EPA, 1990
chronic	NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (4.4 mg cyanogen bromide/kg/day)	NA	rat		NA; weight loss, thyroid effects myelin degeneration	NA	9E-2 ^{a,n}	NA	500	NA/Howard and Hanzal, 1955; Philbrick et al., 1979; U.S. EPA, 1990
Cycloate					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ⁸					U.S. EPA, 1984
Cyclohexanol					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
Cyclohexylamine										
subchronic	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	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
chronic	NA; NA	NA	NA		NA; NA	ND	ND	NA	NA	U.S. EPA, 1987/ U.S. EPA, 1987
Dacthal (DCPA)										
subchronic	NA; 1000 ppm in the in the diet for 2 years (50 mg/kg/day)	NA	rat		NA; kidney and adrenal weights	ND	5E-1	NA	100	NA/Diamond Shamrock Co., 1963; U.S. EPA, 1984, 1990
chronic	NA; 1000 ppm in the in the diet for 2 years (50 mg/kg/day)	NA	rat		NA; kidney and adrenal weights	ND	5E-1 ^a	NA	100	NA/Diamond Shamrock Co., 1963; 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 RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation;	Oral	Inhalation	Oral				Inhalation	Oral	
Dalapon (sodium salt)										
subchronic	NA; 15 mg/kg/day in the diet for 2 years		NA	rat	NA; increased relative kidney weight	ND	3E-2	NA	300	NA/Paynter et al., 1960; U.S. EPA, 1984, 1990
chronic	NA; 15 mg/kg/day in the diet for 2 years		NA	rat	NA; increased relative kidney weight	ND	3E-2 ^a	NA	300	NA/Paynter et al., 1960; U.S. EPA, 1984, 1990
2,4-DB										
subchronic	NA; 8 mg/kg/day in the diet for 90 days		NA	dog	NA; internal hemorrhage, mortality	ND	8E-2	NA	100	NA/Rhodia Inc., 1969; U.S. EPA, 1984, 1990
chronic	NA; 8 mg/kg/day in the diet for 90 days		NA	dog	NA; internal hemorrhage, mortality	ND	8E-3 ^a	NA	1000	NA/Rhodia Inc., 1969; U.S. EPA, 1984, 1990
DDT										
subchronic	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	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	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; Norris et al., 1973, 1975; U.S. EPA, 1987; U.S. EPA, 1990
chronic	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; Norris 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)
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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Diazinon									
subchronic	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	NA/Davies and Holub, 1979, 1980a,b; U.S. EPA, 1984
chronic	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 ^b	NA	100	NA/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	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	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	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	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
Di-n-butyl phthalate									
subchronic	NA; 0.25% of diet for 52 weeks (125 mg/kg/day) (89 mg/kg/day)	NA	rat	NA; mortality	ND	1E+0	NA	100	U.S. EPA, 1987/Smith, 1953; U.S. EPA, 1987

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Compound	Exposure		Species		Effect of Concern		Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral	Inhalation; Oral		[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 0.25% of diet for 52 weeks (125 mg/kg/day)		NA	rat	NA; mortality ¹		ND ^{8g}	1E-1 ^y	NA	1000	U.S. EPA, 1987/Smith, 1953; U.S. EPA, 1987 1990
1,2-Dichlorobenzene											
subchronic	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		rat	rat	decreased body weight gain; liver effects		2E+0 (4E-1)	9E-1	100	100	Hollingsworth et al., 1958; U.S. EPA, 1987/NTP, 1985; U.S. EPA, 1987, 1990
chronic	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 ¹		2E-1 (4E-2)	9E-2 ^a	1000	1000	Hollingsworth et al., 1958; U.S. EPA, 1987/NTP, 1985; U.S. EPA, 1987, 1990
1,3-Dichlorobenzene					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹						U.S. EPA, 1987
1,4-Dichlorobenzene (p-dichlorobenzene)											
subchronic	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	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 ^j	ND	100	NA	Riley et al., 1980; U.S. EPA, 1990/U.S. EPA, 1987
Dichlorobutenes					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (CANCER: SEE TABLE B)						U.S. EPA, 1987
Dichlorodifluoromethane (F-12)											
subchronic	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	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

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Compound	Exposure		Species		Effect of Concern Inhalation; Oral	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
1,1-Dichloroethane										
subchronic	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	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	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) ^g	1E-1 ^g	1000	1000		Hofmann et al., 1971; U.S. EPA, 1984/Hofmann et al., 1971; U.S. EPA, 1983, 1984
1,1-Dichloroethylene										
subchronic	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, 1988/ Quast et al., 1983; U.S. EPA, 1988, 1990
chronic	NA; 50 ppm in drinking water for 2 years (9 mg/kg/day)	NA	rat	NA; liver lesions (also see Table B)	ND ^g	9E-3 ^y	NA	1000		U.S. EPA, 1988/ Quast et al., 1983; U.S. EPA, 1988, 1990
1,2-c-Dichloroethylene										
subchronic	NA; gavage for 90 days (32 mg/kg/day)	NA	rat	NA; decreased hemato- crit and hemoglobin	ND	1E-1	NA	300		U.S. EPA, 1984/ McCauley et al., n.d.; U.S. EPA, 1984, 1990
chronic	NA; gavage for 90 days (32 mg/kg/day)	NA	rat	NA; decreased hemato- crit and hemoglobin ¹	ND	1E-2 ^j	NA	3000		U.S. EPA, 1984/ McCauley et al., n.d.; U.S. EPA, 1984, 1990
1,2-t-Dichloroethylene										
subchronic	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	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

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Compound	Exposure		Species		Effect of Concern	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
2,4-Dichlorophenol										
subchronic	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, 1987/ Exon and Koller, 1985; U.S. EPA, 1987, 1990
chronic	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, 1987/ Exon and Koller, 1985; U.S. EPA, 1986, 1987, 1990
Dichlorophenol, 2,3-, 2,5-, 2,6P-, 3,4- and 3,5-					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
2,4-Dichlorophenoxy acetic acid (2,4-D)										
subchronic	NA; 1.0 mg/kg/day in diet for 91 days	NA	rat		NA; hematologic hepatic and renal toxicity	ND	1E-2	NA	100	NA/Dow Chemical Co., 1983; U.S. EPA, 1990
chronic	NA; 1.0 mg/kg/day in diet for 91 days	NA	rat		NA; hematologic hepatic and renal toxicity	ND	1E-2 ^y	NA	100	NA/Dow Chemical Co., 1983; U.S. EPA, 1990
Dichloroprop					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ⁸					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 (Telone II)										
subchronic	5 ppm (21 mg/m ³) 6 hours/ day, 5 days/week for 2 years, NOAELHEC= 0.69 mg/m ³ ; 3 mg/kg/day in the diet for 90 days	mice	rat		hypertrophy, hyperplasia in nasal mucosa; increased organ weight	2E-2	3E-3	30	1000	Lomax et al., 1989; U.S. EPA, 1990/Dow Chemical Co., 1973; U.S. EPA 1989, 1990
chronic	5 ppm (21 mg/m ³) 6 hours/ day, 5 days/week for 2 years, NOAELHEC= 0.69 mg/m ³ ; 3 mg/kg/day in the diet for 90 days	mice	rat		hypertrophy, hyperplasia in nasal mucosa; increased organ weights (also see Table B)	2E-2 ^j	3E-4 ^a	30	10,000	Lomax et al., 1989; U.S. EPA 1990/Dow Chemical Co., 1973; U.S. EPA 1989, 1990

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Dicyclopentadiene									
subchronic	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	kidney 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	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	kidney 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	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	NA; 0.1 ppm in diet for 2 years (0.005 mg/kg/day)	NA	rat	NA; liver lesions (Cancer: see Table B)	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	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
chronic	NA; 0.2% in drinking water (200 mg/kg/day) for 2 years	NA	rat	NA; kidney histo- pathology	ND	2E+0	NA	100	U.S. EPA, 1984/ Smyth et al., 1964; U.S. EPA, 1984
Diethylformamide									
subchronic	NA; 546 µg/day (1.56 mg/kg/day) in diet x 5 days/week for 73 weeks	NA	rat	NA; no effect	ND	1.1E-1	NA	100	NA/Argus et al., 1965; U.S. EPA, 1986
chronic	NA; 546 µg/day (1.56 mg/kg/day) in diet x 5 days/week for 73 weeks	NA	rat	NA; no effect	ND	1.1E-1	NA	100	NA/Argus et al., 1965; 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral	Inhalation; Oral		[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
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	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	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	NA; 1 ppm (0.05 mg/kg/day) in diet for 2 years	NA	rat		NA; brain cholinesterase inhibition		ND	2E-4	NA	300	NA/American Cyanimid Co., 1986; U.S. EPA, 1990
chronic	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	NA/American Cyanimid Co., 1986; U.S. EPA, 1990
N,N-Dimethylaniline											
subchronic	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	NA/Abdo et al., 1984; U.S. EPA, 1990
chronic	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	NA/Abdo et al., 1984; U.S. EPA, 1990
N,N-Dimethylformamide											
subchronic	LOAEL: occupational exposure to 22 mg/m ³ (HEC=7.9 mg/m ³); 540 ppm (96 mg/kg/day) in diet for 119 days	human	mouse		liver effects; increased liver weight		3E-2	1E+0	300	100	Cirla et al., 1984; Catenacci et al., 1984; U.S. EPA, 1990/ Becci et al., 1983; 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	LOAEL: occupational exposure to 22 mg/m ³ (HEC=7.9 mg/m ³); 540 ppm (96 mg/kg/day) in diet for 119 days	human	mouse	liver effects; increased liver weight	3E-2 ^a	1E-1	300	1000	Cirla et al., 1984; Catenacci et al., 1984; U.S. EPA, 1990/Becci et al., 1983; U.S. EPA, 1986
Dimethylphenols (2,3-, 2,5-)		DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT							U.S. EPA, 1986
2,4-Dimethylphenol									
subchronic	NA; 50 mg/kg/day by gavage for 90 days	NA	mouse	NA; neurological signs and hematological changes	ND	2E-1	NA	300	NA/American Biogenics, 1989; U.S. EPA, 1990
chronic	NA; 50 mg/kg/day by gavage for 90 days	NA	mouse	NA; neurological signs and hematological changes	ND	2E-2 ^a	NA	3000	NA/American Biogenics, 1989; U.S. EPA, 1990
2,6-Dimethylphenol									
subchronic	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
chronic	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-4 ^a	NA	1000	U.S. EPA, 1987/Veldre and Janes, 1979; U.S. EPA, 1987, 1990
3,4-Dimethylphenol									
subchronic	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	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

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	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Dimethyl phthalate										
subchronic	NA; 1000 mg/kg/day in diet for 2 years	NA	rat		NA; minor effect on growth; some nephri- tic involvement	ND	1E+0	NA	100	NA/Lehman, 1955; U.S. EPA, 1987
chronic	NA; 1000 mg/kg/day in diet for 2 years	NA	rat		NA; minor effect on growth; some nephri- tic involvement ¹	ND ⁸⁸	1E+0 ⁸	NA	100	NA/Lehman, 1955; U.S. EPA, 1987
Dimethyl terephthalate										
subchronic	NA; 2500 ppm (125 mg/kg/day) in diet for 103 weeks	NA	rat		NA; chronic kidney inflammation	ND	1E-1	NA	1000	NA/NCI, 1979; U.S. EPA, 1990
chronic	NA; 2500 ppm (125 mg/kg/day) in diet for 103 weeks	NA	rat		NA; chronic kidney inflammation	ND	1E-1 ^a	NA	1000	NA/NCI, 1979; U.S. EPA, 1990
N,N-Dimethylurea					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
m-Dinitrobenzene										
subchronic	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	NA/Cody et al., 1981; U.S. EPA, 1990
chronic	NA; 3 ppm (0.40 mg/kg/ day) in drinking water for 16 weeks	NA	rat		NA; increased splenic weight ¹	ND	1E-4 ^a	NA	3000	NA/Cody et al., 1981; U.S. EPA, 1990
Dinitrobenzenes (o-, p-)										
subchronic	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	NA/Cody et al., 1981; U.S. EPA, 1985
chronic	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	NA/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 ^P					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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
2,4-Dinitrophenol									
subchronic	NA; 2 mg/kg/day, therapeutic use	NA	human	NA; cataract	ND	2E-3	NA	1000	NA/Horner, 1942; U.S. EPA, 1984, 1990
chronic	NA; 2 mg/kg/day, therapeutic use	NA	human	NA; cataract	ND	2E-3 ^a	NA	1000	NA/Horner, 1942; U.S. EPA, 1984, 1990
Dinitrophenols (2,3-; 2,5-; 2,6-; 3,5-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Dinitrotoluenes (2,3-; 2,4- ⁸⁸ ; 2,5-; 2,6-; 3,4-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (Cancer: see Table B)					U.S. EPA, 1986
Di-n-octyl phthalate									
subchronic	NA; 175 mg/kg/day in diet for 7-12 months	NA	rat	NA; elevated kidney and liver weights; increased SGOT and SGPT	ND	2E-2	NA	1000	NA/Piekacz, 1971; U.S. EPA, 1987
chronic	NA; 175 mg/kg/day in diet for 7-12 months	NA	rat	NA; elevated kidney and liver weights; increased SGOT and SGPT	ND	2E-2 ⁸	NA	1000	NA/Piekacz, 1971; U.S. EPA, 1987
Dinoseb									
subchronic	NA; 1 mg/kg/day in diet in 3-generation study	NA	rat	NA; decreased fetal weight	ND	1E-3 ^{aa}	NA	1000	NA/Uniroyal and Cedar Chemical Cos., 1981; U.S. EPA, 1990
chronic	NA; 1 mg/kg/day in diet in 3-generation study	NA	rat	NA; decreased fetal weight ¹	ND	1E-3 ^{a, aa}	NA	1000	NA/Uniroyal and Cedar Chemical Cos., 1981; U.S. EPA, 1990
N,N-Diphenylamine									
subchronic	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	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 ^a	NA	100	U.S. EPA, 1985/Thomas et al., 1967; U.S. EPA, 1990
Direct Lightfast Blue				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Disulfoton									
subchronic	NA; 0.8 ppm in diet for 2 years (0.04 mg/kg/day)	NA	rat	NA; cholinesterase inhibition, optic nerve degeneration	ND	4E-5	NA	1000	U.S. EPA, 1990a/Mobay chemical, 1985; U.S. EPA, 1990a,b
chronic	NA; 0.8 ppm in diet for 2 years (0.04 mg/kg/day)	NA	rat	NA; cholinesterase inhibition, optic nerve degeneration	ND	4E-5 ^a	NA	1000	U.S. EPA, 1990a/Mobay chemical, 1985; U.S. EPA, 1990a,b
Endosulfan									
subchronic	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
chronic	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	NA; 100 ppm disodium endothall in the diet for 2 years (2 mg endothall ion/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	NA; 100 ppm disodium endothall in the diet for 2 years (2 mg endothall ion/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
Endrin									
subchronic	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

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 1 ppm in diet for >2 years (0.025 mg/kg/day)	NA	dog	NA; convulsions and liver lesions ¹	ND	3E-4 ^a	NA	100	U.S. EPA, 1987/ CBI; U.S. EPA, 1985, 1987, 1990
Epichlorohydrin									
subchronic	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 ^b	100	100	Quast et al., 1979; U.S. EPA, 1990/Laskin et al., 1980; U.S. EPA, 1990
chronic	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; U.S. EPA, 1990/Laskin et al., 1980; U.S. EPA, 1990
EPTC (see S-Ethyl dipropylthiocarbamate)									
Ethoprop				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
2-Ethoxyethanol									
subchronic	10 ppm (37 mg/m ³) 6 hours/day on days 6-15 of gestation (6.8 mg/kg/ day); 50 µl (46.6 mg/kg/ day) on days 1-21 of gestation	rat	rat	fetotoxicity; fetotoxicity	2E-1 (7E-2) ^{aa}	5E-1 ^{aa}	100	100	Doe, 1984; U.S. EPA, 1984/ Stenger et al., 1971; U.S. EPA, 1984
chronic	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	2E-1 (5E-2) ^j	4E-1	1000	1000	Barbee et al., 1984; U.S. EPA, 1984/Melnick, 1984; U.S. EPA, 1985, 1990
2-Ethoxyethanol acetate									
subchronic	NA; 50 ppm (30.1 mg/kg) x 6 hours/day on gesta- tional day 6-18	NA	rat	NA; decreased ossification	ND	3E-1 ^{b,aa}	NA	100	NA/Union Carbide, 1984; U.S. EPA, 1985

