United States
Environmental Protection
Agency

OSWER (OS-230)
ORD (RD-689)

OERR 9200 6-303 (90-4)
September 1990
NTIS No PB90-921104

EPA

Health Effects Assessment Summary Tables

Fourth Quarter
FY - 1990

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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 fourth quarter update of the Health Effects Assessment Summary Tables (HEAST) prepared by EPA's Environmental Criteria and Assessment Office in Cincinnati, OH for use at both Superfund and RCRA (Resource Conservation and Recovery Act) sites. Previously, the HEAST addressed only chemicals commonly found at Superfund sites. Beginning with the third quarter of this fiscal year, 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.

This update completely replaces the previous edition of this document. Chemicals considered are those for which Health Effects Assessment Documents, Health and Environmental Effects Profiles, Health and Environmental Effects Documents, Health Assessment documents or Air Quality Criteria Documents have been prepared by ECAO. Radionuclides considered are those believed to be most commonly encountered at Superfund sites. This report is an excellent "pointer" system to identify current literature or changes in risk assessments for many chemicals of interest to the Superfund program.

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 assesments 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.

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. 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 Daniel Cruz of the Office of Solid Waste at (202) 382-4785 to obtain copies. Regional OSW staff are reminded that copies of the HEAST are sent to all 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

The NTIS order number to receive all of the quarters for FY90 is PB-90-921100. The order number to receive the Fourth Quarter HEAST only is PB-90-921104. There is a charge to receive this from NTIS.

3. Consultation with EPA staff (ECAO's Chemical Mixtures Assessment Branch at 513/569-7300; FTS 684-7300).

4. Do not consult either the toxicity tables (Appendix A) in the Superfund Public Health Evaluation Manual (SPHEM, U.S. EPA, 1986) or the September 1988 Public Health Risk Evaluation Data Base (PHRED) as these sources are likely to contain numerous values that have since become out-of-date.

Most cited Agency references (e.g., HEAs, HEEPs, HEEDs, etc.), are (or will soon be) available through the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161 (703/487-4650 or 800/336- 4700). Carcinogen Assessment Group (CAG) Profiles cited in Table B are available through RCRA docket (800/424-9346).

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

WHAT'S NEW IN THE FOURTH QUARTER FY90 HEAST

GENERIC ISSUES:

Following recent guidelines established by the RfD Work Group, which were reviewed and approved by the Risk Assessment Council in July, 1990, the term "inhalation reference dose (RfD)" has been changed to "inhalation reference concentration (RfC)." To reflect this change in Table A, the column with the heading "Reference Dose" and with subheadings "Inhalation" and "Oral" has been replaced by two columns, one with the heading "Inhalation RfC" and the other with the heading "Oral RfD." Consequently, in the "Compound" column the notations "RfD_s" and "RfD" for subchronic and chronic data, respectively, have been deleted.

When only one entry, in units of mg/m^3, appears in the Inhalation RfC column, it was derived using the current EPA Interim Methods for Development of Inhalation Reference Doses (see the User's Guide: Chemical Toxicity for further information). This version of the HEAST, however, also presents inhalation risk assessments derived in earlier Agency documents that used an older methodology, which estimated an inhalation reference dose in mg/kg/day. When this older methodology was used, two entries appear in the Inhalation RfC column, one in units of mg/kg/day and the other in units of mg/m^3. The entry in mg/kg/day was derived by the older methodology; the entry in mg/m^3 was estimated from the entry in the mg/kg/day column by assuming humans weigh 70 kg and inhale 20 m^3/day. ECAO is in the process of reevaluating RfCs

verified by the Workgroup during next fiscal year.

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. RfC/RfD and CRAVE Work Group status reports dated 09/30/90 were used in this update of Tables A and B.

In addition, several other minor changes were made to improve internal consistency and to conserve space in the tables. Most of these involved changes in the references column or section. These changes, when unaccompanied by changes in RfC/RfD values are not detailed in the list below.

CHEMICAL-SPECIFIC CHANGES TO TABLE A: OTHER THAN CARCINOGENICITY

Acetone
The subchronic RfD, which inadvertently had been missing, was added.

Acrylic acid
A recently verified inhalation RfC was added.

Aldicarb
A recently verified oral RfD was added.

Barium
A recently verified oral RfD was added.

Chromium III and VI

A recently verified inhalation RfC for trivalent and hexavalent chromium was added.

1,3-Dichlorobenzene
This chemical was added to Table A from a 1987 HEA.

1,3-Dichloropropene
A recently verified inhalation RfC was added.

N,N-Dimethylformamide

A recently verified inhalation RfC was added.

Ethylene glycol monobutyl ether

The inhalation RfC was changed to reflect recent verification.

Hexachlorocyclohexane, delta and epsilon

These chemicals were moved from Table B to Table A because they are verified EPA weight-of-evidence Group D chemicals

Hydrogen sulfide

Data regarding inhalation exposure and corresponding references have been updated.

Manganese

Data regarding oral exposure and corresponding references have been updated. A recently verified inhalation RfC was added.

Methoxychlor

Data regarding the oral RfD have been updated to reflect recent verification.

4,4'-Methylene-bis-(2-chloroaniline)

This is a new entry to the HEAST from a recently finalized HEED.

Molybdenum

This is a new entry to the HEAST from a recently finalized HEED. It should be noted that the National Research Council considers molybdenum to be an essential trace element and that the oral RfD of 0.001 mg/kg/day calculated in the HEED falls at the lower end of the safe and adequate range for intake by adults. Therefore, an interim RfD of 4E-3 mg/kg/day has been calculated by the Superfund Health Risk Technology Support Center (TSC) and this chemical will be scheduled for Workgroup review in FY91. The interim value derived by the TSC is the one reported in this HEAST.

Naphthalene

Data regarding oral exposure and corresponding references have been updated. The oral RfD remains 4E-3 mg/kg/day.

Phosphorus, inorganic compounds

This is a new entry to the HEAST from an Air Quality Planning and Standards Summary Review Document.

Toluene

Oral data and references have been updated to reflect those available on IRIS.

1,2,4-Trichlorobenzene

An interim oral RfD which is judged to be a more appropriate value than the old number was added.

2,4,6-Trinitrotoluene

This is a new entry to the HEAST from a recently finalized HEED.

Vinyl acetate

This is a new entry to the HEAST from a recently finalized HEED.

CHEMICAL-SPECIFIC CHANGES TO TABLE B: CARCINOGENICITY

Bromoform

The footnote was changed to indicate that the classification and quantitative footnotes are available on IRIS.

1,4-Dichlorobenzene

The classification was changed to C to correspond to the 1987 National Primary Drinking Water Regulations (Federal Register. July 8, 1987. 52: 25690-25717). This chemical is currently under review by the CRAVE Workgroup.

Hexachlorocyclohexane, delta and epsilon

These chemicals were moved from Table B to Table A because they are verified in EPA weight-of-evidence Group D.

Isophorone

The value of the oral quantitative estimate was corrected to correspond to the value that is verified and available on IRIS.

Linuron

This chemical was added to Table B because it is verified an EPA weight-of-evidence Group C chemical.