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 50 ppm (30.1 mg/kg) x 6 hours/day on gestational day 6-18	NA	rat	NA; decreased ossification	ND ^g	3E-1 ^{b,aa}	NA	100	NA/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	NA; 900 mg/kg/day by gavage for 90 days	NA	rat	NA; mortality, body weight loss	ND	9E+0	NA	100	NA/U.S. EPA, 1986a,b, 1990
chronic	NA; 900 mg/kg/day by gavage for 90 days	NA	rat	NA; mortality, body weight loss	ND	9E-1 ^a	NA	1000	NA/U.S. EPA, 1986a,b, 1990
n-Ethylaniline				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986
Ethylbenzene subchronic	100 ppm (434 mg/m ³) 6-7 hours/day on gestation days 1-19 (rats) or 1-24 (rabbits), NOAEL _{HEC} =434mg/m ³ ; 136 mg/kg 5 days/week for 182 days (97.1 mg/kg/day)	rat, rabbit	rat	developmental toxicity; hepatotoxicity and nephrotoxicity	1E+0 ^{aa}	1E+0	300	100	Andrew et al., 1981; Hardin et al., 1981/ Wolf et al., 1956; U.S. EPA, 1984, 1986, 1990
chronic	100 ppm (434 mg/m ³) 6-7 hours/day on gestation days 1-19 (rats) or 1-24 (rabbits), NOAEL _{HEC} =434mg/m ³ ; 136 mg/kg 5 days/week for 182 days (97.1 mg/kg/day)	rat, rabbit	rat	developmental toxicity; hepatotoxicity and nephrotoxicity ¹	1E+0 ^{j,aa}	1E-1 ^a	300	1000	Andrew et al., 1981; Hardin et al., 1981; U.S. EPA, 1990/ Wolf et al., 1956; U.S. EPA, 1984, 1986, 1990
Ethyl chloride subchronic	1504 ppm (4000 mg/m ³) 6 hours/day on gestation days 6-15, NOAEL _{HEC} =4000 mg/m ³ ; NA	rat	NA	developmental toxicity; NA	1E+1 ^{aa}	ND	300	NA	Scortichini et al., 1986/NA
chronic	1504 ppm (4000 mg/m ³) 6 hours/day on gestation days 6-15, NOAEL _{HEC} =4000 mg/m ³ ; NA	rat	NA	developmental toxicity; NA	1E+1 ^{j,aa}	ND	300	NA	Scortichini et al., 1986; U.S. EPA, 1990/ NA

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
S-Ethyl dipropylthiocarbamate (EPTC)									
subchronic	NA; 50 ppm in diet for 2 generations (2.5 mg/kg/day)	NA	rat	NA; degenerative cardiomyopathy	ND	2.5E-2	NA	100	NA/PPG Industries, 1986; U.S. EPA, 1984, 1990
chronic	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	NA/PPG Industries, 1986; U.S. EPA, 1984, 1990
Ethylene cyanohydrin									
subchronic	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	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	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
chronic	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	NA; 200 mg/kg/day in developmental toxicity	NA	rat	NA; fetotoxicity	ND	2E+0 ^{aa}	NA	100	U.S. EPA, 1987/Maronpot et al., 1983; U.S. EPA, 1987

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	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, 1987, 1990
Ethylene glycol monobutyl ether									
subchronic	25 ppm (121 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (HEC=22 mg/m ³); NA	rat	NA	altered hematology; NA	2E-1	ND	100	NA	Dodd et al., 1983; U.S. EPA, 1990/U.S. EPA, 1984
chronic	25 ppm (121 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (HEC=22 mg/m ³); NA	rat	NA	altered hematology; NA	2E-2 ^j	ND	1000	NA	Dodd et al., 1983; U.S. EPA, 1990/U.S. EPA, 1990
Ethylene thiourea				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ⁸ (also see Table B)					U.S. EPA, 1984
Ethyl ether									
subchronic	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
chronic	NA; 500 mg/kg/day for 90 days	NA	rat	NA; liver effects	ND	5E-1 ^a	NA	1000	U.S. EPA, 1987/American Biogenics Corp., 1986; U.S. EPA, 1987, 1990
Ethyl methacrylate									
subchronic	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	NA/Borzelleca et al., 1964; U.S. EPA, 1986
chronic	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 ⁸	NA	100	NA/Borzelleca et al., 1964; U.S. EPA, 1986
Ethyl toluene (o-, p-, m-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
4-Ethyl-o-xylene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Fluoranthene									
subchronic	NA; 125 mg/kg/day by gavage for 90 days	NA	mouse	NA; nephropathy, liver weight changes, hematological changes	ND	4E-1	NA	300	NA/U.S. EPA, 1988
chronic	NA; 125 mg/kg/day by gavage for 90 days	NA	mouse	NA; nephropathy, liver weight changes, hematological changes ¹	ND	4E-2 ^a	NA	3000	NA/U.S. EPA, 1988, 1990
Fluorene									
subchronic	NA; 125 mg/kg/day by gavage for 13 weeks	NA	mouse	NA; hematological changes (decreased RBC)	ND	4E-1	NA	300	NA/U.S. EPA, 1989
chronic	NA; 125 mg/kg/day by gavage for 13 weeks	NA	mouse	NA; hematological changes (decreased RBC) ¹	ND	4E-2 ^a	NA	3000	NA/U.S. EPA, 1989, 1990
Fluorides									
subchronic	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	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	NA; 200 ppm in the diet for 2 years (8 mg/kg/day)	NA	rat	NA; kidney and testes	ND	8E-2	NA	100	NA/Eli Lilly and Co., 1980; U.S. EPA, 1984, 1990
chronic	NA; 200 ppm in the diet for 2 years (8 mg/kg/day)	NA	rat	NA; kidney and testes	ND	8E-2 ^a	NA	100	NA/Eli Lilly and Co., 1980; U.S. EPA, 1984, 1990
Folpet									
subchronic	NA; 10 mg/kg/day in capsules for 1 year	NA	dog	NA; body weight gain, blood chemistry	ND	1E-1	NA	100	NA/Chevron Chemical Corp., 1986; U.S. EPA, 1984, 1990

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	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	NA/Chevron Chemical Corp., 1986; U.S. EPA, 1984, 1990
Formaldehyde cyanohydrin				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1988
Formic acid subchronic	NA; 0.2% in drinking water (200 mg/kg/day), several generation study	NA	rat	NA; decreased growth	ND	2E+0	NA	100	NA/Malorny, 1969; U.S. EPA, 1990a,b
chronic	NA; 0.2% in drinking water (200 mg/kg/day), several generation study	NA	rat	NA; decreased growth	ND	2E+0 ^x	NA	100	NA/Malorny, 1969; U.S. EPA, 1990a,b
Furan subchronic	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	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	20 ppm (77 mg/m ³), 6 hours/day, 5 days/week for 13 weeks (13 mg/kg/day); 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	20 ppm (77 mg/m ³), 6 hours/day, 5 days/week for 13 weeks (13 mg/kg/day); 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	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	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	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
chronic	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
Hexabromobenzene subchronic	NA; 40 ppm in the diet for 12 weeks (2 mg/kg/day)	NA	rat	NA; induced carboxyl-esterase activity	ND	2E-2	NA	100	NA/Mendoza et al., 1977; U.S. EPA, 1984, 1990
chronic	NA; 40 ppm in the diet for 12 weeks (2 mg/kg/day)	NA	rat	NA; induced carboxyl-esterase activity	ND	2E-3 ^a	NA	1000	NA/Mendoza et al., 1977; U.S. EPA, 1984, 1990
Hexachlorobenzene subchronic	NA; 1.6 ppm in diet for 130 weeks (0.08 mg/kg/day)	NA	rat	NA; liver and hematology effects	ND	8E-4	NA	100	U.S. EPA, 1984/Arnold et al., 1985; U.S. EPA, 1990
chronic	NA; 1.6 ppm in diet for 130 weeks (0.08 mg/kg/day)	NA	rat	NA; liver and hematology effects (also see Table B)	ND ⁸⁸	8E-4 ^a	NA	100	U.S. EPA, 1984/Arnold et al., 1985; U.S. EPA, 1990
Hexachlorobutadiene subchronic	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	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
Hexachlorocyclohexane, delta and epsilon				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹					U.S. EPA, 1987
Hexachlorocyclohexane, gamma (Lindane)									
subchronic	NA; 4 ppm in diet for 12 weeks (0.33 mg/kg/day)	NA	rat	NA; liver and kidney toxicity	ND	3E-3	NA	100	U.S. EPA, 1984/ Zoecon Corp., 1983; U.S. EPA, 1990
chronic	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	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; forestomach lesions ¹	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	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; forestomach lesions	7E-5 (2E-5)	7E-3 ^a	1000	1000	Battelle Northwest Laboratories, 1984; U.S. EPA, 1984/SRI, 1981; Abdo et al., 1984; U.S. EPA, 1990
Hexachloroethane									
subchronic	NA; 16-week dietary study (1 mg/kg/day)	NA	rat	NA; kidney degeneration	ND	1E-2	NA	100	U.S. EPA, 1987/ Gorzinski et al., 1985; U.S. EPA, 1989, 1990
chronic	NA; 16-week dietary study (1 mg/kg/day)	NA	rat	NA; kidney degeneration (also see Table B)	ND	1E-3 ^a	NA	1000	U.S. EPA, 1987/ Gorzinski et al., 1985; U.S. EPA, 1989, 1990

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Hexachlorophene									
subchronic	NA; 30 ppm in the diet for 13 weeks (0.75 mg/kg/day)	NA	dog	NA; nervous system effects	ND	3E-3	NA	300	NA/Nationwide Chem. Corp., 1974; U.S. EPA, 1986, 1990
chronic	NA; 30 ppm in the diet for 13 weeks (0.75 mg/kg/day)	NA	dog	NA; nervous system effects	ND	3E-4 ^a	NA	3000	NA/Nationwide Chem. Corp., 1974; U.S. EPA, 1986, 1990
Hexamethylenediamine				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
N-Hexane									
subchronic	73 mg/m ³ TWA for 1-12 years (occupational); 570 mg/kg/day	human	rat	neurotoxicity; neuropathy or testicular atrophy	2E-1	6E-1	300	1000	Sanagi et al., 1980; U.S. EPA, 1990/Krasavage et al., 1980; U.S. EPA, 1989
chronic	73 mg/m ³ TWA for 1-12 years (occupational); 570 mg/kg/day	human	rat	neurotoxicity; neuropathy or testicular atrophy	2E-1 ^a	6E-2	300	10,000	Sanagi et al., 1980; U.S. EPA, 1990/Krasavage et al., 1980; U.S. EPA, 1989
2-Hexanone				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1990
Hydrogen sulfide									
subchronic	30 ppm (42 mg/m ³) 6 hours/day, 5 days/week for 90 days; 3.1 mg/kg/day in dried greens for 105 days	mice	pig	inflammation of nasal mucosa; GI disturbance	9E-3	3E-2	100	100	CIIT, 1983; U.S. EPA, 1990b/Watterau et al., 1964, 1965; U.S. EPA, 1990a,b
chronic	30 ppm (42 mg/m ³) 6 hours/day, 5 days/week for 90 days; 3.1 mg/kg/day in dried greens for 105 days	mice	pig	inflammation of nasal mucosa; GI disturbance	9E-4 ^a	3E-3 ^a	1000	1000	CIIT, 1983; U.S. EPA, 1990b/Watterau et al., 1964, 1965; U.S. EPA, 1990a,b
p-Hydroquinone									
subchronic	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

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 300 mg/day for 3-5 months (4.29 mg/kg/day)	NA	human	NA; hematological effects	ND ^{gg}	4E-2	NA	100	U.S. EPA, 1987/ Carlson and Brewer, 1953; U.S. EPA, 1987
Iron				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Isobutyl alcohol subchronic	NA; 316 mg/kg/day in the diet for 13 weeks	NA	rat	NA; hypoactivity and ataxia	ND	3E+0	NA	100	NA/U.S. EPA, 1986a,b, 1990
chronic	NA; 316 mg/kg/day in the diet for 13 weeks	NA	rat	NA; hypoactivity and ataxia	ND	3E-1 ^a	NA	1000	NA/U.S. EPA, 1986a,b, 1990
Isophorone subchronic	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	NA; 90-day oral (capsules) study (150 mg/kg/day)	NA	dog	NA; kidney lesions (Cancer: see Table B)	ND ^{ff}	2E-1 ^a	NA	1000	U.S. EPA, 1987/ Rohm and Haas, 1972; NTP, 1986; U.S. EPA, 1990
Isopropalin subchronic	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	NA/Eli Lilly Co., 1985; U.S. EPA, 1984, 1990
chronic	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	NA/Eli Lilly Co., 1985; U.S. EPA, 1984, 1990
Lactonitrile				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1988
Lead subchronic	NA; NA	NA	NA	NA; NA	ND ^o	ND	NA	NA	U.S. EPA, 1984, 1986/U.S. EPA, 1984, 1986
chronic	NA; NA	NA	NA	CNS effects; CNS effects (also see Table B)	ND ^o	ND ^p	NA	NA	U.S. EPA, 1984, 1986/U.S. EPA, 1984, 1986

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Lead alkyls: tetraethyl, tetraethyl, tetramethyl, tetrapropyl, triethyl, trimethyl, tripropyl, trimethylethyl, dimethylethyl, methyltriethyl									
subchronic	NA; 0.00017 mg/kg/day by gavage for 20 weeks	NA	rat	NA; liver and neuronal damage	ND	1E-6	NA	1000	NA/Schepers, 1964; U.S. EPA, 1985, 1990
chronic	NA; 0.00017 mg/kg/day by gavage for 20 weeks	NA	rat	NA; liver and neuronal damage	ND	1E-7 ^{a,y}	NA	10,000	NA/Schepers, 1964; U.S. EPA, 1985, 1990
Lindane (see Hexachlorocyclohexane, gamma)									
Linuron									
subchronic	NA; 25 ppm in the diet for 2 years (0.625 mg/kg/day)	NA	dog	NA; hematological	ND	2E-3	NA	300	NA/Du Pont de Nemours and Co., 1962; U.S. EPA, 1984, 1990
chronic	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	NA	300	NA/Du Pont de Nemours and Co., 1962; U.S. EPA, 1984, 1990
Malathion									
subchronic	NA; 16 mg/day in capsules for 47 days (0.23 mg/kg/day)	NA	human	NA; hematological	ND	2E-2	NA	10	NA/Moeller and Rider, 1962; U.S. EPA, 1984, 1990
chronic	NA; 16 mg/day in capsules for 47 days (0.23 mg/kg/day)	NA	human	NA; hematological	ND ^{ff}	2E-2 ^a	NA	10	NA/Moeller and Rider, 1962; U.S. EPA, 1984, 1990
Maleic anhydride									
subchronic	NA; 10 mg/kg/day in the diet for 2 years	NA	rat	NA; kidney lesions	ND	1E-1	NA	100	NA/Jessup et al., 1982; Preache, 1983; U.S. EPA, 1986, 1990

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 10 mg/kg/day in the diet for 2 years	NA	rat	NA; kidney lesions	ND	1E-1 ^a	NA	100	NA/Jessup et al., 1982; Preache, 1983; U.S. EPA, 1986, 1990
Maleic hydrazide									
subchronic	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 Haijden et al., 1981; U.S. EPA, 1989, 1990
chronic	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 Haijden et al., 1981; U.S. EPA, 1989, 1990
Malononitrile									
subchronic	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	NA/Panov et al., 1972; U.S. EPA, 1986
chronic	NA; 0.25 mg/kg/day by gavage 6 days/week for 120 days	NA	rat	NA; liver and spleen	ND	2E-5 ^P	NA	1000	NA/Panov et al., 1972; U.S. EPA, 1986
Mancozeb									
subchronic	NA; 50 ppm in the diet for 90 weeks (2.9 mg/kg/day)	NA	rat	NA; goitrogenic effects	ND	3E-2	NA	100	NA/U.S. EPA, 1984
chronic	NA; 50 ppm in the diet for 90 weeks (2.9 mg/kg/day)	NA	rat	NA; goitrogenic effects	ND	3E-2	NA	100	NA/U.S. EPA, 1984
Maneb									
subchronic	NA; 300 ppm in diet for 6 months (5 mg/kg/day)	NA	monkey	NA; increased thyroid weight	ND	5E-2	NA	100	NA/Rohm and Haas Co., 1977; Maneb Data Task Force, 1986; U.S. EPA, 1984, 1990

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 300 ppm in diet for 6 months (5 mg/kg/day)	NA	monkey	NA; increased thyroid weight	ND	5E-2 ^a	NA	100	NA/Rohm and Haas Co., 1977; Maneb Data Task Force, 1986; U.S. EPA, 1984, 1990
Manganese subchronic	0.97 mg/m ³ occupational, LOAEL _{HEC} =0.34 mg/m ³ ; 0.03-0.16 mg Mn/kg/day chronic dietary intake	human	human	respiratory symptoms and psychomotor disturbances; no effect	4E-4	1E-1	900	1	Roels et al., 1987; U.S. EPA, 1984a,b/NRC, 1989; Schroeder et al., 1966; U.S. EPA, 1984a,b, 1990; WHO, 1973
chronic	0.97 mg/m ³ occupational, LOAEL _{HEC} =0.34 mg/m ³ ; 0.03-0.16 mg Mn/kg/day chronic dietary intake	human	human	respiratory symptoms and psychomotor disturbances; no effect ¹	4E-4 ^j	1E-1 ^a	900	1	Roels et al., 1987; U.S. EPA, 1984/NRC, 1989; Schroeder et al., 1966; U.S. EPA, 1984a,b, 1990; WHO, 1973
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)									
Mephosfolan subchronic	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	NA/U.S. EPA, 1984
chronic	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	NA/U.S. EPA, 1984

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	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Mercury, inorganic										
subchronic	0.009 mg/m ³ , several occupational studies; several oral and parenteral studies in the Brown Norway rat		human	rat	neurotoxicity; kidney effects	3E-4	3E-4	30	1000	Fawer et al., 1983; Piikivi and Tolonen, 1989; Piikivi and Hanninen, 1989; Piikivi, 1989; U.S. EPA, 1984, 1990/ Druet et al., 1978; Bernaudin et al., 1981; Andres, 1984; U.S. EPA, 1987
chronic	0.009 mg/m ³ , several occupational studies; several oral and parenteral studies in the Brown Norway rat		human	rat	neurotoxicity; kidney effects ¹	3E-4 ^j	3E-4 ^j	30	1000	Fawer et al., 1983; Piikivi and Tolonen, 1989; Piikivi and Hanninen, 1989; Piikivi, 1989; U.S. EPA, 1984, 1990/ Druet et al., 1978; Bernaudin et al., 1981; Andres, 1984; U.S. EPA, 1987 1990
Merphos										
subchronic	NA; 0.1 mg/kg/day in capsules for 3 months		NA	hen	NA; ataxia, delayed neurotoxicity	ND	3E-4	NA	300	NA/Abou-Donia et al., 1980; U.S. EPA, 1984, 1990
chronic	NA; 0.1 mg/kg/day in capsules for 3 months		NA	hen	NA; ataxia, delayed neurotoxicity	ND	3E-5 ^a	NA	3000	NA/Abou-Donia et al., 1980; U.S. EPA, 1984, 1990
Merphos oxide										
subchronic	NA; 0.1 mg/kg/day in capsules for 3 months		NA	hen	NA; ataxia, delayed neurotoxicity	ND	3E-4	NA	300	NA/Abou-Donia et al., 1979; U.S. EPA, 1984, 1990

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 0.1 mg/kg/day in capsules for 3 months	NA	hen	NA; ataxia, delayed neurotoxicity	ND	3E-5 ^a	NA	3000	NA/Abou-Donia et al., 1979; U.S. EPA, 1984, 1990
Methacrylonitrile									
subchronic	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	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
Methanol									
subchronic	NA; 500 mg/kg/day by gavage for 90 days	NA	rat	NA; increased serum alkaline phosphatase and SGPT and decreased brain weight	ND	5E+0	NA	100	NA/U.S. EPA, 1986, 1990
chronic	NA; 500 mg/kg/day by gavage for 90 days	NA	rat	NA; increased serum alkaline phosphatase and SGPT and decreased brain weight	ND ^g	5E-1 ^a	NA	1000	NA/U.S. EPA, 1986, 1990
Methomyl									
subchronic	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	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

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

Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Methoxychlor									
subchronic	NA; 5.01 mg/kg/day on days 7-19 of gestation	NA	rabbit	NA; excessive loss of litters	ND	5E-3	NA	1000	NA/Kincaid Enterprises, 1986; U.S. EPA, 1990
chronic	NA; 5.01 mg/kg/day on days 7-19 of gestation	NA	rabbit	NA; excessive loss of litters ¹	ND	5E-3 ^a	NA	1000	NA/Kincaid Enterprises, 1986; U.S. EPA, 1990
2-Methoxyethanol									
subchronic	30 ppm (93 mg/m ³) 6 hours/day, 5 days/week for 13 weeks, NOAELHEC=17mg/m ³ ; 30 ppm (93 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (4.41 mg/kg/day)	rabbit	rabbit	testicular effects; testicular effects	2E-1	4E-2	100	100	Miller et al., 1982, 1983/ Miller et al., 1982, 1983
chronic	30 ppm (93 mg/m ³) 6 hours/day, 5 days/week for 13 weeks, NOAELHEC=17mg/m ³ ; 30 ppm (93 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (4.41 mg/kg/day)	rabbit	rabbit	testicular effects; testicular effects	2E-2	4E-3 ^b	1000	1000	Miller et al., 1982, 1983; U.S. EPA, 1990/ Miller et al., 1982
2-Methoxyethanol acetate									
subchronic	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	rabbit	NA; testicular degeneration	ND	2E-2 ^b	NA	100	NA/Miller et al., 1982; U.S. EPA, 1987
chronic	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	rabbit	NA; testicular degeneration	ND	2E-3 ^b	NA	1000	NA/Miller et al., 1982; 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	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Methyl acetate										
subchronic	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	NA/Toxicity Research Laboratory, 1986; U.S. EPA, 1986
chronic	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	1 ⁸	NA	1000	NA/Toxicity Research Laboratory, 1986; U.S. EPA, 1986
Methyl acrylate										
subchronic	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	NA/Klimisch and Reininghaus, 1984; U.S. EPA, 1987
chronic	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 ¹	ND	3E-2	NA	100	NA/Klimisch and Reininghaus, 1984; U.S. EPA, 1987
Methyl bromide (see Bromomethane)										
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	NA; 6 ppm in the diet for 52 weeks (0.15 mg/kg/day)	NA	dog		NA; kidney and liver	ND	5E-4	NA	300	NA/Industry Task Force, 1986; U.S. EPA, 1984, 1990
chronic	NA; 6 ppm in the diet for 52 weeks (0.15 mg/kg/day)	NA	dog		NA; kidney and liver	ND	5E-4 ^a	NA	300	NA/Industry Task Force, 1986; U.S. EPA, 1984, 1990
4-(2-Methyl-4-chlorophenoxy)-butyric acid (MCPB)										
subchronic	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	NA/Rhodia Inc., 1970a,b; 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 RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral				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	NA/Rhodia Inc., 1970a,b; U.S. EPA, 1984, 1990
2-(2-Methyl-4-chlorophenoxy)-propionic acid (MCP)										
subchronic	NA; 50 ppm in the diet for 90 days (3 mg/kg/day)		NA	rat	NA; kidney weight	ND	1E-2	NA	300	NA/BASF Akt., 1985; U.S. EPA, 1984, 1990
chronic	NA; 50 ppm in the diet for 90 days (3 mg/kg/day)		NA	rat	NA; kidney weight	ND	1E-3 ^a	NA	3000	NA/BASF Akt., 1985; U.S. EPA, 1984, 1990
Methylcyclohexane					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					
4,4'-Methylene-bis(2-chloroaniline)										
subchronic	NA; 100 mg/day, 3 days/week for 3 weeks, then 5 days/week for 9 years (7.3 mg/kg/day)		NA	dog	NA; liver and bladder effects	ND	7E-4	NA	10,000	NA/Stula et al., 1977; U.S. EPA, 1990
chronic	NA; 100 mg/day, 3 days/week for 3 weeks, then 5 days/week for 9 years (7.3 mg/kg/day)		NA	dog	NA; liver and bladder effects (also see Table B)	ND	7E-4	NA	10,000	NA/Stula et al., 1977; U.S. EPA, 1990
Methylene bromide (dibromomethane)										
subchronic	NA; 25 ppm (178 mg/m ³) 6 hours/day for 63 days in a 90-day period, 0.5 absorption factor (11.0 mg/kg/day)		NA	rat	NA; increased carboxyhemoglobin	ND	1E-1 ^b	NA	100	NA/Keyes et al., 1982; U.S. EPA, 1987
chronic	NA; 25 ppm (178 mg/m ³) 6 hours/day for 63 days in a 90-day period, 0.5 absorption factor (11.0 mg/kg/day)		NA	rat	NA; increased carboxyhemoglobin	ND ^c	1E-2 ^b	NA	1000	NA/Keyes et al., 1982; 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 RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Methylene chloride (dichloromethane)										
subchronic	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;	3E+0	6E-2	100	100	Nitschke et al., 1988; U.S. EPA, 1990/National Coffee Associa- tion, 1982; U.S. EPA, 1989, 1990	
chronic	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)	3E+0 ^j	6E-2 ^a	100	100	Nitschke et al., 1988; U.S. EPA, 1990/National Coffee Associa- tion, 1982; U.S. EPA, 1989, 1990	
4,4'-Methylenediphenyl isocyanate										
subchronic	0.2 mg/m ³ 6 hours/day, 5 days/week for 24 months, NOAEL _{HEC} = 0.005 mg/m ³ ; NA	rat	NA	nasal cavity lesions; NA	5E-5	ND	100	NA	Reuzel et al., 1990/NA	
chronic	0.2 mg/m ³ 6 hours/day, 5 days/week for 24 months, NOAEL _{HEC} = 0.005 mg/m ³ ; NA	rat	NA	nasal cavity lesions; NA	5E-5 ^j	ND	100	NA	Reuzel et al., 1990; U.S. EPA, 1990/NA	
Methyl ethyl benzenes (see Ethyltoluene)										
Methyl ethyl ketone										
subchronic	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)	5E-1 ^{b,aa}	100	100	LaBelle and Brieger, 1955; U.S. EPA, 1990/ LaBelle and Brieger, 1955; U.S. EPA, 1989, 1990	
chronic	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 ¹	3E-1 (9E-2) ^g	5E-2 ^{b,y,aa}	1000	1000	LaBelle and Brieger, 1955; U.S. EPA, 1990/ LaBelle and Brieger, 1955; 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	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Methyl isobutyl ketone										
subchronic	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., 1983; U.S. EPA, 1990/ Microbiological Associates, 1986; U.S. EPA, 1989, 1990
chronic	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) ^g	5E-2 ^a	1000	1000	Union Carbide Corp., 1983; U.S. EPA, 1990/ Microbiological Associates, 1986; U.S. EPA, 1989, 1990
Methyl isocyanate					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ^{gg}					U.S. EPA, 1986
Methyl mercury										
subchronic	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	NA/Clarkson et al., 1976; Nordberg and Strangart, 1976; WHO, 1976; U.S. EPA, 1990
chronic	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 ^y	NA	10	NA/Carkson et al., 1976; Nordberg and Strangart, 1976; WHO, 1976; U.S. EPA, 1990
Methyl methacrylate										
subchronic	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	NA/Borzelleca et al., 1964; U.S. EPA, 1985
chronic	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 ^g	NA	100	NA/Borzelleca et al., 1964; U.S. EPA, 1985

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	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Methyl parathion										
subchronic	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	NA/Monsanto Co., 1983; U.S. EPA, 1990
chronic	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	NA/Monsanto Co., 1983; U.S. EPA, 1990
Methyl styrene (industrial mixture)										
subchronic	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) ^g	6E-3 ^b	1000	1000	MRI, 1984a; U.S. EPA, 1987/MRI, 1984a; U.S. EPA, 1987
Methyl styrene, alpha										
subchronic	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	NA/U.S. EPA, 1987; Wolf et al., 1956
chronic	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	NA/U.S. EPA 1987; Wolf et al., 1956
Mirex										
subchronic	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	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

 SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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	exposure		Species	Effect of Concern	Inhalation RfC		Oral RfD		Uncertainty Factor		Reference
					mg/m ³	mg/m ³ /day	mg/kg/day	mg/kg/day	inhalation	oral	
Molybdenum											
subchronic	NA; 50 mg/day in drinking water (total exposure estimated to be 0.20 mg/day or 0.004 mg/kg/day)	NA	human	NA; changes in biochemical indices	ND		4E-3		NA	1	U.S. EPA, 1990/1979; U.S. EPA,
chronic	NA; 50 mg/day in drinking water (total exposure mg/day or 0.004 mg/kg/day)	NA		biochemical indices							Chappell et al., 1990
Molinate											
	gavage			toxicity					NA	100	May/Qualitest Chemical Co., 1991; U.S. EPA, 1990
chronic	NA; 0.2 mg/kg/day by gavage	NA	rat	NA; reproductive toxicity	ND		2E-2		NA	100	May/Qualitest Chemical Co., 1991; U.S. EPA, 1990
monochlorobutadienes											
subchronic	NA; 120 mg/kg, 5 days/week for 13 weeks by gavage	NA		weight gain; convulsions							NTP, 1986; U.S.
chronic	NA; 60 mg/kg, 5 days/week by gavage	NA	rat	NA; mortality	ND		4E-1		NA	100	U.S. EPA, 1989/1989; EPA, 1989
Naphthalene											
	gavage 5 days/week for 13 weeks (25.7 mg/kg/day)			weight gain					NA	1000	U.S. EPA, 1989/1989; NTP, 1980; U.S. EPA, 1980, 1990
chronic	NA; 50 mg/kg/day by gavage 5 days/week for 13 weeks (25.7 mg/kg/day)	NA	rat	NA; decreased body weight gain	ND		1E-2		NA	1000	NTP, 1980; U.S.
1,4-naphthoquinone											U.S. EPA, 1986
				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT							

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Nickel									
subchronic	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	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 ^g	2E-2 ^y	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
Nitric oxide									
subchronic	NA; 10 ppm (10 mg/ℓ) nitrate concentration in infant formula (1.0 mg/kg/day)	NA	human	NA; methemoglobinemia	NA	1E-1	NA	10	NA/Walton, 1951; U.S. EPA, 1990
chronic	NA; 10 ppm (10 mg/ℓ) nitrate concentration in infant formula (1.0 mg/kg/day)	NA	human	NA; methemoglobinemia	NA	1E-1 ^a	NA	10	NA/Walton, 1951; U.S. EPA, 1990
Nitrite									
subchronic	NA; 10 ppm nitrate in drinking water	NA	human	NA; methemoglobinemia	ND	1E-1	NA	10	U.S. EPA, 1989/ Walton, 1951; U.S. EPA, 1989, 1990
chronic	NA; 10 ppm nitrate in drinking water	NA	human	NA; methemoglobinemia	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	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-2	5E-3 ^b	300	1000	CIIT, 1984; U.S. EPA, 1987/ CIIT, 1984; U.S. EPA, 1987

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	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 ¹	2E-3 ^j	5E-4 ^{b,y}	3000	10,000	CIIT, 1984; U.S. EPA, 1987/ CIIT, 1984; U.S. EPA, 1987, 1990
Nitrofurantoin									
Subchronic	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	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 dioxide									
subchronic	0.4 ppm (0.753 mg/m ³) continuous for up to 27 months (HEC=1.56 mg/m ³); 10 ppm nitrate-N in water (1 mg nitrate-N/kg/day)	rat	human	proliferative changes in lungs; methemoglobinemia	2E-2	1E+0	100	1	Kubota et al., 1987; Sagai and Ichinose, 1987; Sagai et al., 1984; U.S. EPA, 1990b/Walton, 1951; U.S. EPA, 1990a,b
chronic	0.4 ppm (0.753 mg/m ³) continuous for up to 27 months (HEC=1.56 mg/m ³); 10 ppm nitrate-N in water (1 mg nitrate-N/kg/day)	rat	human	proliferative changes in lungs; methemo- globinemia	2E-2 ^g	1E+0 ^{a,cc}	100	1	Kubota et al., 1987; Sagai and Ichinose, 1987; Sagai et al., 1984; U.S. EPA, 1990b/Walton, 1951; U.S. EPA, 1990a,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 ^g					U.S. EPA, 1987

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Compound	Exposure		Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
2-Nitropropane										
subchronic	25 ppm (78 mg/m ³) 7 hours/day, 5 days/ week for 22 months, LOAEL _{HEC} =16.3mg/m ³ ; NA	rat	NA		mild liver lesions; NA	2E-2	ND	1000	NA	Angus Chemical Co., 1985a,b; Griffin et al. 1980, 1981/NA
chronic	25 ppm (78 mg/m ³) 7 hours/day, 5 days/ week for 22 months, LOAEL _{HEC} =16.3mg/m ³ ; NA	rat	NA		mild liver lesions; NA	2E-2 ^j	ND	1000	NA	Angus Chemical Co., 1985a,b; Griffin et al. 1980, 1981; U.S. EPA, 1990/ NA
p-Nitrosodiphenylamine			DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT							U.S. EPA, 1986
Nitrotoluenes (o-, m-, p-)										
subchronic	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	NA/Ciss et al., 1980; U.S. EPA, 1986
chronic	NA; 200 mg/kg/day o-nitrotoluene x 5 days/week by gavage for 6 months	NA	rat		NA; splenic lesions	ND	1E-2	NA	10,000	NA/Ciss et al., 1980; U.S. EPA, 1986
Octabromodiphenyl ether										
subchronic	NA; 2.5 mg/kg/day by gavage for 90 days	NA	rat		NA; liver histology	ND	3E-2	NA	100	NA/Carlson, 1980; U.S. EPA, 1983, 1990
chronic	NA; 2.5 mg/kg/day by gavage for 90 days	NA	rat		NA; liver histology ¹	ND	3E-3 ^a	NA	1000	NA/Carlson, 1980; U.S. EPA, 1983, 1990
Octamethylpyrophosphoramide										
subchronic	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	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 ^b	NA	10	U.S. EPA, 1989/ Rider et al., 1969; U.S. EPA, 1989
Ozone and other photochemical oxidants			DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT							U.S. EPA, 1986