4,4'-Methylene-bis-(2-chloroaniline)

This is a new entry to the HEAST from a recently finalized HEED.

N-Nitrosopyrrolidine

The values of both the oral and inhalation quantitative estimates were corrected to correspond to the values that are verified and available on IRIS.

Pentachlorophenol

This chemical and its newly verified values were added to Table B.

Tetrachloroethylene

An inhalation unit risk that is being considered by the CRAVE Workgroup has been added.

Trichloroethylene

The old footnote "i" for oral slope factor has been removed to indicate that this value is expressed in terms of administered dose.

2,4,6-Trinitrotoluene

This is a new entry to the HEAST from a recently finalized HEED.

Vinyl Chloride

The recently verified oral unit risk and slope factor and inhalation unit risk have been added.

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 RfC/RfD 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):

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

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 inhalaed 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 (mg/kg/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 mg/kg/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:

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

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 $\mu g/m^3$

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 m^3/day) or the water consumption rate (2 ℓ/day), respectively, for risk associated with unit concentration in air or water. Hence,

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

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

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 $\mu g/m^3$) corresponding to an upper-bound increased lifetime cancer risk of $1x10^{-5}$ is calculated as follows:

$$\mu g/m^3 \text{ in air} = \frac{1x10^{-5}}{\text{unit risk in } (\mu g/m^3)^{-1}}$$

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 $1x10^{-5}$ is calculated as follows:

$$mg/\ell \text{ in water} = \frac{1x10^{-5} x\ 70\ kg}{\text{slope factor in } (mg/kg/day)^{-1} \times 2\ \ell/day}$$

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update September, 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
Acenaphthene									
subchronic	NA; 175 mg/kg/day by gavage for 90 days	NA	mouse	NA, hepatotoxicity	ND	6E-1	NA	300	U S EPA, 1987/ U S EPA, 1987, 1989, 1990
chronic	NA; 175 mg/kg/day by gavage for 90 days	NA	mouse	NA, hepatotoxicity	ND	6E-2[j]	NA	3000	U S EPA, 1987/ U S EPA, 1987, 1989, 1990
Acenaphthylene			DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT[l]						U S EPA, 1987
Acephate									
subchronic	NA, 2 ppm in the diet for 13 weeks (0 135 mg/kg/day)	NA	rat	NA, inhibition of brain AChase	ND	4E-3	NA	30	NA/Chevron Chem Co . 1987. U S EPA, 1984, 1990
chronic	NA, 2 ppm in the diet for 13 weeks (0 135 mg/kg/day)	NA	rat	NA, inhibition of brain AChase (also see Table B)	ND	4E-3[a]	NA	30	NA/Chevron Chem Co , 1987; U S EPA, 1984, 1989
Acetone									
subchronic	NA, 100 mg/kg/day for 90 days by gavage	NA	rat	NA increased liver and kidney weight, nephro-toxicity	ND	1E+0	NA	100	U S EPA, 1988/ U S. EPA, 1986, 1988, 1990
chronic	NA, 100 mg/kg/day for 90 days by gavage	NA	rat	NA, increased liver and kidney weight, nephro-toxicity	ND	1E-1[a,l]	NA	1000	U S. EPA, 1988/ U S EPA, 1986, 1988, 1990
Acetone cyanohydrin									
subchronic	10 1 ppm (35.2 mg/m^3) 6 hours/day, 5 days/week for 14 weeks (4.0 mg/kg/day); 10.8 mg CN/kg/day for 104 weeks from diet treated with HCN	rat	rat	CNS signs; body weight, thyroid and CNS effects	1E-1 (4E-2)	7E-2[n]	100	500	Blank and Thake, 1984, U S. EPA, 1988/Howard and Hanzal, 1955; U S EPA, 1985a,b, 1988
chronic	10.1 ppm (35.2 mg/m^3) 6 hours/day, 5 days/week for 14 weeks (4 0 mg/kg/day); 10.8 mg CN/kg/day for 104 weeks from diet treated with HCN	rat	rat	CNS signs, body weight, thyroid and CNS effects	1E-1 (4E-2)	7E-2[n]	100	500	Blank and Thake, 1984; U S. EPA, 1988/Howard and Hanzal, 1955, U S EPA, 1985a,b, 1988

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: 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	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,z]	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 dystrophy, 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 dystrophy, reduced albumin/ globulin ration, none observed	2E-5 (5E-6)[q]	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 composition, 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 composition, NA (also see Table B)	1E-4[j]	ND	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: September, 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	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)=0.33 mg/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 33 mg/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[J]	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					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/Hazelton 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/Hazelton Labs America, Inc , 1988

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

Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: 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	occupational NA	human	NA	liver NA	ND	2E-3[b]	NA	100	NA/ACGIH, 1980, U S EPA, 1983
chronic	occupational, NA	human	NA	liver, NA (also see Table B)	ND	2E-3[b]	NA	100	NA/ACGIH, 1980; U S EPA, 1983
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
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update September, 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
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)[I]	ND	2E-5[g]	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
chronic	0 36 mg/m^3 continuous; 34 mg/ℓ in drinking water	human	human	odor threshold, taste threshold	0 36[c,g]	34 mg/ℓ in drinking water[d]	none	none	Carson et al., 1981, U S EPA, 1987/Campbell et al., 1958, U S EPA, 1981, 1987, WHO, 1986

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
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[j]	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 Bs/kg/day, 0.46 mg Sb_2O_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
chronic	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0.35 mg Sb/kg/day, 0.46 mg Sb_2O_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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
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_2O_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_2O_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_2O_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
chronic	NA; 5 ppm Sb from antimony potassium tartrate in drinking water, lifetime (0 35 mg Sb/kg/day, 0 42 mg Sb_2O_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[8]	NA	100	U S EPA, 1989/ Popper et al , 1960, Oser and Oser, 1962

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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), 10 mg/ℓ Ba in drinking water (1 5 ℓ/day) for 10 weeks	rat	human	fetotoxicity, increased blood pressure	5E-3 (1E-3)[bb]	7E-2	100	3	Tarasenko et al , 1977, U S EPA, 1984/ Wones et al , 1990, Brenniman and Levy, 1984, U S EPA, 1985, 1990
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), 10 mg/ℓ Ba in drinking water (1.5 ℓ/day) for 10 weeks	rat	human	fetotoxicity, increased blood pressure	5E-4 (1E-4)[bb]	7E-2[a]	1000	3	Tarasenko et al , 1977, U S EPA, 1984/ Wones et al , 1990, Brenniman and Levy, 1984, U S EPA, 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[z]	NA	100	NA/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
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
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

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
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
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	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 hemo- globin 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 hemo- globin and possible erythrocyte destruction	ND	4E-2[a]	NA	1000	NA/Mitsumori et al., 1979, U S EPA, 1990

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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	1,000	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
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						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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
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, hyper- plasia 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; hyper- plasia of forestomach epithelium[I]	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
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

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; 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
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

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

Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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[l]								U S EPA, 1988/ U S EPA, 1988
Butyrolactone, gamma	DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT								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[cc]	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,cc]	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
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

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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update. September, 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
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	NA, 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)	NA	rabbit	NA, fetal toxicity, malformation	ND	1E-1	NA	100	NA/Hardin et al., 1981, U S EPA, 1990
chronic	NA, 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)	NA	rabbit	NA, fetal toxicity; malformation	1E-2[J]	1E-1[b,z]	NA	100	U S EPA, 1990/ Hardin et al., 1981, U S EPA, 1990
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

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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[g]	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
Chloroacetaldehyde		DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT[q]							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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
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)[6]	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
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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 (36 mg/m^3), NA	rat	NA	alopecia, retarded growth, NA	1E-1(4E-2)	2E-2[b,q]	100	NA	Du Pont, 1985, U S EPA, 1989, U S EPA, 1989
chronic	10 ppm, 6 hours/day, 5 days/week for 2 years (36 mg/m^3), NA	rat	NA	alopecia, retarded growth, NA	1E-1(4E-2)	2E-2[b,q]	100	NA	Du Pont, 1985, U S. EPA, 1989/ U S EPA, 1989
1-Chlorobutane									
subchronic	NA, 120 mg/kg, 5 days/ week for 13 weeks by gavage (86 mg/kg/day)	NA	rat	NA, CNS and hemato-poietic 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
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
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 , 1978, 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)									
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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 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[a]	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
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 erthrocyte 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 erthrocyte cholinesterase	ND	8E-4	NA	100	NA/Worthing and Walker, 1983, U S EPA, 1986
Chromium (III)									
subchronic	LOAEL of 0 002 mg Cr(VI)/m^3 (as chromic acid) LOAEL(HEC)= 0 000714 mg/m^3, 5% Cr_2O_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

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 0 002 mg Cr(VI)/m^3 (as chromic acid) LOAEL(HEC)= 0.000714 mg/m^3, 5% Cr_2O_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 (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 (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
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[l]	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

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-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
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

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, 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/wk for 4 weeks, 110 mg/kg/day for 194 days	rat	rat	CNS involvement, nasal irritation, renal	9E-2	4E-1	1000	300	Monsanto Company 1986; U S. EPA, 1987, 1990/ Wolfe, 1956, U S EPA, 1990
chronic	105 1 ppm (517 mg/m^3) for 6 hrs/day, 5 days/wk for 4 weeks 110 mg/kg for 194 days	rat	rat	CNS involvement, nasal irritation, renal	9E-3[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[l]	ND	2E-2[a]	NA	500	U S EPA, 1984/ Howard and Hanzal, 1955, U S EPA, 1984, 1990a,b

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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
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[s]							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

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
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
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 80 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

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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
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[a]	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

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
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
chronic	NA; 0 25% of diet for 52 weeks (125 mg/kg/day)	NA	rat	NA, mortality[1]	ND[88]	1E-1[z]	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 8 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); 80 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

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	4136 mg/m^3, 8 hours/day, 5 days/week for 6 weeks (482 3 mg/kg/day); 15 mg/kg/day for 2 years	guinea pig	rat	lung and liver lesions, depressed body weight gain	2E-1 (5E-2)	2E-1[a]	10,000	100	Prendergast et al , 1967, U S EPA, 1987/ Sherman, 1974, U S EPA, 1982, 1987, 1990
1,1-Dichloroethane									
subchronic	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)[8]	1E-1[8]	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[8]	9E-3[z]	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 hematocrit 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 hematocrit and hemoglobin[1]	ND	1E-2[j]	NA	3000	U S EPA, 1984/ McCauley et al n d , 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
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
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-, 2,6[g]-, 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[z]	NA	100	NA/Dow Chemical Co , 1983, U S EPA, 1990
Dichloroprop				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT[s]					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 [NOAEL(HEC)= 0 69 mg/m^3], 3 mg/kg/day in the diet for 90 days 90 days	mice	rat	hypertrophy, hyper- plasia 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

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	5 ppm (21 mg/m^3) 6 hours/day, 5 days/week for 2 years (NOAEL(HEC)= 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
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 histopathology	ND	2E+0	NA	100	U S EPA, 1984/ Smyth et al., 1964, U S EPA, 1984

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC (mg/m^3 (mg/kg/day))	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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
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

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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
N,N-Dimethylformamide									
subchronic	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, Caten et al., 1984, U S EPA, 1990/ Becci et al., 1983, U S EPA, 1986
chronic	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[J]	1E-1	300	1000	Cirla et al., 1984, Caten 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[J]	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
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
Dimethyl phthalate									
subchronic	NA; 1000 mg/kg/day in diet for 2 years	NA	rat	NA, minor effect on growth, some nephritic involvement	ND	1E+0	NA	100	NA/Lehman, 195 U S EPA, 1987
chronic	NA; 1000 mg/kg/day in diet for 2 years	NA	rat	NA; minor effect on growth, some nephritic involvement[l]	ND	1E+0[s]	NA	100	NA/Lehman, 195' 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[l]	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[q]					U S EPA, 1986

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A· SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
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-; 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[s]	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[bb]	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[l]	ND	1E-3[a,bb]	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)
Update: September, 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
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

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

Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: 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	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)[bb]	5E-1bb	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 hemotology, reduced body weight	2E-1 (5E-2)	4E-1	1000	1000	Barbee et al , 1984, U S EPA, 1984/Melnick, 1984, U S EPA, 1985
2-Ethoxyethanol acetate									
subchronic	NA; 50 ppm (30.1 mg/kg) x 6 hours/day on gestational day 6-18	NA	rat	NA, decreased ossification	ND	3E-1b,bb	NA	100	NA/Union Carbide, 1984, U S EPA, 1985

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

Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: 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	3E-1[b,bb]	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	NA 136 mg/kg 5 days/week for 182 days (97 1 mg/kg/day)	NA	rat	NA hepatotoxicity and nephrotoxicity	ND	1E+0	NA	100	U S EPA, 1984/ Wolf et al , 1956, U S EPA, 1984, 1986, 1990
chronic	NA, 136 mg/kg 5 days/week for 182 days (97 1 mg/kg/day)	NA	rat	NA hepatotoxicity, and nephrotoxicity[1]	ND	1E-1[a]	NA	1000	U S EPA, 1984/ Wolf et al , 1956, U S EPA, 1984, 1986, 1990
Ethyl chloride				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U S EPA, 1987
S-Ethyl dipropylthiocarbamate (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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
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 dihydro-chloride (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 dihydro-chloride (22.6 mg ethylenediamine/kg/day)	NA	rat	NA, liver and hemato-logic 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[bb]	NA	100	U S EPA, 1987/ Maronpot et al , 1983; U S EPA, 1987
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
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[J]	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 (molec- ular 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 (molec- ular 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
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, hematolog- ical 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, hematolog- ical changes[1]	ND	4E-2[J]	NA	3000	NA/U S EPA, 1988, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A· SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Inhalation 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
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)[i]	ND	4E-2[j]	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
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

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
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[a]	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
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

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
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 a	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 hemato-logic 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 hemato-logic effects (also see Table B)	ND	8E-4[a]	NA	100	U S EPA, 1984/ Arnold et al , 1985, U S EPA, 1990
Hexachlorobutadiene									
subchronic	NA, 2-year dietary study (0.2 mg/kg/day)	NA	rat	NA, kidney toxicity	ND	2E-3	NA	100	U.S EPA, 1984/ Kociba et al , 1977, U S EPA, 1990
chronic	NA, 2-year dietary study (0.2 mg/kg/day)	NA	rat	NA; kidney toxicity (Cancer, see Table B)	ND	2E-3[a]	NA	100	U S EPA, 1984/ Kociba et al , 1977, U S EPA, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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]	1,000	1,000	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