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

Compound	Exposure		Species		Effect of Concern Inhalation; Oral	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Paraldehyde					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986
Parathion										
subchronic	NA; CBI	NA	human	NA; cholinesterase inhibition	ND		6E-3	NA	10	U.S. EPA, 1987/ U.S. EPA, 1987
chronic	NA; CBI	NA	human	NA; cholinesterase inhibition, (see also Table B)	ND		6E-3 ⁸	NA	10	U.S. EPA, 1987/ U.S. EPA, 1987
Particulate matter and sulfur oxides					RISK ASSESSMENT VALUES NOT DERIVED					U.S. EPA, 1987
Pebulate										
subchronic	NA; 5 mg/kg/day subchronic feeding study	NA	rat	NA; anticoagulant effects	ND		5E-2	NA	100	NA/CBI; U.S. EPA, 1984
chronic	NA; 5 mg/kg/day subchronic feeding study	NA	rat	NA; anticoagulant effects	ND		5E-2	NA	100	NA/CBI; U.S. EPA, 1984
Pendimethalin										
subchronic	NA; 12.5 mg/kg/day, 7 days/week in capsules for 2 years	NA	dog	NA; liver	ND		4E-2	NA	300	NA/American Cyanimid, 1979; U.S. EPA, 1984, 1990
chronic	NA; 12.5 mg/kg/day, 7 days/week in capsules for 2 years	NA	dog	NA; liver	ND		4E-2 ^a	NA	300	NA/American Cyanimid, 1979; U.S. EPA, 1984, 1990
Pentabromodiphenyl ether										
subchronic	NA; 1.8 mg/kg/day by gavage for 90 days	NA	rat	NA; liver enzymes	ND		2E-2	NA	100	NA/Carlson, 1980; U.S. EPA, 1983, 1990
chronic	NA; 1.8 mg/kg/day by gavage for 90 days	NA	rat	NA; liver enzymes ¹	ND		2E-3 ^a	NA	1000	NA/Carlson, 1980; U.S. EPA, 1983, 1990
Pentachlorobenzene										
subchronic	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 et al., 1980; U.S. EPA, 1989, 1990

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

Compound	Exposure		Species		Effect of Concern Inhalation; Oral	Inhalation RfC [mg/m ³ (mg/kg/day)]		Oral RfD (mg/kg/day)		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral		Inhalation	Oral						Inhalation	Oral	
chronic	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 et al., 1980; U.S. EPA, 1989, 1990
Pentachlorocyclopentadiene					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹							U.S. EPA, 1988
Pentachloronitrobenzene subchronic	NA; 30 ppm (0.75 mg/kg/day) in diet for 2 years		NA	dog	NA; liver toxicity	ND		3E-3		NA	300	NA/Olin Corp., 1968; U.S. EPA, 1990
chronic	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	NA/Olin Corp., 1968; U.S. EPA, 1990
Pentachlorophenol subchronic	NA; 3 mg/kg/day by gavage 62 days before mating through gestation		NA	rat	NA; fetotoxicity	ND		3E-2 ^{aa}		NA	100	U.S. EPA, 1984/ Schwetz et al., 1978; U.S. EPA, 1986, 1990
chronic	NA; 3 mg/kg/day by gavage for 22-24 months		NA	rat	NA; liver and kidney pathology (also see Table B)	ND ^g		3E-2 ^a		NA	100	U.S. EPA, 1984/ Schwetz et al., 1978; U.S. EPA, 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 ¹							U.S. EPA, 1984, 1987
Phenol subchronic	NA; 60 mg/kg/day by gavage during organogenesis		NA	rat	NA; reduced fetal body weight	ND		6E-1 ^{aa}		NA	100	U.S. EPA, 1984/ Research Triangle Institute, 1983; U.S. EPA, 1990
chronic	NA; 60 mg/kg/day by gavage during organogenesis		NA	rat	NA; reduced fetal body weight ¹	ND ^{ff}		6E-1 ^{a,aa}		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: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
m-Phenylenediamine									
subchronic	NA; 6.0 mg/kg/day for 90 days	NA	rat	NA; liver lesions	ND	6E-2	NA	100	NA/Hofer and Hruby, 1982; U.S. EPA, 1990
chronic	NA; 6.0 mg/kg/day for 90 days	NA	rat	NA; liver lesions	ND	6E-3 ^a	NA	1000	NA/Hofer and Hruby, 1982; U.S. EPA, 1990
Phenylmercuric acetate									
subchronic	NA; 0.1 ppm mercury in diet for 2 years (0.0084 mg mercuric acetate/kg/day) ^{dd}	NA	rat	NA; renal damage	ND	8E-5	NA	100	NA/Fitzhugh et al., 1950; U.S. EPA, 1990
chronic	NA; 0.1 ppm mercury in diet for 2 years (0.0084 mg mercuric acetate/kg/day) ^{dd}	NA	rat	NA; renal damage	ND	8E-5 ^a	NA	100	NA/Fitzhugh et al., 1950; U.S. EPA, 1990
Phosgene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ^{ss}					U.S. EPA, 1984
Phosphine									
subchronic	1 ppm (1.4 mg/m ³) 34 hours/week for 24 weeks, NOAELHEC=0.28 mg/m ³ ; 0.026 mg/kg/day in the diet for 2 years	rat	rat	renal effects; no effect	3E-4	3E-4	100	100	Klimmer, 1969; U.S. EPA, 1989/ Hackenberg, 1972; U.S. EPA, 1989
chronic	1 ppm (1.4 mg/m ³) 34 hours/week for 24 weeks, NOAELHEC=0.28 mg/m ³ ; 0.026 mg/kg/day in the diet for 2 years	rat	rat	renal effects; no effect	3E-5	3E-4 ^a	1000	100	Klimmer, 1969; U.S. EPA, 1989/ Hackenberg, 1972; U.S. EPA, 1989, 1990
Phosphorus (inorganic compounds)				RISK ASSESSMENT NOT AVAILABLE					U.S. EPA, 1989
Phthalic acids (o-, m-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1986
p-Phthalic acid									
subchronic	NA; 142 mg/kg/day in diet for 2 years	NA	rat	NA; hyperplasia of bladder urothelium	ND	1E+0	NA	100	NA/CIIT, 1982; Gross, 1974; U.S. EPA, 1986
chronic	NA; 142 mg/kg/day in diet for 2 years	NA	rat	NA; hyperplasia of bladder urothelium	ND	1E+0	NA	100	NA/CIIT, 1982; Gross, 1974; U.S. EPA, 1986

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Chemical	Exposure	Species	Sex	Route of Exposure	Exposure Reg	Chemical	Exposure Reg	Exposure Level	Reference
Exposure	Exposure	Exposure	Exposure	Exposure	Exposure	Exposure	Exposure	Exposure	Exposure
Phthalic anhydride									
mg/kg/day) in diet for				histopathology					U.S. EPA. 1990
mg/kg/day) in diet for				histopathology					U.S. EPA. 1990
polychlorinated biphenyls									
subchronic NA: Firemaster FF-1	NA	rat	NA: elevated liver	weight and liver	ND	7E-6	NA	1000	U.S. EPA. 1990/
0.1 mg/kg by gavage,									NIF, 1983; U.S.
(U.O/ mg/kg/day)									
chronic NA; Firemaster FF-1	NA	rat	NA; elevated liver	lesions	ND	7E-6	NA	10,000	U.S. EPA, 1989/
5 days/week for 25 weeks									EPA, 1989
subchronic NA; 10.8 mg/kg/day	NA	rat	NA: weight loss.	myelin degeneration	ND	5E-2	NA	500	NA/Howard and
food for 2 years									Philbrick et
									al., 1978; U.S.
									EPA. 1990
chronic NA: 10.8 mg/kg/day	NA	rat	NA: weight loss	myelin degeneration	ND	5E-2	NA	500	NA/Howard and
potassium silver cyanide in									Hanzal, 1955;
food for 2 years									Philbrick et
(41 mg/kg/day)									al., 1978; U.S.
									EPA. 1990
subchronic NA; 10.8 mg/kg/day	NA	rat	NA; weight loss,	myelin degeneration	ND	2E-14	NA	500	NA/Howard and
food for 2 years									Philbrick et
potassium silver cyanide									EPA. 1990
fumigated cyanide in				thyroid effects, and					Hanzal 1955.
(equivalent to				myelin degeneration					Philbrick et
potassium silver cyanide									al. 1978; U.S.
at 82.7 mg/kg/day)									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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Profluralin									
subchronic	NA; subchronic feeding study; no details provided (CBI)	NA	rat	NA; NR	ND	6E-3	NA	NR	NA/CBI; U.S. EPA, 1984
chronic	NA; subchronic feeding study; no details provided (CBI)	NA	rat	NA; NR	ND	6E-3	NA	NR	NA/CBI; U.S. EPA, 1984
Pronamide									
subchronic	NA; 300 ppm in diet for 2 years (7.5 mg/kg/day)	NA	dog	NA; none observed	ND	8E-2	NA	100	NA/Rohm & Haas, Co., 1970; U.S. EPA, 1990
chronic	NA; 300 ppm in diet for 2 years (7.5 mg/kg/day)	NA	dog	NA; none observed	ND	8E-2 ^a	NA	100	NA/Rohm & Haas, Co., 1970; U.S. EPA, 1990
Propachlor									
subchronic	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	NA/Monsanto, 1964; U.S. EPA, 1984, 1990
chronic	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	NA/Monsanto, 1964; U.S. EPA, 1984, 1990
Propazine									
subchronic	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	NA/Geigy, 1980; U.S. EPA, 1984, 1990
chronic	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 ^a	NA	300	NA/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

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

Update: December, 1990

Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Propylene glycol									
subchronic	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 et al., 1947; U.S. EPA, 1987/ Guerrant et al., 1947; U.S. EPA, 1987
chronic	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 et al., 1947; U.S. EPA, 1987/ Gaunt et al., 1972; U.S. EPA, 1987
Propylene glycol monoethyl ether									
subchronic	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	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
Propylene glycol monomethyl ether									
subchronic	1000 ppm (3685 mg/m ³) 6 hours/day, 5 days/week for 13 weeks, NOAEL _{HFC} =658mg/m ³ ; 947 mg/kg, 5 days/week for 35 days (676 mg/kg/day) by gavage	rat, rabbit	rat	mild CNS effects; liver and kidney histopathology	7E+0	7E+0	100	100	Landry et al., 1983; Miller et al., 1984; U.S. EPA, 1984/ Rowe et al., 1954; U.S. EPA, 1984
chronic	1000 ppm (3685 mg/m ³) 6 hours/day, 5 days/week for 13 weeks, NOAEL _{HFC} =658mg/m ³ ; 947 mg/kg, 5 days/week for 35 days (676 mg/kg/day) by gavage	rat, rabbit	rat	mild CNS effects; liver and kidney histopathology	7E-1 ^j	7E-1	1000	1000	Landry et al., 1984; Miller et al., 1984; U.S. EPA, 1984, 1990/Rowe et al., 1954; 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	Inhalation RfC		Oral RfD		Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral		Inhalation	Oral		[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation	Oral	
Propylene oxide												
subchronic	71 mg/m ³ 6 hours/day, 5 days/week for 2 years, LOAELHEC=2.9 mg/m ³ ; NA		rat	NA	nasal epithelium; NA	3E-2	ND			100	NA	Kuper et al., 1988; U.S. EPA, 1985, 1990/ U.S. EPA, 1985, 1990
chronic	71 mg/m ³ 6 hours/day, 5 days/week for 2 years, LOAELHEC=2.9 mg/m ³ ; NA		rat	NA	nasal epithelium; NA (see also Table B)	3E-2 ^a	ND			100	NA	Kuper et al., 1988; U.S. EPA, 1985, 1990/ U.S. EPA, 1985, 1990
Pyrene												
subchronic	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, 1990
chronic	NA; 75 mg/kg/day by gavage for 13 weeks		NA	mouse	NA; renal effects ¹	ND		3E-2 ^a		NA	3000	U.S. EPA, 1984/ U.S. EPA, 1989, 1990
Pyridine												
subchronic	NA; 1 mg/kg/day by gavage for 90 days		NA	rat	NA; increased liver weight	ND		1E-2		NA	100	NA/U.S. EPA, 1986a,b, 1990
chronic	NA; 1 mg/kg/day by gavage for 90 days		NA	rat	NA; increased liver weight	ND		1E-3 ^a		NA	1000	NA/U.S. EPA, 1986a,b, 1990
RDX (Cyclonite)												
subchronic	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	NA; 0.3 mg/kg/day for 105 weeks		NA	rat	NA; prostate inflam- mation, hemosiderosis (also see Table B)	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	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Ronnel									
subchronic	NA; 5 mg/kg/day in the diet for 2 years	NA	rat	NA; liver and kidney effects	ND	5E-2	NA	100	NA/McCollister et al., 1959; U.S. EPA, 1984
chronic	NA; 5 mg/kg/day in the diet for 2 years	NA	rat	NA; liver and kidney effects	ND	5E-2 ^S	NA	100	NA/McCollister et al., 1959; U.S. EPA, 1984
Selenious acid									
subchronic	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	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 ^Y	NA	15	U.S. EPA, 1989/ Yang et al., 1983; U.S. EPA, 1989, 1990
Selenourea									
subchronic	NA; 0.046 mg/kg/day, exposure to selenium in high-selenium areas, converted to 0.072 mg selenourea/kg/day	NA	human	NA; selenosis	ND	5E-3	NA	15	NA/Yang et al., 1983; U.S. EPA, 1990
chronic	NA; 0.046 mg/kg/day, exposure to selenium in high-selenium areas, converted to 0.072 mg selenourea/kg/day	NA	human	NA; selenosis	ND	5E-3 ^Y	NA	15	NA/Yang et al., 1983; U.S. EPA, 1990
Silver									
subchronic	NA; 0.9-1.5 g silver arsphenamine by i.v. for 2-3 years (average, 0.0031 mg/kg/day); 6.4 g total dosage silver nitrate in 1 year (0.077 mg/kg/day); 6.4 g total dosage silver acetate over 2.5 years (0.0048 mg/kg/day) Average of 3 studies, 0.0052 mg/kg/day	NA	human	NA; argyria	ND	3E-3	NA	2	NA/Gaul and Staud, 1935; Blumberg and Carey, 1934; East et al., 1980; 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 0.9-1.5 g silver arsphenamine by i.v. for 2-3 years (average, 0.0031 mg/kg/day); 6.4 g total dosage silver nitrate in 1 year (0.077 mg/kg/day); 6.4 g total dosage silver acetate over 2.5 years (0.0048 mg/kg/day) Average of 3 studies, 0.0052 mg/kg/day	NA	human	NA; argyria ¹	ND	3E-3 ^a	NA	2	NA/Gaul and Staud, 1935; Blumberg and Carey, 1934; East et al., 1980; U.S. EPA, 1990
Silver cyanide subchronic	NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (55.7 mg silver cyanide/kg/day)	NA	rat	NA; weight loss, thyroid effects and myelin degeneration	ND	1E-1 ⁿ	NA	500	NA/Howard and Hanzal, 1955; Philbrick et al., 1979; U.S. EPA, 1990
chronic	NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (55.7 mg silver cyanide/kg/day)	NA	rat	NA; weight loss, thyroid effects and myelin degeneration	ND	1E-1 ^{a,n}	NA	500	NA/Howard and Hanzal, 1955; Philbrick et al., 1979; U.S. EPA, 1990
Simazine subchronic	NA; 0.52 mg/kg/day in the diet for 2 years	NA	rat	NA; decreased weight gain, hematological effects	ND	2E-3	NA	300	NA/Ciba-Geigy Corp., 1988; U.S. EPA, 1984, 1990
chronic	NA; 0.52 mg/kg/day in the diet for 2 years	NA	rat	NA; decreased weight gain, hematological effects (also see Table B)	ND	2E-3 ^a	NA	300	NA/Ciba-Geigy Corp., 1988; U.S. EPA, 1984, 1990
Sodium cyanide subchronic	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 ⁿ	NA	500	U.S. EPA, 1984/Howard and Hanzal, 1955; U.S. EPA, 1984
chronic	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 ^{a,n}	NA	500	U.S. EPA, 1984/Howard and Hanzal, 1955; U.S. EPA, 1984, 1990

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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Sodium diethyldithio-carbamate									
subchronic	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	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 ^a	NA	1000	U.S. EPA, 1988/ Sunderman et al., 1967; U.S. EPA, 1988 1990
Sodium metavanadate									
subchronic	NA; 10 ppm sodium metavanadate in drinking water for 3 months (1.32 mg sodium metavanadate/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	NA; 10 ppm sodium metavanadate in drinking water for 3 months (1.32 mg sodium metavanadate/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
Stiropfos (see Tetrachlorvinphos)									
Strychnine									
subchronic	NA; 2.5 mg/kg by gavage for 28 days	NA	rat	NA; toxicity histopathology	ND	3E-3	NA	1000	NA/Seidl and Zbinden, 1982; U.S. EPA, 1990
chronic	NA; 2.5 mg/kg by gavage for 28 days	NA	rat	NA; toxicity histopathology	ND	3E-4 ^a	NA	10,000	NA/Seidl and Zbinden, 1982; U.S. EPA, 1990
Styrene									
subchronic	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, 1989/ Quast et al., 1979; U.S. EPA, 1984, 1989, 1990
chronic	NA; 200 mg/kg/day by gavage for 19 months	NA	dog	NA; red blood cell and liver effects (also see Table B)	ND ^g	2E-1 ^z	NA	1000	U.S. EPA, 1989/ Quast et al., 1979; U.S. EPA, 1984, 1989, 1990