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: 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[J]	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

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, 300 mg/day for 3-5 months (4.29 mg/kg/day)	NA	human	NA, hematological effects	ND[88]	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									
suchronic	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	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[p]	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[p]	ND[q]	NA	NA	U.S EPA, 1984, 1986/U S EPA, 1984, 1986

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure	Species		Effect of Concern	Inhalation 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: tetrabutyl, 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,x]	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[bb]	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
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 Heijden 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 Heijden 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[q]	NA	1000	NA/Panov et al 1972, U.S EPA, 1986
Mancozeb									
subchronic	NA, 50 ppm in the diet for 80 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 80 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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A. SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: 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[f]	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: 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[I]	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

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 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[s]	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)
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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
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	10 ppm (31 mg/m^3) 6 hours/day, 5 days/ week for 13 weeks (2 9 mg/kg/day), 10 ppm (31 mg/m^3) 6 hours/day, 5 days/week for 13 weeks (1 47 mg/kg/day)	rabbit	rabbit	fetotoxicity and testicular effects, fetotoxicity and testicular effects	1E-1 (3E-2)[o,bb]	1E-2[b,bb]	100	100	Miller et al , 1982/Miller et al , 1982, U S EPA, 1986
chronic	10 ppm (31 mg/m^3) 6 hours/day, 5 days/ week for 13 weeks (2 9 mg/kg/day), 10 ppm (31 mg/m^3) 6 hours/day, 5 days/week for 13 weeks (1 47 mg/kg/day)	rabbit	rabbit	fetotoxicity and testicular effects, fetotoxicity and testicular effects	1E-2 (3E-3)[o,bb]	1E-3[b,g,bb]	1000	1000	Miller et al , 1982/Miller et al , 1982, U S. EPA, 1986
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: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC: [mg/m^3 (mg/kg/day)]	Oral RfD: (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: 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[g]	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)-buturic 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	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, 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 (MCPP)									
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					U S EPA, 1984
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[8]	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: Inhalation, Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: 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 Association, 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 Association, 1982, U S. EPA, 1989, 1990
4,4'-Methylenediphenyl isocyanate		DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT							U S EPA, 1985
Methyl ethyl benzenes (see Ethyltoluene)									
Methyl ethyl ketone									
subchronic	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,bb]	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[l]	3E-1 (9E-2)[s]	5E-2[b,z,bb]	1000	1000	LaBelle and Brieger, 1955, U S EPA, 1990/ LaBelle and Brieger, 1955, U S EPA, 1989, 1990
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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					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[z]	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[s]	NA	100	NA/Borzelleca et al , 1964, U S. EPA, 1985
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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
Molybdenum									
subchronic	NA, 50 µg/day in drinking water (total exposure estimated to be 0 28 mg/day or 0 004 mg/kg/day)	NA	human	NA, changes in biochemical indices	ND	4E-3	NA	1	U S EPA, 1990/ Chappell et al , 1979, U S EPA, 1990
chronic	NA, 50 µg/day in drinking water (total exposure estimated to be 0 28 mg/day or 0 004 mg/kg/day)	NA	human	NA, changes in biochemical indices	ND	4E-3	NA	1	U S EPA, 1990/ Chappell 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
Molinate									
subchronic	NA; 0.2 mg/kg/day by gavage	NA	rat	NA, reproductive toxicity	ND	2E-3	NA	100	NA/Stauffer Chemical Co., 1981, U S EPA, 1990
chronic	NA; 0 2 mg/kg/day by gavage	NA	rat	NA, reproductive toxicity	ND	2E-3[a]	NA	100	NA/Stauffer Chemical Co., 1981, U S EPA, 1990
Monochlorobutanes									
subchronic	NA; 120 mg/kg, 5 days/ week for 13 weeks by gavage	NA	rat	NA, reduced body weight gain; hyperactivity, convulsions	ND	9E-1	NA	100	U S EPA, 1989/ NTP, 1986; U S EPA, 1989
chronic	NA, 60 mg/kg, 5 days/ week for 103 weeks by gavage	NA	rat	NA, mortality	ND	4E-1	NA	100	U.S EPA, 1989/ NTP, 1986, U S EPA, 1989
Naphthalene									
subchronic	NA 50 mg/kg/day by gavage 5 days/week for 13 weeks (35.7 mg/kg/ day)	NA	rat	NA decreased body weight gain	ND	4E-2	NA	1,000	U S EPA, 1988/ NTP, 1980, U S EPA, 1988, 1990
chronic	NA, 50 mg/kg/day by gavage 5 days/week for 13 weeks (35.7 mg/kg/ day)	NA	rat	NA, decreased body weight gain	ND	4E-3[s,t]	NA	10,000	U S EPA, 1988/ NTP, 1980, U S EPA, 1988, 1990
1,4-Naphthoquinone				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U S EPA, 1986
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[s]	2E-2[z]	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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
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[i]	2E-3[j]	5E-4[b,z]	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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, methemoglobinemia	2E-2[g]	1E+0[a,dd]	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
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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[a]	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
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[a]	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

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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
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
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[bb]	NA	100	U S EPA, 1984/ Schwetz et al , 1978, U S EPA, 1986, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation; Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
chronic	NA, 3 mg/kg/day by gavage for 22-24 months	NA	rat	NA, liver and kidney pathology (also see Table B)	ND[s]	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[l]					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[bb]	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[l]	ND[ss]	6E-1[a,bb]	NA	100	U S EPA, 1984/ Research Triangle Institute, 1983, U S EPA, 1990
Phenylenediamines (o-, p-)				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT (Cancer	see Table B)				U S EPA, 1985
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 mecuric acetate/kg/day)[oo]	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 mecuric acetate/kg/day)[oo]	NA	rat	NA, renal damage	ND	8E-5[a]	NA	100	NA/Fitzhugh et al., 1950, 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
Phosgene				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT[88]					U S EPA, 1984
Phosphine									
subchronic	1 ppm (1 4 mg/m^3) 34 hours/week for 24 weeks, 0.026 mg/kg/day in the diet for 2 years	rat	rat	renal effects, no effect	3E-4	3E-4	1	100	Klimmer, 1969, U S EPA, 1989/ Hackenberg, 1972, U S. EPA, 1989
chronic	1 ppm (1 4 mg/m^3) 34 hours/week for 24 weeks, 0 026 mg/kg/day in the diet for 2 years	rat	rat	renal effects; no effect	3E-5	3E-4[a]	10	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
Phthalic anhydride									
subchronic	NA; 12,019 ppm (1562 mg/kg/day) in diet for 104 weeks	NA	mouse	NA, lung and kidney histopathology	ND	2E+0	NA	1000	NA/NCI, 1979 U S EPA, 1990
chronic	NA; 12,019 ppm (1562 mg/kg/day) in diet for 104 weeks	NA	mouse	NA; lung and kidney histopathology (also see Table B)	ND	2E+0[a]	NA	1000	NA/NCI, 1979, U S EPA, 1990
Polybrominated biphenyls									
subchronic	NA, Firemaster FF-1 0.1 mg/kg by gavage, 5 days/week for 25 weeks (0 07 mg/kg/day)	NA	rat	NA; elevated liver weight and liver lesions	ND	7E-5	NA	1000	U S EPA, 1989/ NTP, 1983; U S EPA, 1989
chronic	NA, Firemaster FF-1 0 1 mg/kg by gavage, 5 days/week for 25 weeks (0 07 mg/kg/day)	NA	rat	NA, elevated liver weight and liver lesions (also see Table B)	ND	7E-6	NA	10,000	U S EPA, 1989/ NTP, 1983, U S EPA, 1989

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A· SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
Potassium cyanide									
subchronic	NA; 10 8 mg/kg/day fumigated cyanide in food for 2 years (27 mg/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 (27 mg/kg/day)	NA	rat	NA, weight loss, thyroid effects, and myelin degeneration	ND	5E-2[a]	NA	500	NA/Howard and Hanzal, 1955, Philbrick et al , 1979, U S EPA, 1990
Potassium silver cyanide									
subchronic	NA, 10 8 mg/kg/day fumigated cyanide in food for 2 years (equivalent to potassium silver cyanide at 82 7 mg/kg/day)	NA	rat	NA, weight loss, thyroid effects, and myelin degeneration	ND	2E-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 (equivalent to potassium silver cyanide at 82 7 mg/kg/day)	NA	rat	NA, weight loss, thyroid effects, and myelin degeneration	ND	2E-1[a,n]	NA	500	NA/Howard and Hanzal, 1955, Philbrick et al., 1979, U S EPA, 1990
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

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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
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

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation; Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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; 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, 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
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[J]	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
chronic	NA, 0 3 mg/kg/day for 105 weeks	NA	rat	NA, prostate inflammation, hemosiderosis (also see Table B)	ND	3E-3[a]	NA	100	U S EPA, 1989/ Levine et al , 1984, U S EPA, 1989, 1990
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[b]	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[z]	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[z]	NA	15	NA/Yang et al , 1983, U.S EPA, 1990

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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
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[l]	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 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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
chronic	NA, 0 52 mg/kg/day in 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
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
Stirophos (see Tetrachlorvinphos)									

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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	10000	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
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[v]	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[v]	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[s]	NA	100	NA/U S EPA, 1984

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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
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 centri-lobular 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 centri-lobular hypertrophy	ND	3E-2[a]	NA	1000	U.S. EPA, 1987/ U S EPA, 1986, 1990
Tetrachlorophenol, 2,3,4,5-, 2,3,5,6-			DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT						U S. EPA, 1987
1,1,2,3-Tetrachloropropene			DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT						U S EPA, 1983

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
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
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	ND	7E-5[y]	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

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 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	ND	9E-5[a]	NA	3000	U S EPA, 1988/ MRI, 1986, U S EPA, 1986, 1990
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	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	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	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)
Update- September, 1990

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC: [mg/m^3 (mg/kg/day)]	Oral RfD: (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
Thallium selenite (Tl_2Se)									
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[z]	NA	3000	U.S EPA, 1988/ MRI, 1986, U S EPA, 1986, 1990
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	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[s]	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
Update: September, 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
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
Toluene									
subchronic	40 ppm for 6 hours (151 mg/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 (151 mg/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[I]	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

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, 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,aa]	NA	100	NA/Monsanto Co 1979, U S EPA, 1990
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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)[s]	9E-1[b]	100	100	Torkelson et al , 1958, U S EPA, 1984/ Torkelson et al , 1958, U S EPA, 1990
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[l]	1E+0 (3E-1)[s,s]	9E-2[b,z]	1000	1000	Torkelson et al., 1958, U S EPA, 1984/ Torkelson et al , 1958, U S EPA, 1990
1 1 2-Trichloroethane									
subchronic	NA) 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,) 9 mg/kg/day by drinking water for 90 days	NA	mouse	NA, clinical chemistry alterations (Cancer see Table B)	ND[s]	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 continuously 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 continuously for 90 days (1940 mg/kg/day), 488 mg/kg/day, 5 days/week for 66 weeks (348 6 mg/kg/day)	dog	rat	elevated BUN, lung lesions, mortality	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

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
2,4,4'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)									
Trichlorophenol, 2,3,4-, 2,3,5-, 2,3,6-, and 3,4,5-		DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT							U S EPA, 1987
2,4,5-Trichlorophenol									
subchronic	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 - see Table B									
2,4,5-Trichlorophenoxyacetic 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

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, 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-				DATA INADEQUATE FOR QUANTITATIVE RISK ASSESSMENT					U S EPA, 1987
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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
1,1,2-Trichloro-1,2,2-trifluoroethane									
subchronic	10,000 ppm (76,638 mg/m^3) 6 hours/day, 5 days/week for 24 months; 10,000 ppm (76,638 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	10,000 ppm (76,638 mg/m^3) 6 hours/day, 5 days/week for 24 months, 10,000 ppm (76,638 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,z]	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, methemo-globinemia	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, methemo-globinemia (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-dinitro-benzene in drinking water for 16 weeks (0.4 mg/kg/ day equivalent to 0 51 mg/kg/day 1,3,5-trinitro-benzene)	NA	rat	NA, increased spleen weight	ND	5E-4	NA	1000	U S EPA, 1989/ Cody et al , 1981, U S. EPA, 1989, 1990

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE A: SUBCHRONIC AND CHRONIC TOXICITY (OTHER THAN CARCINOGENICITY)
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
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
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[a]	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

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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
Vanadyl sulfate									
subchronic	NA; 5 ppm vanadium from vanadyl sulfate in drinking water for lifetime (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 lifetime (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	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	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[j]	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

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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
m-Xylene									
subchronic	4750 mg/m^3, 8 hours/day, 7 days/week for 1 year (1009 mg/kg/day)[w]; 500 mg/kg mixed xylenes 5 days/week for 103 weeks (357 mg mixed xylenes/kg/day)	rat	rat	hepatomegaly, none observed	4E+0 (1E+0)	4E+0	1000	100	Tatrai et al., 1981, U S EPA, 1989/NTP, 1986
chronic	4750 mg/m^3, 8 hours/day, 7 days/week for 1 year (1009 mg/kg/day)[w]; 250 mg/kg mixed xylenes 5 days/week for 103 weeks (179 mg mixed xylenes/kg/day)	rat	rat	hepatomegaly; 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)[bb]	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 (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 (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: September, 1990

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Effect of Concern: Inhalation, Oral	Inhalation RfC [mg/m^3 (mg/kg/day)]	Oral RfD (mg/kg/day)	Uncertainty Factor: Inhalation	Uncertainty Factor: Oral	Reference: Inhalation/Oral
Xylenes, mixed									
subchronic	20 ppm 7.5 hours/day for 5 days (27 mg/m^3); 500 mg/kg mixed xylenes 5 days/week by gavage for 13 weeks (357 mg mixed xylenes/kg/day)	human	rat	CNS effects, nose and throat 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 (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[l]	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[l]	ND	2E-1[s]	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)
Update: September, 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
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-2[a]	NA	500	NA/Blackwell-Smith et al , 1953, U S EPA, 1984, 1990

[a]Verified, available on IRIS

[b]Based on route-to-route extrapolation

[c]Specifically related to organoleptic threshold and potential for respiratory tract irritation, not to systemic toxicity

[d]Specifically related to organoleptic threshold, safe concentration may be higher but data are inadequate to assess

[e]Inhalation study with antimony trioxide in rats (Watt, 1980, 1981, 1983, ASARCO, Inc , 1980) provides qualitative evidence of lung cancer, cancer potency not estimated.