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

Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Succinonitrile				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1987
Sulfuric acid									
subchronic	0.066-0.098 mg/m ³ occupational; NA	human	NA	respiratory; NA	ND ^u	ND	NA	NA	Carson et al., 1981; U.S. EPA, 1984/NA
chronic	0.066-0.098 mg/m ³ occupational; NA	human	NA	respiratory; NA	ND ^u	ND	NA	NA	Carson et al., 1981; U.S. EPA 1984/NA
Temephos									
subchronic	NA; 200 ppm in the diet for 99 days (11-24 mg/kg/day)	NA	rat	NA; no effect	ND	2E-1	NA	100	NA/Gaines et al., 1967; U.S. EPA, 1984
chronic	NA; 200 ppm in the diet for 99 days (11-24 mg/kg/day)	NA	rat	NA; no effect	ND	2E-2	NA	1000	NA/Gaines et al., 1967; U.S. EPA, 1984
Terbufos									
subchronic	NA; 0.01 mg/kg/day in the diet for 6 months	NA	dog	NA; no effect	ND	1E-4	NA	100	NA/U.S. EPA, 1984
chronic	NA; 0.01 mg/kg/day in the diet for 6 months	NA	dog	NA; no effect	ND	1E-4 ⁸	NA	100	NA/U.S. EPA, 1984
Terephthalic acid				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Tetrachloroazoxybenzene (TCAOB)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1985
1,2,4,5-Tetrachlorobenzene									
subchronic	NA; 50 ppm in diet for 13 weeks (converted to 0.34 mg/kg/day by authors)	NA	rat	NA; kidney lesions	ND	3E-3	NA	100	NA/Chu et al., 1984; U.S. EPA, 1990
chronic	NA; 50 ppm in diet for 13 weeks (converted to 0.34 mg/kg/day by authors)	NA	rat	NA; kidney lesions	ND	3E-4 ^a	NA	1000	NA/Chu et al., 1984; U.S. EPA, 1990
Tetrachlorocyclopentadiene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹					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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Tetrachloroethylene (perchloroethylene)										
subchronic	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	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	NA; 25 mg/kg/day for 90 days	NA	rat		NA; increased liver weights and centrilobular hypertrophy	ND	3E-1	NA	100	U.S. EPA, 1987/ U.S. EPA, 1986, 1990
chronic	NA; 25 mg/kg/day for 90 days	NA	rat		NA; increased liver weights and centrilobular 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
Tetrachlorvinphos (Stirofos)										
subchronic	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	NA/Shell Chem. Co., 1968; U.S. EPA, 1984, 1990
chronic	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	NA/Shell Chem. Co., 1968; U.S. EPA, 1984, 1990
Tetraethyl dithiopyrophosphate										
subchronic	NA; 10 ppm in diet for 3 months (0.5 mg/kg/day)	NA	rat		NA; depressed RBC and plasma cholinesterase activity	ND	5E-3	NA	100	NA/Kimmerle and Klimmer, 1974; 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	NA; 10 ppm in diet for 3 months (0.5 mg/kg/day)	NA	rat	NA; depressed RBC and plasma cholinesterase activity	ND	5E-4 ^a	NA	1000	NA/Kimmerle and Klimmer, 1974; U.S. EPA, 1990
Tetraethyl lead									
subchronic	NA; 1.7 µg/kg/day in peanut oil by gavage for 20 weeks, 5 days/week (1.2 µg/kg/day)	NA	rat	NA; histopathology of liver and thymus	ND	1E-7	NA	10,000	NA/Schepers, 1964; U.S. EPA, 1990
chronic	NA; 1.7 µg/kg/day in peanut oil by gavage for 20 weeks, 5 days/week (1.2 µg/kg/day)	NA	rat	NA; histopathology of liver and thymus	ND	1E-7 ^a	NA	10,000	NA/Schepers, 1964; U.S. EPA, 1990
Thallic oxide [Thallium(III) oxide]									
subchronic	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	NA; 0.02 mg thallium/kg/day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia ¹	ND	7E-5 ^x	NA	3000	U.S. EPA, 1988/MRI, 1986; U.S. EPA, 1986
Thallium (in soluble salts)									
subchronic	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	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	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	NA; 0.20 mg thallium/kg/day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia ¹	ND	9E-5 ^a	NA	3000	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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Thallium(I) carbonate									
subchronic	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	NA; 0.20 mg thallium/kg/day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia ¹	ND	8E-5 ^a	NA	3000	U.S. EPA, 1988/MRI, 1986; U.S. EPA, 1986, 1990
Thallium(I) chloride									
subchronic	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	NA; 0.20 mg thallium/kg/day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia ¹	ND	8E-5 ^a	NA	3000	U.S. EPA, 1988/MRI, 1986; U.S. EPA, 1986, 1990
Thallium(I) nitrate									
subchronic	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	NA; 0.20 mg thallium/kg/day (from thallium sulfate) for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia ¹	ND	9E-5 ^a	NA	3000	U.S. EPA, 1988/MRI, 1986; U.S. EPA, 1986, 1990
Thallium selenite (Tl ₂ Se)									
subchronic	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	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 ^y	NA	3000	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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Thallium(I) sulfate									
subchronic	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
chronic	NA; 0.25 mg/kg/day for 90 days	NA	rat	NA; increased SGOT and serum LDH levels, alopecia ¹	ND	8E-5 ^a	NA	3000	U.S. EPA, 1988/ MRI, 1986; U.S. EPA, 1986, 1990
2-(Thiocyanomethylthio)-benzothiazole (TCMTB)									
subchronic	NA; 333 ppm in the diet diet, subchronic (25 mg/kg/day)	NA	rat	NA; stomach lesions	ND	3E-1	NA	100	NA/U.S. EPA, 1984
chronic	NA; 333 ppm in the diet diet, subchronic (25 mg/kg/day)	NA	rat	NA; stomach lesions	ND	3E-2	NA	1000	NA/U.S. EPA, 1984
Thiofanox									
subchronic	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	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	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	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	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	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure		Species		Effect of Concern	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Toluene										
subchronic	40 ppm for 6 hours, NOAEL _{HEC} =15mg/m ³ ; 312 mg/kg 5 days/week for 13 weeks (223 mg/kg/day)		human	rat	CNS effects, eyes and nose irritation; changes in liver and kidney weights	2E+0	2E-0	100	100	Andersen et al., 1983; CIIT, 1980; U.S. EPA, 1990/NTP, 1989; U.S. EPA 1990
chronic	40 ppm for 6 hours, NOAEL _{HEC} =15mg/m ³ ; 312 mg/kg 5 days/week for 13 weeks (223 mg/kg/day)		human	rat	CNS effects, eyes and nose irritation; changes in liver and kidney weights ¹	2E+0 ^j	2E-1 ^a	100	1000	Andersen et al., 1983; CIIT, 1980; U.S. EPA, 1990/NTP 1989; 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	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	NA/NCI, 1978; U.S. EPA, 1984
chronic	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	NA/NCI, 1978; U.S. EPA, 1984
Toluene-2,6-diamine										
subchronic	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	NA/NCI, 1980; U.S. EPA, 1984
chronic	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	NA/NCI, 1980; U.S. EPA, 1984
m-Toluidine					DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U.S. EPA, 1984
Triallate										
subchronic	NA; 1.3 mg/kg/day in the diet for 24 months		NA	dog	NA; spleen and liver	ND	1.3E-2	NA	100	NA/Monsanto Co., 1979; U.S. EPA, 1990
chronic	NA; 1.3 mg/kg/day in the diet for 24 months		NA	dog	NA; spleen and liver	ND	1.3E-2 ^{a,z}	NA	100	NA/Monsanto Co., 1979; 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	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
1,2,4-Tribromobenzene										
subchronic	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	NA/Carlson and Tardiff, 1977; U.S. EPA, 1984, 1990
chronic	NA; 5 mg/kg/day in the diet for 45 or 90 days	NA	rat		NA; liver weight and enzyme induction	ND	5E-3 ^a	NA	1000	NA/Carlson and Tardiff, 1977; U.S. EPA, 1984, 1990
Tribromomethane (see Bromoform)										
1,2,4-Trichlorobenzene										
subchronic	3 ppm (22 mg/m ³) 6 hours/day, 5 days/week for 3 months (2.5 mg/kg/day); 22.3 mg/m ³ 6 hours/day, 5 days/week for 3 months	rat	rat		increased uroporphyrin; porphyria ¹	9E-2 (3E-2)	1.31E-2	100	100	Watanabe et al., 1978; U.S. EPA, 1987/Watanabe et al., 1978; U.S. EPA, 1987a,b
chronic	3 ppm (22 mg/m ³) 6 hours/day, 5 days/week for 3 months (2.5 mg/kg/day); 22.3 mg/m ³ 6 hours/day, 5 days/week for 3 months	rat	rat		increased uroporphyrin; porphyria ¹	9E-3 (3E-3)	1.31E-3	1000	1000	Watanabe et al., 1978; U.S. EPA, 1987/Watanabe et al., 1978; U.S. EPA, 1987a,b
Trichlorocyclopentadiene			DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT ¹							U.S. EPA, 1988
1,1,1-Trichloroethane										
subchronic	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) ^r	9E-1 ^b	100	100	Torkelson et al., 1958; U.S. EPA, 1984/Torkelson et al., 1958; 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 RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
chronic	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) ^{g,r}	9E-2 ^{b,y}	1000	1000	Torkelson et al., 1958; U.S. EPA, 1984/ Torkelson et al., 1958; U.S. EPA, 1990
1,1,2-Trichloroethane subchronic	NA; 3.9 mg/kg/day by drinking water for 90 days	NA	mouse	NA; clinical chemistry alterations	ND	4E-2	NA	100	U.S. EPA, 1984/ White et al., 1985; Sanders et al., 1985; U.S. EPA, 1990
chronic	NA; 3.9 mg/kg/day by drinking water for 90 days	NA	mouse	NA; clinical chemistry alterations (Cancer: see Table B)	ND ^g	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	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 BUN, lung lesions; mortality	7E+0 (2E+0)	7E-1	1000	1000	Jenkins et al., 1970; U.S. EPA, 1987/NCI, 1978; U.S. EPA, 1987
chronic	5600 mg/m ³ contin- uously 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	7E-1 (2E-1)	3E-1 ^a	10,000	1000	Jenkins et al., 1970; U.S. EPA, 1987/NCI, 1978; U.S. EPA, 1987, 1990
2,4,4'-Trichloro- 2'-hydroxydiphenyl ether subchronic	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	NA; NA	NA	NA	ND; ND	ND	ND	NA	NA	U.S. EPA, 1987/ U.S. EPA, 1987
Trichloromethane (see Chloroform)									

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Compound	Exposure		Species		Effect of Concern		Inhalation RfC		Oral RfD		Uncertainty Factor		Reference		
	Inhalation; Oral		Inhalation	Oral	Inhalation; Oral		[mg/m ³ (mg/kg/day)]		(mg/kg/day)		Inhalation	Oral	Inhalation/Oral		
Trichlorophenol, 2,3,4-, 2,3,5-, 2,3,6-, and 3,4,5-														U.S. EPA, 1987	
DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT															
2,4,5-Trichlorophenol															
subchronic	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	NA; 1000 ppm of diet for 98 days (100 mg/kg/day)	NA	rat	NA; hepatotoxicity, kidney effects	ND		1E-1 ^a	NA	1000	U.S. EPA, 1984, 1987/McCollister et al., 1961; U.S. EPA, 1984, 1987, 1990					
2,4,6-Trichlorophenol														U.S. EPA, 1984, 1987	
RISK ASSESSMENT VALUES NOT DERIVED (see Table B)															
2,4,5-Trichloro-phenoxyacetic acid															
subchronic	NA; 10 mg/kg/day for 90 days	NA	rat	NA; liver and kidney weights	ND		1E-1	NA	100	U.S. EPA, 1989/Gehring and Betso, 1978; U.S. EPA, 1989					
chronic	NA; 3 mg/kg/day 3-generation study	NA	rat	NA; decreased survival	ND		1E-2 ^a	NA	300	U.S. EPA, 1989/Kociba et al., 1979; U.S. EPA, 1989, 1990					
2(2,4,5-Trichlorophenoxy) propionic acid (Silvex)															
subchronic	NA; 30 ppm in diet for 2 years (0.75 mg/kg/day)	NA	dog	NA; histopathological changes in liver	ND		8E-3	NA	100	NA/Mullison, 1966; Gehring and Betso, 1978; U.S. EPA, 1990					
chronic	NA; 30 ppm in diet for 2 years (0.75 mg/kg/day)	NA	dog	NA; histopathological changes in liver ¹	ND		8E-3 ^a	NA	100	NA/Mullison, 1966; Gehring and Betso, 1978; U.S. EPA, 1990					
Trichloropropane, 1,1,1- and 1,1,2-														U.S. EPA, 1987	
DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT															

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	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference Inhalation/Oral
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
1,1,2-Trichloropropane										
subchronic	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/ Villaneuve et al., 1985; U.S. EPA, 1990
chronic	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/ Villaneuve et al., 1985; U.S. EPA, 1990
1,2,3-Trichloropropane										
subchronic	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	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	3 ppm (18 mg/m ³), 6 hours/day, 5 days/week for 66 weeks; NA	dog	NA		eye irritation; NA	ND	5E-3 ^b	NA	100	NA/McKenna et al., 1978; U.S. EPA, 1983
chronic	3 ppm (18 mg/m ³), 6 hours/day, 5 days/week for 66 weeks; NA	dog	NA		eye irritation; NA	ND	5E-3 ^b	NA	100	NA/McKenna et al., 1978; U.S. EPA, 1983
2,3,6-Trichlorotoluene										
subchronic	NA; 0.5 ppm in diet (0.05 mg/kg/day) for 28 days	NA	rat		NA; liver kidney, thyroid lesions	ND	5E-5	NA	1000	U.S. EPA, 1987/ Chu et al., 1984; U.S. EPA, 1987
chronic	NA; NA	NA	NA		NA; NA	ND	ND	NA	NA	U.S. EPA, 1987/ U.S. EPA, 1987
α,2,6-Trichlorotoluene										
subchronic	NA; 0.5 ppm in diet (0.05 mg/kg/day) for 28 days	NA	rat		NA; liver, kidney, thyroid lesions	ND	5E-5	NA	1000	U.S. EPA, 1987/ Chu et al., 1984; U.S. EPA, 1987
chronic	NA; NA	NA	NA		NA; NA	ND	ND	NA	NA	U.S. EPA, 1987/ 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 RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
1,1,2-Trichloro-1,2,2-trifluoroethane										
subchronic	2000 ppm (15,328 mg/m ³) 6 hours/day, 5 days/week for 24 months, NOAEL _{HEC} = 2737 mg/m ³ ; 2000 ppm (15,328 mg/m ³) 6 hours/day, 5 days/week for 24 months (343 mg/kg/day absorbed dose)	rat	rat	decreased body weight; decreased body weight	27E+0	3E+0 ^b	100	100	Trachimowicz et al., 1988; U.S. EPA, 1990/ Trachimowicz et al., 1988; U.S. EPA, 1990	
chronic	2000 ppm (15,328 mg/m ³) 6 hours/day, 5 days/week for 24 months, NOAEL _{HEC} = 2737 mg/m ³ ; 2000 ppm (15,328 mg/m ³) 6 hours/day, 5 days/week for 24 months (343 mg/kg/day absorbed dose)	rat	rat	decreased body weight; decreased body weight	27E+0 ⁸	3E+0 ^{b,y}	100	100	Trachimowicz et al., 1988; U.S. EPA, 1990/ Trachimowicz et al., 1988; U.S. EPA, 1990	
Trifluralin										
subchronic	NA; 30 ppm in the diet for 12 months (0.75 mg/kg/day)	NA	dog	NA; increased liver weight, methemoglobinemia	ND	7.5E-3	NA	100	NA/Hoechst, 1984; U.S. EPA, 1984, 1990	
chronic	NA; 30 ppm in the diet for 12 months (0.75 mg/kg/day)	NA	dog	NA; increased liver weight, methemoglobinemia (Cancer: see Table B)	ND	7.5E-3 ^a	NA	100	NA/Hoechst, 1984; U.S. EPA, 1984, 1990	
Trimethylbenzenes			DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT						U.S. EPA, 1987	
1,3,5-Trinitrobenzene										
subchronic	NA; 3 ppm 1,3-dinitrobenzene in drinking water for 16 weeks (0.4 mg/kg/day equivalent to 0.51 mg/kg/day 1,3,5-trinitrobenzene)	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	NA; 3 ppm 1,3-dinitrobenzene in drinking water for 16 weeks (0.4 mg/kg/day equivalent to 0.51 mg/kg/day 1,3,5-trinitrobenzene)	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	