[f]Calculated by analogy to antimony by correcting for differences in molecular weight

[g]Under review by RfC/RfD Work Group

[h]Because of background dietary exposure, a subchronic oral RfD was not estimated

[i]Verified 2 separate RfDs, 1E-3 for food and 5E-4 for water

[j]Verified; Workgroup concurrence on final data base file and IRIS input pending

[k]Current drinking water standard of 1.3 mg/ℓ; Drinking Water Criteria Document concluded toxicity data were inadequate for calculation of an RfD for copper

[l]CRAVE-verified as an EPA weight-of-evidence Group D substance

[m]These 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

[n]Calculated by analogy to free cyanide by correcting for differences in molecular weight

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

[p]Final Draft of Air Quality Criteria Document (600/8-83-028F) declines to derive an air quality criterion for lead

[q]Oral RfD not verified and further discussion not scheduled

[r]Based on RfD for methyl mercury

[s]These 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

[t]A minor calculation error in estimation of transformed dose in 1986 HEEP is corrected here

[u]Verified as a Group C carcinogen, no quantitative estimate available

[v]An acceptable air concentration of 0 07 mg/m^3 was estimated by Carson et al (1981) from available data

[w]Experiment performed with o-xylene

[x]From toxicity data on tetraethyl lead

[y]Withdrawn from IRIS

[z]The oral RfD, while still available on IRIS, is being reconsidered by the RfD Workgroup

[aa]The verified RfD appears on IRIS as 1 3E-3 because of a typographical error

[bb]Developmental effects have been used as the basis of calculation

[cc]Based on arsenic equivalents

[dd]This value for nitrogen dioxide-N is based on analogy to nitrate

[ee]Calculated by analogy to mercury by correcting for differences in molecular weight

[ff]A new RfD is verified and the old number on IRIS will be changed

[gg]Inhalation RfC not verified and further discussion not scheduled

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

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

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

Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
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[f]	C/ND[f]	U S EPA, 1983, 1990/U S EPA, 1983, 1990

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

Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation, Oral	Inhalation	Oral	Inhalation	Oral	Inhalation $(\mu g/m^3)^{-1}$ [(mg/kg/day)$^{-1}$]	Oral $(\mu g/\ell)^{-1}$ [(mg/kg/day)$^{-1}$]	Inhalation/Oral
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 $\mu g/m^3$ 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/mℓ)$^{-1}$ m	A/ND	U S EPA, 1986, 1990/NTP, 1985, U S EPA, 1985, 1990
Azobenzene	NA, 2-year dietary	NA	rat	NA	abdominal cavity	B2/3 1E-5 [1 1E-1][a,b]	B2/3 1E-6 [1 1E-1][a]	U S EPA, 1990/ NCI, 1979, U S EPA, 1986, 1990
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
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

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
Benzo(a)anthracene	NA; NA	NA	NA	NA	NA	B2/NA[f,u]	B2/ND[f,u]	U.S EPA, 1990
Benzo(a)pyrene	2 2-8 5 mg/m^3, 4 5 hours/day for ≤86 4 weeks, 1-250 ppm diet for ≈110 days	hamster	mouse	respiratory tract	stomach	B2/ND[a,u]	B2/ND[a,u]	Thyssen et al , 1990, U S EPA, 1990/Neal and Rigdon, 1967, U S EPA,1980, 1990
Benzo(b)fluoranthene	NA, NA	NA	NA	NA	NA	B2/ND[f,u]	B2/ND[f,u]	U S EPA, 1990/ U S EPA, 1990
Benzo(k)fluoranthene	NA, NA	NA	NA	NA	NA	B2/ND[f,u]	B2/ND[f,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

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

Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation, Oral	Inhalation	Oral	Inhalation	Oral	Inhalation $(\mu g/m^3)^{-1}$ $[(mg/kg/day)^{-1}]$	Oral $(\mu g/\ell)^{-1}$ $[(mg/kg/day)^{-1}]$	Inhalation/Oral
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[f]	B2/3 7E-6 [1 3E-1][f]	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,l]	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

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

Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation; Oral	Inhalation	Oral	Inhalation	Oral	Inhalation $(\mu g/m^3)^{-1}$ $[(mg/kg/day)^{-1}]$	Oral $(\mu g/\ell)^{-1}$ $[(mg/kg/day)^{-1}]$	Inhalation/Oral
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
Chloroethane (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

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

Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
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][c]	U S EPA, 1986/ U S EPA, 1986, Weisburger et al 1978
4-Chloro-2-2-methyl-aniline hydrochloride	NA, 9-4000 ppm in the diet for 18 months	NA	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
Chlorthalonil	NA; 80-week dietary study	NA	rat	NA (also see Table A)	kidney	B2/ND	B2/8 2E-8 [2.9E-3][g]	U S. EPA, 1984/ NCI, 1978, U S EPA, 1984
Chromium (VI)	occupational, NA	human	NA	lung (also see Table A)	NA	A/1 2E-2 [4 1E+1][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[f]	B2/NA[f]	U S EPA, 1990/ U S EPA, 1990

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

Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
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[f]	C/ND[f]	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 (Decabromodiphenyl 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[f,u]	B2/ND[f,u]	U S EPA, 1990/ U S EPA, 1990

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

Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
Dibromochloromethane	NA, 105-week gavage study	NA	mouse	NA (also see Table A)	hepatocellular adenomas or carcinomas	C/ND[f]	C/2 4E-6 [8 4E-2][f]	U S EPA, 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'-Dichloro-benzidine	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[f]	C/ND[f]	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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE B: CARCINOGENICITY
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Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
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][g]	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][f]	B2/5 1E-6 [1 8E-1][f]	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[b], 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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE B: CARCINOGENICITY
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Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
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][s]	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][s]	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[f]	B2/1 9E-5 [6 8E-1][f,n]	U S EPA, 1987, 1990/Ellis et al 1979, U S. EPA, 1987, 1990
2,6-Dinitrotoluene	NA, NA	NA	NA	NA (also see Table A)	NA	B2/ND[f]	B2/1 9E-5 [6 8E-1][f,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[b], 2-year dietary study	rat	rat	liver	liver	B2/2 2E-4 [8 0E-1][a,b]	B2/2 2E-5 [8 0E-1][a]	NCI, 1978; U S EPA, 1980, 1990/NCI, 1978, U S. EPA, 1980, 1987, 1988, 1990
Direct Black 38	NA; 190-1500 ppm in diet for 93 days	NA	rat	NA	liver	A/ND	A/2 4E-4 [8 7E+0][s]	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][s]	U S EPA, 1987/ NCI, 1978, U S EPA, 1987