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Trinitrophenylmethylnitramine	subchronic NA; 125 mg/kg/day daily by gavage for 9 months	NA	rabbits	ND; histopathological effects on the liver, kidney and spleen	ND	1E-1	NA	1000	U.S. EPA, 1990/ Fati and Daniele, 1965; U.S. EPA, 1990
	chronic NA; 125 mg/kg/day daily by gavage for 9 months	NA	rabbits	ND; histopathological effects on the liver, kidney and spleen	ND	1E-2	NA	10,000	U.S. EPA, 1990/ Fati and Daniele, 1965; U.S. EPA, 1990
2,4,6-Trinitrotoluene	subchronic NA; 0.5 mg/kg/day by gavage for 26 weeks	NA	dog	NA; liver effects	ND	5E-4	NA	1000	U.S. EPA, 1990a/ U.S. DOD, 1983; U.S. EPA, 1990a,b
	chronic NA; 0.5 mg/kg/day by gavage for 26 weeks	NA	dog	NA; liver effects (also see Table B)	ND	5E-4 ^a	NA	1000	U.S. EPA, 1990a/ U.S. DOD, 1983; U.S. EPA, 1990a,b
Vanadium	subchronic 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 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
Vanadium pentoxide	subchronic NA; 10 ppm vanadium in diet from vanadium pentoxide for lifetime (0.9 mg vanadium pentoxide/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 NA; 10 ppm vanadium in diet from vanadium pentoxide for lifetime (0.9 mg vanadium pentoxide/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

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

Update: December, 1990

Compound	Exposure		Species		Effect of Concern	Inhalation RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation; Oral		Inhalation	Oral				Inhalation	Oral	
Vanadyl sulfate										
subchronic	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	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	NA; 20 ppm in the diet (1 mg/kg/day) reproductive	NA	rat		NA; decreased body weight	ND	1E-2	NA	100	NA/Stauffer Chem. Co., 1983; U.S. EPA, 1983, 1990
chronic	NA; 20 ppm in the diet (1 mg/kg/day) reproductive	NA	rat		NA; decreased body weight	ND	1E-3 ^a	NA	1000	NA/Stauffer Chem. Co., 1983; U.S. EPA, 1983, 1990
Vinyl acetate										
subchronic	NOAEL: 50 ppm (176 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (HEC=5 mg/m ³); 1000 ppm in the drinking water for 2 years (100 mg/kg/day)	mouse	rat		nasal lesions; no effect on body and kidney weight	2E-1	1E+0	30	100	Owen, 1988; Dreef-Vander Meulen, 1988; Beems, 1988; U.S. EPA, 1990/Shaw, 1988; U.S. EPA, 1989
chronic	NOAEL: 50 ppm (176 mg/m ³) 6 hours/day, 5 days/week for 13 weeks (HEC=5 mg/m ³); 1000 ppm in the drinking water for 2 years (100 mg/kg/day)	mouse	rat		nasal lesions; no effect on body and kidney weight	2E-1 ^a	1E+0	30	100	Owen, 1988; Dreef-Vander Meulen, 1988; Beems, 1988; U.S. EPA, 1990/Shaw, 1988; U.S. EPA, 1989
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)
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Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
m-Xylene									
subchronic	4750 mg/m ³ , 8 hours/day, 7 days/week for 1 year (1009 mg/kg/day) ^V ; 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	4750 mg/m ³ , 8 hours/day, 7 days/week for 1 year (1009 mg/kg/day) ^V ; 250 mg/kg mixed xylenes 5 days/week for 103 weeks (179 mg mixed xylenes/kg/day)	rat	rat	hepatomegaly; hyperactivity, decreased body weight, increased 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	150 mg/m ³ continuous on days 7-14 of gestation (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) ^{aa}	4E+0	100	100	Ungvary et al., 1980; U.S. EPA, 1989/NTP, 1986
chronic	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; hyperactivity, decreased body weight, increased 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	20 ppm 7.5 hours/day for 5 days, NOAEL _{HEC} = 27 mg/m ³ ; NA	human	NA	CNS effects, nose and throat irritation; NA	3E-1	ND	100	NA	Hake et al., 1981; U.S. EPA, 1989/ U.S. EPA, 1989
chronic	20 ppm 7.5 hours/day for 5 days, NOAEL _{HEC} = 27 mg/m ³ ; NA	human	NA	CNS effects, nose and throat irritation; 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: December, 1990

Compound	Exposure	Species		Effect of Concern	Inhalation RfC	Oral RfD	Uncertainty Factor		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation; Oral	[mg/m ³ (mg/kg/day)]	(mg/kg/day)	Inhalation	Oral	Inhalation/Oral
Xylenes, mixed	subchronic 20 ppm 7.5 hours/day for 5 days, NOAEL _{HEC} = 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 irritation; none observed	3E-1	4E+0	100	100	Hake et al., 1981; Litton Bionetics, 1978; U.S. EPA, 1989/NTP, 1986; U.S. EPA, 1990
	chronic 20 ppm 7.5 hours/day for 5 days, NOAEL _{HEC} = 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 irritation; hyperactivity, decreased body weight and increased mortality at higher dosage ¹	3E-1 ^j	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 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 NA; 2.14 mg/kg/day therapeutic dosage	NA	human	NA; anemia ¹	ND	2E-1 ^g	NA	10	U.S. EPA, 1984/Pories et al., 1967; Prasad et al., 1975; U.S. EPA, 1984
Zinc cyanide	subchronic NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (67.5 mg zinc cyanide/kg/day)	NA	rat	NA; weight loss, thyroid effects and myelin degeneration	ND	5E-2 ⁿ	NA	500	NA/Howard and Hanzal, 1955; Philbrick et al., 1979; U.S. EPA, 1990
	chronic NA; 10.8 mg/kg/day fumigated cyanide in food for 2 years (67.5 mg zinc cyanide/kg/day)	NA	rat	NA; weight loss, thyroid effects and myelin degeneration	ND	5E-2 ^{a,n}	NA	500	NA/Howard and Hanzal, 1955; Philbrick et al., 1979; 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 RfC [mg/m ³ (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor		Reference
	Inhalation	Oral	Inhalation	Oral				Inhalation	Oral	
Zinc phosphide	subchronic	NA; 50 ppm in diet for 13 weeks, converted to 3.48 mg/kg/day by authors	NA	rat	NA; reduction of food intake and body weight	ND	3E-3	NA	1000	NA/Bai et al., 1980; U.S. EPA, 1990
	chronic	NA; 50 ppm in diet for 13 weeks, converted to 3.48 mg/kg/day by authors	NA	rat	NA; reduction of food intake and body weight	ND	3E-4 ^a	NA	10,000	NA/Bai et al., 1980; U.S. EPA, 1990
Zineb	subchronic	NA; 500 ppm in the diet for 2 years (25 mg/kg/day)	NA	rat	NA; thyroid hyperplasia	ND	5E-2	NA	500	NA/Blackwell-Smith et al., 1953; U.S. EPA, 1984, 1990
	chronic	NA; 500 ppm in the diet for 2 years (25 mg/kg/day)	NA	rat	NA; thyroid hyperplasia	ND	5E-2a	NA	500	NA/Blackwell-Smith et al., 1953; 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/RfC Work Group

^hBecause of background dietary exposure, a subchronic oral RfD was not estimated.

ⁱVerified 2 separate RfDs, 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 an EPA weight-of-evidence Group D substance

^mThese values differ from those in the HEED (U.S. EPA, 1987) because the uncertainty factors for deriving the inhalation RfD values presented herein were changed to correspond to those used by IRIS (U.S. EPA, 1990) for generating the oral RfD from the same (inhalation) study.

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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ⁿCalculated by analogy to free cyanide by correcting for differences in molecular weight

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

^pOral RfD not verified and currently not under discussion

^qBased on RfD for methyl mercury

^rThese 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.

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

^tVerified as a Group C carcinogen; no quantitative estimate available.

^uAn acceptable air concentration of 0.07 mg/m³ was estimated by Carson et al. (1981) from available data.

^vExperiment performed with o-xylene

^wFrom toxicity data on tetraethyl lead

^xWithdrawn from IRIS

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

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

^{aa}Developmental effects have been used as the basis of calculation.

^{bb}Based on arsenic equivalents

^{cc}This value for nitrogen dioxide-N is based on analogy to nitrate.

^{dd}Calculated by analogy to mercury by correcting for differences in molecular weight.

^{ee}A new RfD is verified and the old number on IRIS will be changed.

^{ff}Inhalation RfC not verified and currently not under discussion.

^{gg}This chemical's RfC or RfD is considered "not verifiable" (further explanation available on IRIS).

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

Notes: To estimate acceptable water concentrations from oral RfDs/RfD, multiply by 70 and divide by 2 l.
If exposure occurs by both oral and inhalation routes, the route-specific RfDs/RfD must be proportionally reduced.

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE B: CARCINOGENICITY
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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]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
Acephate	NA; 2-year dietary	NA	mouse	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, 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, 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, 1990/ Quast et al., 1980; Bio/dynamics, Inc. 1980a,b; U.S. EPA, 1983, 1987, 1990
Alachlor	NA; NA	NA	NA	NA (also see Table A)	NA	B2/ND ^f	B2/2.3E-6 [8.1E-2] ^f	U.S. EPA, 1984, 1990/U.S. EPA, 1984, 1990
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, 1987, 1990/NCI, 1977; Davis and Fitzhugh, 1962; Epstein, 1975; Davis, 1965; U.S. EPA, 1986, 1987, 1990
Allyl chloride	NA; NA	NA	NA	NA (also see Table A)	NA	C/ND ^a	C/ND ^a	U.S. EPA, 1983, 1990/U.S. EPA, 1983, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE B: CARCINOGENICITY
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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]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
Aniline	NA; 2-year dietary	NA	rat	NA	spleen	B2/ND	B2/1.6E-7 [5.7E-3] ^a	U.S. EPA, 1990/ CIIT, 1982; U.S. EPA, 1985, 1990
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]	Popper et al., 1960; Oser and Oser, 1962; U.S. EPA, 1989/ Popper et al., 1960; Oser and Oser, 1962; U.S. EPA, 1989
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/ $\text{m}\ell$) ^{-1m}	A/ND	U.S. EPA, 1986, 1990/NTP, 1985; U.S. EPA, 1985, 1990
Atrazine	NA; 2-year dietary	NA	rat	NA	mammary gland adenoma, fibro- adenomas, adeno- carcinomas and carcinosarcomas	C/ND	C/6.3E-6 [2.22E-1] ^f	U.S. EPA, 1984/ Ciba-Geigy, 1986, U.S. EPA, 1984
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
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, 1987, 1989, 1990/ Ott et al., 1978; Rinsky et al., 1981; Wong et al., 1983; U.S. EPA, 1985, 1987, 1989, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE B: CARCINOGENICITY
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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]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
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 ^{a,u}	B2/ND ^{a,u}	U.S. EPA, 1990
Benzo[a]pyrene	2.2-9.5 mg/m ³ , 4.5 hours/day for ≤96.4 weeks; 1-250 ppm diet for ≈110 days	hamster	mouse	respiratory tract	stomach	B2/1.7E-3 [6.1] ^{u,w}	B2/3.3E-4 [11.5] ^{u,w}	Thyssen et al., 1990; U.S. EPA, 1984, 1990/Neal and Rigdon, 1967; U.S. EPA, 1980, 1984, 1990
Benzo[b]fluoranthene	NA; NA	NA	NA	NA	NA	B2/ND ^{a,u}	B2/ND ^{a,u}	U.S. EPA, 1990/ U.S. EPA, 1990
Benzo[k]fluoranthene	NA; NA	NA	NA	NA	NA	B2/ND ^{a,u}	B2/ND ^{a,u}	U.S. EPA, 1990/ U.S. EPA, 1990
Benzotrichloride	NA; 0.26 mg/kg/day, 2 days/week by gavage for 25 weeks	mouse	mouse	lung	lungs	B2/NA ^g	B2/3.6E-4 [1.3E+1] ^a	U.S. EPA, 1990/ Fukuda et al., 1978; U.S. EPA, 1986, 1990
Benzyl chloride	NA; 0, 15, 30 mg/kg, 3 days/week by gavage for 104 weeks	NA	rat	NA	thyroid	B2/ND	B2/4.9E-6 [1.7E-1] ^a	U.S. EPA, 1990/ Lijinski, 1986; U.S. EPA, 1986, 1990
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, 1975; 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

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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]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
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, 1990/ NTP, 1982, U.S. EPA, 1986, 1988, 1990
Bromodichloromethane	NA; 102-week gavage study	NA	mouse	NA (also see Table A)	liver	B2/ND ^a	B2/3.7E-6 [1.3E-1] ^a	U.S. EPA, 1987, 1990/NTP, 1986; U.S. EPA, 1987, 1990
Bromoethene (vinyl bromide)	2-year inhalation study; NA	rat	NA	liver	NA	B2/3.2E-5 [1.1E-1]	B2/ND	Benya et al., 1982; U.S. EPA, 1984/ U.S. EPA, 1984
Bromoform	NA; 103-week gavage study	NA	rat	NA (also see Table A)	large intestine	B2/1.1E-6 [3.9E-3] ^a	B2/2.3E-7 [7.9E-3] ^a	U.S. EPA, 1989, 1990/NTP, 1988; U.S. EPA, 1989, 1990
1,3-Butadiene	two inhalation studies; NA	mouse	rat	hematopoietic system, Leydig cell, thyroid	NA	B2/2.8E-4 [1.8E+0] ^{a,1}	ND	ND/Hazelton Labs, 1981; U.S. EPA, 1985, 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, 1990
Captafol	NA; dietary study (CBI)	NA	mouse	NA (also see Table A)	lymphosarcoma	C/ND	C/2.4E-7 [8.6E-3]	U.S. EPA, 1984/ U.S. EPA, 1984

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		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
						$(\mu\text{g}/\text{m}^3)^{-1}$ [(mg/kg/day) $^{-1}$]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) $^{-1}$]	
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, 1990/U.S. EPA, 1984, 1990
Carbazole	NA; 96-week dietary study	NA	mouse	NA	liver	B2/ND	B2/2.8E-7 [2E-2]	U.S. EPA, 1986/ Tsuda et al., 1982; U.S. EPA, 1986
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, 1984a,b, 1990
Chloranil	NA; 82-week oral study	NA	mouse	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	liver	B2/ND	B2/2.4E-6 [8.4E-2]	U.S. EPA, 1987/ NTP, 1985; U.S. EPA, 1987
Chloroethene (see vinyl chloride)								
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

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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) $^{-1}$]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) $^{-1}$]	
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, 1981; NIOSH, 1984; U.S. EPA, 1987/CIIT, 1981; NIOSH, 1984; U.S. EPA, 1986, 1987
4-Chloro-2-methyl-aniline	NA; 0-4000 ppm in the diet for 18 months	NA	mouse	NA	vascular hemangiomas and hemangio-sarcomas	B2/ND	B2/1.6E-4 [5.8E-1] ^o	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	mouse	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	mouse	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	mouse	NA	vascular tumors	B2/ND	B2/5.1E-7 [1.8E-2]	U.S. EPA, 1985/ U.S. EPA, 1985; Weisburger et al., 1978
Chlorothalonil	NA; dietary study for 27-32 months	NA	rat	NA (also see Table A)	kidney	B2/ND	B2/3.1E-7 [1.1E-2] ^f	U.S. EPA, 1984/ IRDC, 1985; U.S. EPA, 1984
Chromium (VI)	occupational; NA	human	NA	lung (also see Table A)	NA	A/1.2E-2 [4.1E+1] ^a	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 ^a	B2/NA ^a	U.S. EPA, 1990/ U.S. EPA, 1990

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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]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
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
Creosote	NA; NA	NA	NA	NA	NA	B1/ND ^a	B1/ND ^a	U.S. EPA, 1990/ U.S. EPA, 1990
Cresol, o-, m- and p-	NA; NA	NA	NA	NA (also see Table A)	NA	C/ND ^a	C/ND ^a	U.S. EPA, 1984, 1990/U.S. EPA, 1984, 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
DDD	NA; 250 ppm in diet for 130 weeks	NA	mouse	NA	liver	NA	B2/6.9E-6 [2.4E-1] ^a	U.S. EPA, 1990/ Tomatis et al., 1974; U.S. EPA, 1990
DDE	NA; doses of 0-1,000 ppm in diet in 3 studies	NA	mouse, hamster	NA	liver	B2/ND	B2/9.7E-6 [3.4E-1] ^a	U.S. EPA, 1990/ NCI, 1978; Tomatis et al., 1974; Rossi et al., 1983; U.S. EPA, 1990
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 ^a	C/ND ^a	U.S. EPA, 1984, 1987, 1990/U.S. EPA, 1984, 1987 1990
Diallate	NA; 19-month oral study	NA	mouse	NA	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 ^{a,u}	B2/ND ^{a,u}	U.S. EPA, 1990/ U.S. EPA, 1990