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE B. CARCINOGENICITY
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Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE B: CARCINOGENICITY
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Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE B: CARCINOGENICITY
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
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][8]	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 hyrazine sulfate	rat	mouse	nasal cavity	liver	B2/4 8E-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[f,u]	B2/ND[f,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

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE B: CARCINOGENICITY
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Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
2-Methylaniline	NA; 2-methylaniline-hydrochloride in diet for 83 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/ Kammineni 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 1E-6 [1 4E-2][m]	B2/2 1E-7 [7 5E-3][m]	NTP, 1986, U S EPA; 1984, 1990/NTP, 1986, NCA, 1983, U S EPA, 1985, 1990
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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xposure tion; Oral	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation	Oral	Inhalation	Oral	Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Inhalation/Oral
	NA	NA	NA	NA	B2/ND	B2/ND	U S EPA, 1987/ U S EPA, 1987
ional; 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
week dietary	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
h inhalation 22-month ion 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
g water for rinking or 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
or 64 ppm in g water for ks	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
g water months, g water r 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
g water, g 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: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
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-Nitrosomethylethyl-amine	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	B2/6E-4 [2 1E+0][a,b]	B2/6E-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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Compound	Exposure	Species		Tumor Site		EPA Group/Unit Risk [Slope Factor]		Reference
	Inhalation, Oral	Inhalation	Oral	Inhalation	Oral	Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Inhalation/Oral
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 (also see Table A)	hepatocellular carcinoma and neoplastic nodules	B2/ND	B2/2 5E-4 [8 9E+0]	U S EPA, 1989/ NTP, 1983, U S EPA, 1989
Polychlorinated biphenyls	NA, Aroclor 1260 in diet	NA	rat	NA	liver	B2/ND	B2/2 2E-4 [7 7E+0][a]	U S EPA, 1984, 1990/Norback and Weltman, 1985, U S EPA, 1987, 1990
Propylene oxide	2-year inhalation study, 150-week gavage study	mouse	rat	nasal cavity	forestomach	B2/3 7E-6 [1 3E-2][f]	B2/6 8E-6 [2 4E-1][f]	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 (also see Table A)	liver hepatocellular carcinomas and adenomas	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 A0	NA	C/ND[f]	C/3 4E-6 [1 2E-1][f]	U S EPA, 1984, 1988/U S EPA, 1984, 1990

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
Sodium diethyldithiocarbamate	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
Stirophos (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[s] $(pg/m^3)^{-1}$ [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-Tetrachloroethane	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-Tetrachloroethane	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	B2/1 5E-6 [5 1E-2][g]	NTP, 1986, U S EPA 1986, 1988/NCI, 1977; U S EPA, 1985, 1988
p,α,α,α-Tetrachlorotoluene	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 (stirophos)	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

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

Compound	Exposure: Inhalation, Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [(mg/kg/day)$^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [(mg/kg/day)$^{-1}$]	Reference: Inhalation/Oral
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

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

Compound	Exposure: Inhalation; Oral	Species: Inhalation	Species: Oral	Tumor Site: Inhalation	Tumor Site: Oral	EPA Group/Unit Risk [Slope Factor]: Inhalation $(\mu g/m^3)^{-1}$ [$(mg/kg/day)^{-1}$]	EPA Group/Unit Risk [Slope Factor]: Oral $(\mu g/\ell)^{-1}$ [$(mg/kg/day)^{-1}$]	Reference: Inhalation/Oral
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

[a] Verified, available on IRIS

[b] Based on route-to-route extrapolation

[c] There is inadequate evidence for carcinogenicity of this compound by the oral route

[d] Incorporates an absorption factor of 0 4

[e] Based on occupational data for coke-oven workers

[f] Verified; Workgroup concurrence on final data file and IRIS input pending

[g] Under review by CRAVE Workgroup

[h] Values removed from IRIS pending further review, new verified values are pending input into IRIS

[i] Based on metabolized dose

[j] B2 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

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

[l]Slope factor is for internal dose; ambient concentration was calculated by assuming an absorption factor of 54%

[m]The slope factor, while still available on IRIS, is being reconsidered by the CRAVE Workgroup

[n]This value applies to the mixture of 2,4- and 2,6-dinitrotoluene isomers

[o]Based on results with 4-chloro-2-methylaniline hydrochloride

[p]An absorption factor of 30% is used to calculate the unit risk from the slope factor

[q]Based on results with the alpha isomer

[s]An absorption factor of 75% is used to calculate the unit risk from the slope factor

[t]CRAVE-EPA group verified and available on IRIS; quantitative estimates, derived more recently than IRIS evaluation, have not been verified

[u]For RCRA activities only, contact Daniel Cruz of the Office of Solid Waste (FTS 382-4785 or (202)382-4785) for RCRA-approved numeric assessment for this compound

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 Draft Environmental Impact Statement for Proposed NESHAPs for Radionuclides (EPA 520/1-89-005) for a more detailed discussion of EPA's current radiation risk assessment methodology.

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

slope factor = risk per unit intake or exposure = risk per pCi inhaled or ingested or as risk per year per pCi/m^2 due to external exposure.

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* 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/m^3 (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 m^3/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,

risk per pCi/m^3 (air)	=	slope factor (risk per pCi inhaled) x 20 m^3/day x 25,550 days
risk per pCi/L (water)	=	slope factor (risk per pCi ingested) x 2 L/day x 25,550 days
risk per pCi/g (soil) (soil ingestion)	=	slope factor (risk per pCi ingested) x [(0.2 g/day x 1,825 days) + (0.1 g/day x 23,360 days)]

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

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* 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 kg/m^2 = 0.10 m (soil depth) x 1.43×10^3 kg/m^3 (soil density)), and by multiplying all values by 70 years (i.e., by the lifetime exposure). Hence,

risk per pCi/g (soil) = slope factor (risk per year per pCi/m^2) x 143 kg/m^2 x 10^3 (g/kg) x 70 years

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

Total risk = Risk from Cs-137 + Risk from Ba-137m

= (pCi/g Cs-137 x Risk per pCi/g Cs-137)
+ (pCi/g Ba-137m x Risk per pCi/g Ba-137m)

= (1 pCi/g x 0.0E+00 risk per pCi/g Cs-137)
+ (1 pCi/g x 3.4E-04 risk per pCi/g Ba-137m)

= 3.4×10^{-4} total lifetime excess cancer risk

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/m^3) corresponding to a best estimate of the increased lifetime cancer risk of $1x10^{-5}$ is calculated as follows:

$$pCi/m^3 \text{ in air} = \frac{1x10^{-5}}{\text{unit risk in } (pCi/m^3)^{-1}}$$

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

$$pCi/L \text{ in water} = \frac{1x10^{-5}}{\text{unit risk in } (pCi/L)^{-1}}$$

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:

$$\text{pCi/g in soil (ingestion exposure)} = \frac{1x10^{-5}}{\text{unit risk in } (pCi/g)^{-1} \text{ (soil ingestion)}}$$