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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]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
Dibromochloromethane	NA; 105-week gavage study	NA	mouse	NA (also see Table A)	hepatocellular adenomas or carcinomas	C/ND ^a	C/2.4E-6 [8.4E-2] ^a	U.S. EPA, 1990/ NTP, 1985; U.S. EPA, 1987, 1989, 1990
1,2-Dibromo-3-chloropropane	Inhalation study; Studies include gavage and skin application	rat, mouse	rat, mouse	lung, nasal cavity, tongue, pharynx, adrenal cortex	forestomach, mammary gland, lung, skin	B2/6.3E-3 [2.2E+1]	B2/6.3E-4 [2.2E+1]	SRC, 1982; U.S. EPA, 1985, 1986/SRC 1982; U.S. EPA, 1985, 1986
1,2-Dibromoethane (ethylene dibromide)	88-103 week inhalation 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	C/ND	C/6.8E-7 [2.4E-2] ^g	Federal Register, 1987; U.S. EPA, 1987/Federal Register, 1987; NTP, 1986; U.S. EPA, 1987
3,3'-Dichlorobenzidine	NA; lifetime dietary study	NA	rat	NA	mammary	B2/ND	B2/1.3E-5 [4.5E-1] ^a	U.S. EPA, 1990/ Stula et al., 1975; U.S. EPA, 1988, 1990
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 ^a	C/ND ^a	U.S. EPA, 1984, 1990/NCI, 1978; U.S. EPA, 1985, 1990
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,i}	C/1.7E-5 [6E-1] ^a	Maltoni et al., 1985; U.S. EPA, 1985, 1990/NTP, 1982; U.S. EPA, 1985, 1988, 1990

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Compound	Exposure Inhalation; Oral	Species Inhalation Oral		Tumor Site Inhalation Oral		EPA Group/Unit Risk [Slope Factor]		Reference Inhalation/Oral
						Inhalation	Oral	
						$(\mu\text{g}/\text{m}^3)^{-1}$ [(mg/kg/day) ⁻¹]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
Dichloromethane: see Methylene chloride								
1,2-Dichloropropane	NA; gavage	NA	mouse	NA (also see Table A)	liver	B2/ND	B2/1.9E-6 [6.8E-2] ⁸	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] ^t	B2/5.1E-6 [1.8E-1] ^t	Lomax et al., 1989; U.S. EPA, 1989, 1990/NTP, 1985; U.S. EPA, 1985, 1989, 1990
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; Meierhenrey et al., 1983; NCI, 1978; U.S. EPA, 1990/Thorpe and Walker, 1973; Davis, 1965; Walker et al., 1972; Tennekes et al., 1981; Meierhenrey et al., 1983; NCI, 1978; U.S. EPA, 1987, 1990
Diethylstilbesterol	Oral studies; Oral studies	rat, mouse	rat, mouse	mammary gland, uterus, cervix	mammary gland, uterus, cervix	A/1.4E-1 [4.9E+2] ^b	A/1.4E-2 [4.9E+2]	SRC, 1983; U.S. EPA, 1986/SRC, 1983; U.S. EPA, 1986
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

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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]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
7,12-Dimethylbenz(a) anthracene				Data Inadequate for Risk Assessment ^u				
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/ND ^a	B2/ND ^a	U.S. EPA, 1985, 1990/U.S. EPA, 1985, 1990
2,4-Dinitrotoluene	NA; 2-year dietary study	NA	rat	NA (also see Table A)	liver, mammary gland	B2/ND ^a	B2/1.9E-5 [6.8E-1] ^{a,n}	U.S. EPA, 1987, 1990/Ellis et al., 1979; U.S. EPA, 1987, 1990
2,6-Dinitrotoluene	NA; NA	NA	NA	NA (also see Table A)	NA	B2/ND ^a	B2/1.9E-5 [6.8E-1] ^{a,n}	U.S. EPA, 1987, 1990/U.S. EPA, 1987, 1990
1,4-Dioxane	NA; 0-530 mg/kg/day for 110 weeks	NA	rat	NA	nasal cavity, liver	B2/ND	B2/3.1E-7 [1.1E-2] ^a	U.S. EPA, 1990/ NCI, 1978; U.S. EPA, 1990
1,2-Diphenylhydrazine	2-year dietary study; 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] ^g	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] ^g	U.S. EPA, 1987/ NCI, 1978; U.S. EPA, 1987

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		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
						$(\mu\text{g}/\text{m}^3)^{-1}$ [(mg/kg/day) $^{-1}$]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) $^{-1}$]	
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] ^g	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 acrylate study	NA	rat	NA	forestomach	B2/ND	B2/1.4E-6 [4.8E-2] ^g	U.S. EPA, 1987/ NTP, 1986; U.S. EPA, 1987
Ethylene dibromide (see 1,2-Dibromoethane)								
Ethylene oxide	2-year inhalation study; NA	rat	NA	blood cells, brain	NA	B1/1E-4 [3.5E-1] ^g	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 (also see Table A)	thyroid	B2/ND	B2/1E-6 [3.6E-2] ^g	U.S. EPA, 1984/ Graham et al., 1975; U.S. EPA, 1984
Folpet	NA; 112-113-week dietary study	NA	mouse	NA (also see Table A)	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	rodent	nasal cavity	nasal cavity	B1/1.3E-5 [4.5E-2] ^a	B1/8.6E-7 [3.0E-2]	Kerns et al., 1983; U.S. EPA, 1990/ U.S. EPA, 1985, 1988a,b
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

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		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
						$(\mu\text{g}/\text{m}^3)^{-1}$ [(mg/kg/day) ⁻¹]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
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	rat	NA (also see Table A)	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
Heptachlor epoxide	0-10 ppm in diet for 2 years ^b ; 0-10 ppm in diet for 2 years	mouse	mouse	liver	liver	B2/2.6E-3 [9.1E+0] ^{a,b}	B2/2.6E-4 [9.1E+0] ^a	Davis, 1965; Velsicol Chemical Corp., 1973; U.S. EPA, 1990/Davis, 1965; Velsicol Chemical Corp., 1973; U.S. EPA, 1990
Hexachlorobenzene	diet; diet	hamster	hamster	liver (also see Table A)	liver	B2/4.6E-4 [1.6E+0] ^{b,f}	B2/4.6E-5 [1.6E+0] ^f	Cabral et al., 1977; U.S. EPA, 1984, 1990/Cabral et al., 1977; U.S. EPA, 1984, 1985, 1990
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	mouse	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

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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]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
Hexachlorocyclohexane- beta	NA; 110-week dietary study	NA	mouse	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- 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- technical	NA; 6- to 20-month dietary study	NA	mouse	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, 1989, 1990/NCI, 1978; U.S. EPA, 1980, 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, 1990a,b/ Bianciflori, 1970; U.S. EPA, 1984, 1990a,b
Indeno[1,2,3-c,d] pyrene	NA; NA	NA	NA	NA	NA	B2/ND ^{a,u}	B2/ND ^{a,u}	U.S. EPA, 1990/ U.S. EPA, 1990
Isophorone	NA; 2-year gavage study	NA	rat	NA (also see Table A)	kidney, preputial gland	C/ND ^f	C/1.2E-7 [4.1E-3] ^a	U.S. EPA, 1987, 1990/NTP, 1986; U.S. EPA, 1986, 1987, 1990
Lead	NA; NA	NA	NA	NA (also see Table A)	NA	B2/ND ^a	B2/ND ^a	U.S. EPA, 1984, 1990/U.S. EPA, 1984, 1990
Linuron	NA; NA	NA	NA	NA (also see Table A)	NA	C/ND ^a	C/ND ^a	U.S. EPA, 1990/ U.S. EPA, 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

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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]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
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
Methyl chloride (see Chloromethane)								
3-Methylchol-anthracene				Data Inadequate for Risk Assessment ^u				
4,4'-Methylenebis benzelamine	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 (2-chloroaniline)	NA; 2-year diet study	NA	rat	NA (also see Table A)	lung	B2/3.7E-5 [1.3E-1]	B2/3.7E-6 [1.3E-1]	U.S. EPA, 1990/ Kamminen et al., 1979; Stula et al., 1975; U.S. EPA, 1990
4,4'-Methylene bis (N,N'-dimethylaniline)	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	B2/4.7E-7 ^{a,v}	B2/2.1E-7 [7.5E-3] ^a	NTP, 1986; U.S. EPA, 1984, 1990/NTP, 1986; NCA, 1983; U.S. EPA, 1985, 1990
Methylhydrazine	NA; lifetime oral study	NA	hamster	NA	liver	NA/ND	NA/3.1E-5 [1.1E+0]	U.S. EPA, 1984/Toth 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

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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) $^{-1}$]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) $^{-1}$]	
Niagara Blue 4B	NA; NA	NA	NA	NA	NA	B2/ND	B2/ND	U.S. EPA, 1987/ U.S. EPA, 1987
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, 1990/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; 22-month inhalation study	rat,	rat, rabbit	liver	liver	B2/2.7E-3 [9.4E+0] ^g	B2/2.7E-4 [9.5E+0] ^g	Lewis et al., 1979; U.S. EPA, 1985/ U.S. EPA, 1985, 1986
N-Nitroso-di-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
N-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 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]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
N-Nitrosodiphenyl-amine	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/ Peto et al., 1984; NCI, 1979; U.S. EPA, 1980, 1986a,b, 1987, 1990
N-Nitrosodi-n-propyl-amine	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-Nitroso-n-methyl-ethylamine	NA; in 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-Nitrosomethylvinyl-amine	NA; NA	NA	NA	NA	NA	B2/ND	B2/ND	U.S. EPA, 1986/ U.S. EPA, 1986
N-Nitrosopyrrolidine	0-3 mg/kg/day in drinking water ^b ; 0-3 mg/kg/day in drinking water	rat	rat	liver	liver	B2/6.1E-4 [2.1E+0] ^{a,b}	B2/6.1E-5 [2.1E+0] ^a	Preussman et al., 1977; U.S. EPA, 1990/Preussman et al., 1977; U.S. EPA, 1990
Parathion	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
PCBs (see Polychlorinated biphenyls)								
1,2,3,4,5-Penta-bromo-6-chloro-cyclo-hexane	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] ^q	U.S. EPA, 1985/ Blair, 1981; U.S. EPA, 1985
Pentachloronitro-benzene	NA; 72-week oral study	NA	mouse	NA (also see Table A)	liver	C/ND	C/7.4E-6 [2.6E-1] ^g	U.S. EPA, 1986/ Innes et al., 1969; U.S. EPA, 1986
Pentachlorophenol	NA; two 2-year dietary studies with technical grade and Dowicide EC-7	NA	mouse	NA (also see Table A)	liver, adrenal, circulatory system	B2/ND	B2/3E-6 [1.2E-1] ^f	U.S. EPA, 1990/ NTP, 1989; U.S. EPA, 1990

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		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
						$(\mu\text{g}/\text{m}^3)^{-1}$ [(mg/kg/day) $^{-1}$]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) $^{-1}$]	
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
2-Phenylphenol	NA; 2-phenylphenol 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
Polybrominated biphenyls	NA; Firemaster FF-1 by gavage for 25 weeks followed by 23-month observation	NA	rat	NA	hepatocellular carcinoma and neoplastic 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 ^{a,v}	B2/6.8E-6 [2.4E-1] ^a	NTP, 1985; Renne et al., 1986; U.S. EPA, 1985, 1990/ Dunkelberg, 1982; U.S. EPA, 1985, 1990
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
RDX (Cyclonite)	NA; 2-year diet study	NA	mouse	NA	liver hepato-cellular carcinomas and adenomas (also see Table A)	C/ND	C/3.1E-6 [1.1E-1] ^a	U.S. EPA, 1989, 1990/Lish et al., 1984; U.S. EPA, 1989, 1990
Selenium sulfide	NA; 2-year oral study	NA	rat, mouse	NA	liver, lung	B2/ND ^f	B2/ND ^f	U.S. EPA, 1989/ NCI/NTP, 1980; U.S. EPA, 1989
Simazine	NA; NA	NA	NA	NA (also see Table A)	NA	C/ND ^f	C/3.4E-6 [1.2E-1] ^f	U.S. EPA, 1984, 1988/U.S. EPA, 1984, 1990

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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]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
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
Stiropfos (see Tetrachlorvinphos)								
Styrene	20-month inhalation study; gavage study	rat	mouse	leukemia (also see Table A)	lung and bronchi	B2/5.7E-7 [2.0E-3] ^g	B2/8.6E-7 [3.0E-2] ^g	Jersey et al., 1978; U.S. EPA, 1989, 1990/NCI, 1979; U.S. EPA, 1989, 1990
2,3,7,8-TCDD	diet; diet	rat	rat	several	several	B2 ^j /3.3E-5 ^g (pg/m ³) ⁻¹ [1.5E+5] ^{b, f}	B2 ^j /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
1,1,1,2-Tetrachloro- ethane	0-500 mg/kg/day in corn oil by gavage 5 days/ week for 103 weeks ^b ; 0-500 mg/kg/day in corn corn oil by gavage 5 days/week for 103 weeks	mouse	mouse	liver	liver	C/7.4E-6 [2.6E-2] ^{a, b}	C/7.4E-7 [2.6E-2] ^a	NTP, 1983; U.S. EPA, 1990/NTP, 1983; U.S. EPA, 1990
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, 1990/NCI, 1978; U.S. EPA, 1980, 1990
Tetrachloroethylene (perchloroethylene)	inhalation; gavage	rat, mouse	mouse	leukemia, liver (also see Table A)	liver	B2/5.2E-7 ^f	B2/1.5E-6 [5.1E-2] ^f	NTP, 1986; U.S. EPA 1986, 1988/NCI, 1977; U.S. EPA, 1985, 1988
p,α,α,α-Tetrachloro- toluene	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
Tetrachlorvinphos (stiropfos)	NA; 560-day dietary study	NA	mouse	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

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		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
						$(\mu\text{g}/\text{m}^3)^{-1}$ [(mg/kg/day) $^{-1}$]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) $^{-1}$]	
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	mouse	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
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,i}	B2/3.2E-7 [1.1E-2] ^h	Maltoni et al., 1986; Fukuda et al., 1983; U.S. EPA, 1988/NCI, 1976; NTP, 1983; U.S. EPA, 1985, 1987, 1988
2,4,6-Trichlorophenol	diet; diet	mouse	mouse	liver	liver	B2/3.1E-6 [1.1E-2] ^a	B2/3.1E-7 [1.1E-2] ^a	NCI, 1979; U.S. EPA, 1980, 1987, 1990/NCI, 1979; U.S. EPA, 1980, 1984, 1987, 1990

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Compound	Exposure Inhalation; Oral	Species Inhalation Oral		Tumor Site Inhalation Oral		EPA Group/Unit Risk [Slope Factor]		Reference Inhalation/Oral
						Inhalation	Oral	
						$(\mu\text{g}/\text{m}^3)^{-1}$ [(mg/kg/day) ⁻¹]	$(\mu\text{g}/\ell)^{-1}$ [(mg/kg/day) ⁻¹]	
Trifluralin	NA; in the diet for 2 years	NA	rat	NA (also see 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	mouse	NA	uterus	B2/ND	B2/1.1E-6 [3.7E-2]	U.S. EPA, 1985/ NCI, 1978; U.S. EPA, 1985
2,4,6-Trinitroluene	NA; 2-year dietary study	NA	rat	NA (also see Table A)	urinary bladder	C/ND	C/9.0E-7 [3.0E-2] ^a	U.S. EPA, 1990a,b/ U.S. DOD, 1984; U.S. EPA, 1990a,b
Vinyl bromide (see bromoethene)								
Vinyl chloride	1-year inhalation study; 10-50 ppm diet	rat	rat	liver	lung	A/8.4E-5 ^f	A/5.4E-5 [1.9E+0] ^f	Maltoni et al., 1980, 1981; U.S. EPA, 1985b; ATSDR, 1988/Feron et al., 1981; U.S. EPA, 1984, 1985a

^aVerified, available on IRIS

^bBased on 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 file and IRIS input pending

^gUnder review by CRAVE Workgroup

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

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¹Slope factor is for internal dose; ambient concentration was calculated by assuming an absorption factor of 54%.

^mThe slope factor, while still available on IRIS, is being reconsidered by the CRAVE Workgroup.

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 to calculate the unit risk from the slope factor.

^qBased on results with the alpha isomer

^rCRAVE-EPA group verified, pending input into IRIS. Quantitative estimates were not calculated by the CRAVE Workgroup.

^sAn absorption factor of 75% is used to calculate the unit risk from the slope factor

^tCRAVE-EPA group verified and available on IRIS; quantitative estimates, derived more recently than IRIS evaluation, have not been verified.

^uFor RCRA activities only, contact Steve Kroner of the Office of Solid Waste (FTS 382-5219 or (202)382-5219) for RCRA-approved numeric assessment for this compound

^vU.S. EPA (1990) only verified a unit risk for inhalation exposure.

^wCRAVE-EPA group verified and available on IRIS; quantitative estimates, derived in a HEA document (U.S. EPA, 1984), have not been verified.

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 at low dose and dose rate exposures from risks observed at higher doses using non-threshold, 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 lifetime total excess cancer risk per unit intake or exposure. HEAST users should consult Volume I of the Background Information Document for the 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 year per pCi/m² 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) = 3.7×10^{-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,

$$\text{risk per pCi/m}^3 \text{ (air)} = \text{slope factor (risk per pCi inhaled)} \times 20 \text{ m}^3/\text{day} \times 25,550 \text{ days}$$

$$\text{risk per pCi/L (water)} = \text{slope factor (risk per pCi ingested)} \times 2 \text{ L/day} \times 25,550 \text{ days}$$

$$\begin{aligned} \text{risk per pCi/g (soil)} &= \text{slope factor (risk per pCi} \\ \text{(soil ingestion)} &\text{ ingested)} \times [(0.2 \text{ g/day} \\ &\times 1,825 \text{ days}) + (0.1 \text{ g/day} \\ &\times 23,360 \text{ days})] \end{aligned}$$

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,

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

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:

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

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 ^{**} 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 (yr/(pCi/m ²)) ⁻¹	Air (pCi/m ³) ⁻¹	Drinking Water (pCi/L) ⁻¹	External Exposure ₁ (pCi/g) ⁻¹	Soil Ingestion ₁ (pCi/g) ⁻¹
Ac-225	Y	1.0E-03	2.4E-09	1.7E-11	9.4E-13	1.2E-03	8.7E-07	9.4E-06	4.6E-08
Ac-227	Y	1.0E-03	8.3E-08	3.5E-10	1.3E-14	4.2E-02	1.8E-05	1.3E-07	9.5E-07
Ac-228	Y	1.0E-03	2.6E-11	5.1E-13	5.1E-11	1.3E-05	2.6E-08	5.1E-04	1.4E-09
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
At-217	D	9.5E-01	5.6E-17	4.5E-18	1.4E-14	2.9E-11	2.3E-13	1.4E-07	1.2E-14
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-210	W	5.0E-02	8.1E-11	1.9E-12	0.0E+00	4.1E-05	9.7E-08	0.0E+00	5.1E-09
Bi-211	W	5.0E-02	1.9E-13	1.2E-14	2.8E-12	9.7E-08	6.1E-10	2.8E-05	3.2E-11
Bi-212	W	5.0E-02	6.9E-12	3.6E-13	1.0E-11	3.5E-06	1.8E-08	1.0E-04	9.7E-10
Bi-213	W	5.0E-02	3.2E-13	2.3E-13	8.1E-12	1.6E-07	1.2E-08	8.1E-05	6.2E-10
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

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 (yr/(pCi/m ²)) ⁻¹	Air (pCi/m ³) ⁻¹	Drinking Water (pCi/L) ⁻¹	External Exposure ₁ (pCi/g) ⁻¹	Soil Ingestion ₁ (pCi/g) ⁻¹
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
Eu-152	W	1.0E-02	1.2E-08	2.1E-12	6.3E-11	6.1E-03	1.1E-07	6.3E-04	5.7E-09
Eu-154	W	1.0E-02	1.4E-10	3.0E-12	6.8E-11	7.2E-05	1.5E-07	6.8E-04	8.1E-09
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
Fr-221	D	9.5E-01	9.2E-13	5.9E-14	1.9E-12	4.7E-07	3.0E-09	1.9E-05	1.6E-10
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-125	D	9.5E-01	1.7E-11	2.6E-11	1.7E-12	8.7E-06	1.3E-06	1.7E-05	7.0E-08
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
I-133	D	9.5E-01	1.2E-11	2.1E-11	3.5E-11	6.1E-06	1.1E-06	3.5E-04	5.7E-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 ^{**} 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 (yr/(pCi/m ²)) ⁻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
Ni-59	W	5.0E-02	6.9E-13	8.7E-14	3.4E-14	3.5E-07	4.4E-09	3.4E-07	2.3E-10
Ni-63	W	5.0E-02	1.7E-12	2.3E-13	0.0E+00	8.7E-07	1.2E-08	0.0E+00	6.2E-10
Ni-65	W	5.0E-02	1.9E-13	2.6E-13	2.8E-11	9.7E-08	1.3E-08	2.8E-04	7.0E-10
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
Np-239	W	1.0E-03	1.5E-12	9.3E-13	1.1E-11	7.7E-07	4.8E-08	1.1E-04	2.5E-09
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
Pa-231	Y	1.0E-03	4.0E-08	1.9E-10	2.0E-12	2.0E-02	9.7E-06	2.0E-05	5.1E-07
Pa-233	Y	1.0E-03	8.7E-12	1.0E-12	1.3E-11	4.4E-06	5.1E-08	1.3E-04	2.7E-09
Pa-234	Y	1.0E-03	5.4E-13	6.8E-13	1.1E-10	2.8E-07	3.5E-08	1.1E-03	1.8E-09
Pa-234m	Y	1.0E-03	1.6E-15	5.8E-15	6.4E-13	8.2E-10	3.0E-10	6.4E-06	1.6E-11
Pb-209	D	2.0E-01	7.0E-14	8.5E-14	0.0E+00	3.6E-08	4.3E-09	0.0E+00	2.3E-10
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-211	D	2.0E-01	2.9E-12	1.8E-13	2.9E-12	1.5E-06	9.2E-09	2.9E-05	4.9E-10
Pb-212	D	2.0E-01	4.7E-11	7.2E-12	9.2E-12	2.4E-05	3.7E-07	9.2E-05	1.9E-08
Pb-214	D	2.0E-01	2.9E-12	1.8E-13	1.5E-11	1.5E-06	9.2E-09	1.5E-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-212	W	1.0E-01	6.1E-22	2.2E-23	0.0E+00	3.1E-16	1.1E-18	0.0E+00	5.9E-20
Po-213	W	1.0E-01	8.0E-21	3.2E-22	1.7E-15	4.1E-15	1.6E-17	1.7E-08	8.6E-19
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
Po-215	W	1.0E-01	5.7E-18	2.8E-19	8.7E-15	2.9E-12	1.4E-14	8.7E-08	7.6E-16
Po-218	W	1.0E-01	5.8E-13	2.8E-14	0.0E+00	3.0E-07	1.4E-09	0.0E+00	7.6E-11

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 (yr/(pCi/m ²)) ⁻¹	Air (pCi/m ³) ⁻¹	Drinking Water (pCi/L) ⁻¹	External Exposure (pCi/g) ⁻¹	Soil Ingestion (pCi/g) ⁻¹
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-03	4.1E-08	3.1E-10	2.6E-14	2.6E-02	1.6E-05	2.6E-07	8.4E-08
Pu-239 oxide	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-03	4.1E-08	3.1E-10	5.9E-14	2.1E-02	1.6E-05	5.9E-07	8.4E-08
Pu-240 oxide	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-03	3.9E-08	3.0E-10	4.9E-14	2.1E-02	1.5E-05	4.8E-07	8.1E-08
Pu-242 oxide	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-223	W	2.0E-01	3.1E-09	8.0E-11	8.4E-12	1.6E-03	4.1E-06	8.4E-05	2.2E-07
Ra-224	W	2.0E-01	1.2E-09	4.8E-11	6.2E-13	6.1E-04	2.5E-06	6.2E-06	1.3E-07
Ra-225	W	2.0E-01	1.6E-09	6.6E-11	8.0E-13	8.2E-04	3.4E-06	8.0E-06	1.8E-07
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-219 (only)	g	--	4.6E-14	--	3.5E-12	2.4E-08	--	3.5E-05	--
Rn-220 (only)	g	--	1.2E-13	--	3.0E-14	6.1E-08	--	3.0E-07	--
Rn-222 (only)	g	--	7.2E-13	--	2.2E-14	3.7E-07	--	2.2E-07	--
Rn-222+progeny	g	--	1.1E-11	--	--	5.6E-06	--	--	--
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

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 (yr/(pCi/m ²)) ⁻¹	Air (pCi/m ³) ⁻¹	Drinking Water (pCi/L) ⁻¹	External Exposure (pCi/g) ⁻¹	Soil Ingestion (pCi/g) ⁻¹
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
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-227	Y	2.0E-04	4.9E-09	4.8E-12	6.6E-12	2.5E-03	2.5E-07	6.6E-06	1.3E-08
Th-228	Y	2.0E-04	7.7E-08	1.5E-11	1.6E-13	3.9E-02	7.7E-07	1.6E-06	4.1E-08
Th-229	Y	2.0E-04	7.7E-08	3.9E-11	5.8E-12	3.9E-02	2.0E-06	5.8E-05	1.1E-07
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-231	Y	2.0E-04	4.9E-13	4.0E-13	1.1E-12	2.5E-07	2.0E-08	1.1E-05	1.1E-09
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
Th-234	Y	2.0E-04	3.2E-11	4.0E-12	5.6E-13	1.6E-05	2.0E-07	5.6E-06	1.1E-08
Tl-207	D	9.5E-01	4.5E-15	1.3E-14	1.2E-13	2.3E-09	6.6E-10	1.2E-06	3.5E-11
Tl-208	D	9.5E-01	5.1E-15	1.8E-14	1.7E-10	2.6E-09	9.2E-10	1.7E-03	4.9E-11
Tl-209	D	9.5E-01	4.3E-15	1.4E-14	1.1E-10	2.2E-09	7.2E-10	1.1E-03	3.8E-11
U-233	Y	2.0E-01	2.7E-08	1.4E-10	3.2E-14	1.4E-02	7.2E-06	3.2E-07	3.8E-07
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
Y-90	Y	1.0E-04	5.5E-12	3.2E-32	0.0E+00	2.8E-06	1.6E-07	0.0E+00	8.6E-09

* 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)	Ingestion (Bq)	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
Ac-225	Y	1.0E-03	6.5E-08	4.6E-10	2.5E-11	3.3E-02	2.3E-05	2.5E-04	1.2E-08
Ac-227	Y	1.0E-03	2.2E-06	9.5E-09	3.5E-13	1.1E+00	4.9E-04	3.5E-06	2.6E-05
Ac-228	Y	1.0E-03	7.0E-10	1.4E-11	1.4E-09	3.6E-04	7.0E-07	1.4E-02	3.7E-08
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
At-217	D	9.5E-01	1.5E-15	1.2E-16	3.8E-13	7.7E-10	6.2E-12	3.8E-06	3.3E-13
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-210	W	5.0E-02	2.2E-09	5.1E-11	0.0E+00	1.1E-03	2.6E-06	0.0E+00	1.4E-07
Bi-211	W	5.0E-02	5.1E-12	3.2E-13	7.6E-11	2.6E-06	1.6E-08	7.6E-04	8.6E-10
Bi-212	W	5.0E-02	1.9E-12	9.7E-12	2.7E-10	9.5E-05	4.9E-07	2.7E-03	2.6E-08
Bi-213	W	5.0E-02	8.6E-12	6.2E-12	2.2E-10	4.3E-06	3.2E-07	2.2E-03	1.7E-08
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

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	Oral S. (Bq/m ³ /yr) ⁻¹	Air (Bq/m ³) ⁻¹	Drinking Water (Bq/L) ⁻¹	External Exposure (Bq/g) ⁻¹	Soil Ingestion (Bq/g) ⁻¹
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
Eu-152	W	1.0E-02	3.2E-07	5.7E-11	1.7E-09	1.7E-01	2.9E-06	1.7E-02	1.5E-07
Eu-154	W	1.0E-02	3.8E-09	8.1E-11	1.8E-09	1.9E-03	4.1E-06	1.8E-02	2.2E-07
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
Fr-221	D	9.5E-01	2.5E-11	1.6E-12	5.1E-11	1.3E-05	8.1E-08	5.1E-04	4.3E-09
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-125	D	9.5E-01	4.6E-10	7.0E-10	4.6E-11	2.3E-04	3.6E-05	4.4E-04	1.9E-06
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
I-133	D	9.5E-01	3.2E-10	5.7E-10	9.5E-10	1.7E-04	2.9E-05	9.5E-03	1.5E-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 ^{**} 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 ³ (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
Ni-59	W	5.0E-02	1.9E-11	2.4E-12	9.2E-13	9.5E-06	1.2E-07	9.2E-06	6.4E-09
Ni-63	W	5.0E-02	4.6E-11	6.2E-12	0.0E+00	2.3E-05	3.2E-07	0.0E+00	1.7E-08
Ni-65	W	5.0E-02	5.1E-12	7.0E-12	7.6E-10	2.6E-06	3.6E-07	7.6E-03	1.9E-08
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
Np-239	W	1.0E-03	4.1E-11	2.5E-11	3.0E-10	2.1E-05	1.3E-06	3.0E-03	6.8E-08
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
Pa-231	Y	1.0E-03	1.1E-06	5.1E-09	5.4E-11	5.5E-01	2.6E-04	5.4E-04	1.4E-05
Pa-233	Y	1.0E-03	2.4E-10	2.7E-11	3.5E-10	1.2E-04	1.4E-06	3.5E-03	7.3E-08
Pa-234	Y	1.0E-03	1.5E-11	1.8E-11	3.0E-09	7.5E-06	9.4E-07	3.0E-02	5.0E-08
Pa-234m	Y	1.0E-03	4.3E-14	1.6E-13	1.7E-11	2.2E-08	8.0E-09	1.7E-04	4.2E-10
Pb-209	D	2.0E-01	1.9E-12	2.3E-12	0.0E+00	9.7E-07	1.2E-07	0.0E+00	6.2E-09
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-211	D	2.0E-01	7.8E-11	4.9E-12	7.8E-11	4.0E-05	2.5E-07	7.8E-04	1.3E-08
Pb-212	D	2.0E-01	1.3E-09	1.9E-10	2.5E-10	6.5E-04	9.9E-06	2.5E-03	5.3E-07
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-212	W	1.0E-01	1.6E-20	5.9E-22	0.0E+00	8.4E-15	3.0E-17	0.0E+00	1.6E-18
Po-213	W	1.0E-01	2.2E-19	8.6E-21	4.6E-14	1.1E-13	4.4E-16	4.6E-07	2.3E-17
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
Po-215	W	1.0E-01	1.5E-16	7.6E-18	2.4E-13	7.9E-11	3.9E-13	2.4E-06	2.0E-14
Po-218	W	1.0E-01	1.6E-11	7.6E-13	0.0E+00	8.1E-06	2.2E-10	0.0E+00	2.1E-09

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
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-03	1.1E-06	8.4E-09	7.0E-13	5.6E-01	4.3E-04	7.0E-06	2.3E-06
Pu-239 oxide	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-03	1.1E-06	8.4E-09	1.6E-12	5.6E-01	4.3E-04	1.6E-05	2.3E-06
Pu-240 oxide	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-03	1.1E-06	8.1E-09	1.3E-12	5.6E-01	4.1E-04	1.3E-05	2.2E-06
Pu-242 oxide	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-223	W	2.0E-01	8.4E-08	2.2E-09	2.3E-10	4.3E-02	1.1E-04	2.3E-03	5.8E-06
Ra-224	W	2.0E-01	3.2E-08	1.3E-09	1.7E-11	1.7E-02	6.6E-05	1.7E-04	3.5E-06
Ra-225	W	2.0E-01	4.3E-08	1.8E-09	2.2E-11	2.2E-02	9.1E-05	2.2E-04	4.8E-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-219 (only)	g	--	1.2E-12	--	9.5E-11	6.4E-07	--	9.5E-04	--
Rn-220 (only)	g	--	3.2E-12	--	8.1E-13	1.7E-06	--	8.1E-06	--
Rn-222 (only)	g	--	1.9E-11	--	5.9E-13	9.9E-06	--	6.0E-06	--
Rn-222+progeny	g	--	3.0E-10	--	--	1.5E-04	--	--	--
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
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

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 ³ (Bq/m ³) ⁻¹	Drinking Water (Bq/L) ⁻¹	External Exposure (Bq/g) ⁻¹	Soil Ingestion (Bq/g) ⁻¹
Th-227	Y	2.0E-04	1.3E-07	1.3E-10	1.8E-10	6.8E-02	6.6E-06	1.8E-03	3.5E-07
Th-228	Y	2.0E-04	2.1E-06	4.1E-10	4.3E-12	1.1E+00	2.1E-05	4.3E-05	1.1E-06
Th-229	Y	2.0E-04	2.1E-06	1.1E-09	1.6E-10	1.1E+00	5.4E-05	1.6E-03	2.8E-06
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-231	Y	2.0E-04	1.3E-11	1.1E-11	3.0E-11	6.8E-06	5.5E-07	3.0E-04	2.9E-08
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
Th-234	Y	2.0E-04	8.6E-10	1.1E-10	1.5E-11	4.4E-04	5.5E-06	1.5E-04	2.9E-07
TL-207	D	9.5E-01	1.2E-13	3.5E-13	3.2E-12	6.2E-08	1.8E-08	3.2E-05	9.5E-10
TL-208	D	9.5E-01	1.4E-13	4.9E-13	4.6E-09	7.0E-08	2.5E-08	4.6E-02	1.3E-09
TL-209	D	9.5E-01	1.2E-13	3.8E-13	3.0E-09	5.9E-08	1.9E-08	3.0E-02	1.0E-09
U-233	Y	2.0E-01	2.7E-08	1.4E-10	3.2E-14	1.4E-02	7.2E-06	3.2E-07	3.8E-07
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
Y-90	Y	1.0E-04	1.5E-10	8.6E-11	0.0E+00	7.6E-05	4.4E-06	0.0E+00	2.3E-07

*

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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