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 $1x10^{-5}$ is calculated as follows:

$$\text{pCi/g in soil (external exposure)} = \frac{1x10^{-5}}{\text{unit risk in } (\text{pCi/g})^{-1} \text{ (external exposure)}}$$

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

Nuclide	ICRP** Lung Class	GI*** Absorption Factor (f_1)	Slope Factor: Age-averaged lifetime excess total cancer risk per unit intake or exposure			Pathway-Specific Unit Risk: 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 $(pCi/g)^{-1}$
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	D	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: Age-averaged lifetime excess total cancer risk per unit intake or exposure			Pathway-Specific Unit Risk: 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)$^{-1}$
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: Age-averaged lifetime excess total cancer risk per unit intake or exposure			Pathway-Specific Unit Risk: 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-16	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

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

Nuclide	ICRP** Lung Class	GI*** Absorption Factor (f_1)	Slope Factor: Age-averaged lifetime excess total cancer risk per unit intake or exposure			Pathway-Specific Unit Risk: 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-04	4.1E-08	3.1E-11	2.6E-14	2.6E-02	1.6E-06	2.6E-07	8.4E-08
Pu-240	Y	1.0E-04	4.1E-08	3.1E-11	5.9E-14	2.1E-02	1.6E-06	5.9E-07	8.4E-08
Pu-241	Y	1.0E-03	2.9E-10	4.8E-12	0.0E+00	1.5E-04	2.5E-07	0.0E+00	1.3E-08
Pu-242	Y	1.0E-04	3.9E-08	3.0E-11	4.9E-14	2.1E-02	1.5E-06	4.8E-07	8.1E-08
Ra-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	G	--	4.6E-14	--	3.5E-12	2.4E-08	--	3.5E-05	--
Rn-220	G	--	1.2E-13	--	3.0E-14	6.1E-08	--	3.0E-07	--
Rn-222	G	--	7.2E-13	--	2.2E-14	3.7E-07	--	2.2E-07	--
Ru-106	Y	5.0E-02	4.4E-10	9.6E-12	0.0E+00	2.3E-04	4.9E-07	0.0E+00	2.6E-08
S-35	D	8.0E-01	1.9E-13	2.2E-13	0.0E+00	9.6E-08	1.1E-08	0.0E+00	5.9E-10
Sr-89	D	3.0E-01	2.9E-12	3.0E-12	7.8E-15	1.5E-06	1.5E-07	7.8E-08	8.1E-09
Sr-90	D	3.0E-01	5.6E-11	3.3E-11	0.0E+00	2.8E-05	1.7E-06	0.0E+00	8.9E-08
Tc-99	W	8.0E-01	8.3E-12	1.3E-12	3.4E-17	4.2E-06	6.6E-08	3.4E-10	3.5E-09
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

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

Nuclide	ICRP** Lung Class	GI*** Absorption Factor (f_1)	Slope Factor: Age-averaged lifetime excess total cancer risk per unit intake or exposure			Pathway-Specific Unit Risk: 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 $(pCi/g)^{-1}$
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-12	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: Age-averaged lifetime excess total cancer risk per unit intake or exposure			Pathway-Specific Unit Risk: Age-averaged lifetime excess total cancer risk per unit daily intake or exposure for 70 years			
			Inhalation $(Bq)^{-1}$	Ingestion $(Bq)^{-1}$	Ground Surface $(yr/(Bq/m^2))^{-1}$	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-06
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-10	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	D	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: Age-averaged lifetime excess total cancer risk per unit intake or exposure			Pathway-Specific Unit Risk: Age-averaged lifetime excess total cancer risk per unit daily intake or exposure for 70 years			
			Inhalation $(Bq)^{-1}$	Ingestion $(Bq)^{-1}$	Ground Surface $(yr/(Bq/m^2))^{-1}$	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	4.6E-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: Age-averaged lifetime excess total cancer risk per unit intake or exposure			Pathway-Specific Unit Risk: Age-averaged lifetime excess total cancer risk per unit daily intake or exposure for 70 years			
			Inhalation $(Bq)^{-1}$	Ingestion $(Bq)^{-1}$	Ground Surface $(yr/(Bq/m^2))^{-1}$	Air $(Bq/m^3)^{-1}$	Drinking Water $(Bq/L)^{-1}$	External Exposure $(Bq/g)^{-1}$	Soil Ingestion $(Bq/g)^{-1}$
Nb-94	Y	1.0E-02	5.7E-09	5.7E-11	2.4E-09	2.9E-03	2.9E-06	2.4E-02	1.5E-07
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

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

Nuclide	ICRP** Lung Class	GI*** Absorption Factor (f_1)	Slope Factor: Age-averaged lifetime excess total cancer risk per unit intake or exposure			Pathway-Specific Unit Risk: Age-averaged lifetime excess total cancer risk per unit daily intake or exposure for 70 years			
			Inhalation $(Bq)^{-1}$	Ingestion $(Bq)^{-1}$	Ground Surface $(yr/(Bq/m^2))^{-1}$	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-04	1.1E-06	8.4E-10	7.0E-13	5.6E-01	4.3E-05	7.0E-06	2.3E-06
Pu-240	Y	1.0E-04	1.1E-06	8.4E-10	1.6E-12	5.6E-01	4.3E-05	1.6E-05	2.3E-06
Pu-241	Y	1.0E-03	7.8E-09	1.3E-10	0.0E+00	4.0E-03	6.6E-06	0.0E+00	3.5E-07
Pu-242	Y	1.0E-04	1.1E-06	8.1E-10	1.3E-12	5.6E-01	4.1E-05	1.3E-05	2.2E-06
Ra-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	D	--	1.2E-12	--	9.5E-11	6.4E-07	--	9.5E-04	--
Rn-220	D	--	3.2E-12	--	8.1E-13	1.7E-06	--	8.1E-06	--
Rn-222	D	--	1.9E-11	--	5.9E-13	9.9E-06	--	6.0E-06	--
Ru-106	Y	5.0E-02	1.2E-08	2.6E-10	0.0E+00	6.1E-03	1.3E-05	0.0E+00	7.0E-07
S-35	D	8.0E-01	5.1E-12	5.9E-12	0.0E+00	2.6E-06	3.0E-07	0.0E+00	1.6E-08
Sr-89	D	3.0E-01	7.8E-11	8.1E-11	2.1E-13	4.0E-05	4.1E-06	2.1E-06	2.2E-07
Sr-90	D	3.0E-01	1.5E-09	8.9E-10	0.0E+00	7.7E-04	4.5E-05	0.0E+00	2.4E-06
Tc-99	W	8.0E-01	2.2E-10	3.5E-11	9.2E-16	1.1E-04	1.8E-06	9.2E-09	9.5E-08
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: Age-averaged lifetime excess total cancer risk per unit intake or exposure			Pathway-Specific Unit Risk: Age-averaged lifetime excess total cancer risk per unit daily intake or exposure for 70 years			
			Inhalation $(Bq)^{-1}$	Ingestion $(Bq)^{-1}$	Ground Surface $(yr/(Bq/m^2))^{-1}$	Air $(Bq/m^3)^{-1}$	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	7.3E-07	3.8E-09	8.6E-13	3.7E-01	1.9E-04	8.7E-06	1.0E-05
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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