CTEC-ESCM, Inc.

"Saving the Earth"

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December 7, 1999

Alameda County Health Care Services
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

ATTN: Ms. Eva Chu, Haz. Materials Spec

Subject: OSHA PEL DATA for
Former Printpack Property
2101 Williams Street
San Leandro, Alameda County, CA

Dear Ms. Chu;

Reference is made to our discussions this afternoon regarding the subject facility and CTEC-ESCM's letter of October 14, 1999 (enclosed.) During our discussion it was determined that CTEC-ESCM had inadvertently omitted Trichloroethene from the listed concentrations in Table 1. It has been added to Table 1, forwarded by this letter.

Table 1 shows the detected air concentrations (highest only shown) and the respective OSHA Permissible Exposure Limits (PEL). The PEL is the acceptable level of exposure for a factory worker. It is based upon an eight hour per day, five day per week exposure during his working lifetime and has a risk factor of 1/1,000,000. California has adopted the OSHA Standards in all cases.

TABLE 1
COMPOUND CONCENTRATIONS
(REVISED December 7, 1999)*

COMPOUND	DETECTED CONCENTRATION (PPM)	OSHA PEL (PPM)
Dichloroethane	0.012	100
Dichloroethene	0.017	200
Ethyl Benzene	0.0074	100
Heptane	0.092	400
Toluene	2.300	100
Trichloroethylene*	0.012	50 (NIOSH is 100)
Trimethyl Benzene	0.0098 (added both)	25
Vinyl Chloride	0.018	1
Xylene	0.0331 (added both)	100

Your review and consideration of this data instead of running the very expensive air models will be appreciated. We believe this approach is eminently reasonable since, as we discussed, the OSHA PELs are risk-based standards and the monitored soil gas levels are several orders of magnitude lower.

We also discussed Alameda County's desire to have groundwater samples collected and analyzed for chlorinated solvents from the on-site monitoring wells. It is understood that both Trichloroethylene (TCE) and Tetrachloroethlyene (PCE) have been detected in significant concentrations in both the soils and groundwater on the Watkins Terminals property that adjoins the property at 2101 Williams Street. Groundwater flows due west from the Watkins Terminals property directly onto the property at 2101 Williams Street. Concentrations of PCE were detected as high as 7800 ug/L in early 1997. Therefore, it appears that the wells to sample to determine the impact from this offsite migration, as well as to check on any possible onsite releases (Printpack has no information indicating any onsite release of chlorinated solvents), would be upgradient wells W-6 and W-8 and downgradient wells TW-2 and TW-3.

We understand that the Alameda County Health Care Services may be able to approve the previously submitted Risk Based Corrective Action Report of April 25, 1997, considering the enclosed Air Quality data. We also understand the desire to get additional ground water monitoring data on chlorinated solvents to improve the understanding of the Watkins Terminals plum. With this in mind, we recommend quarterly monitoring well sampling and analysis for two quarters with semi-annual monitoring thereafter. It is anticipated that monitoring would last for two years, unless site conditions change such that other actions are required.

In order for this effort to proceed in a timely manner, Printpack requested that the Alameda County Health Care Services submit a letter to Printpack approving the previously submitted risk based corrective action report with an explicit statement to the effect that ". . . unless previously unknown contamination is discovered, the property located at 2101 Williams Street will require no further action except for monitoring of ground water." Additionally, Printpack requested that a specific scope of ground water monitoring (exact wells and constituents as indicated above) and time line (two years unless additional monitoring is required for cause) be included in the letter. Printpack feels that since the property at 2101 Williams Street has been under open review for more than five years, that the path forward must address how the facility is to get "out of the woods", before either the present or former owners can expend additional resources on this matter. It appears, from our recent telephone discussions and you past help that you are somewhat in agreement with Printpacks' concerns.

Your continued assistance in this project is appreciated.

Sincerely

Edward A. Shaw
President

Attachments: October 14, 1999, Letter from CTEC-ESCM (Copy)
OSHA Regulated Hazardous Substances (Partial), 23 pages
29 CFR 1910.1000 (Partial), 6 pages

cc: Doug Cook, Printpack

CTEC-ESCM, Inc.

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COPY

October 14, 1999

Alameda County Health Care Services
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

ATTN: Ms. Eva Chu, Haz. Materials Spec

Subject: OSHA PEL DATA for
Former Printpack Property
2101 Williams Street
San Leandro, Alameda County, CA

Dear Ms. Chu;

Reference is made to our recent discussions regarding running of air models for the volatile air constituents detected in during our soil gas sampling program that was conducted on July 1, 1998 at the subject facility. We discussed either running models (i.e., 8 models) for each soil gas constituent or show that each constituent detected was detected in such low concentrations that no further action was required. In order to show that the concentrations were in such low concentrations, it was requested that either an air model be run on each constituent or that copies of either U.S. or California Guidelines be submitted to prove that the constituents were not harmful to human health.

Table 1 shows the detected air concentrations (highest only shown) and the respective OSHA Permissible Exposure Limits. California has adopted the OSHA Standards in all cases.

TABLE 1
COMPOUND CONCENTRATIONS

COMPOUND	DETECTED CONCENTRATION (PPM)	OSHA PEL (PPM)
Dichloroethane 1,2-DCA	0.012	100
Dichloroethene cis 1,2-DCE	0.017	200
Ethyl Benzene	0.0074	100
Heptane	0.092	400
Toluene	2.300	100
Trimethyl Benzene	0.0098 (added both)	25
Vinyl Chloride	0.018	1
Xylene	0.0331 (added both)	100

TCE .010

COPY

It was determined that collecting the OSHA information was much more economical for our client than running eight air models at a cost of approximately $1000 each.. Copies of the OSHA document are attached for your review and use. Also attached is part of 29 CFR 1910.1000 which is the federal regulation (California Adopted) concerning "Air Contaminants". We trust that this should resolve the matter regarding potential air hazards to workers at this facility. Your assistance in this matter is appreciated.

Sincerely,

Edward A. Shaw
President

Attachments: OSHA Regulated Hazardous Substances (Partial), 21 pages
29 CFR 1910.1000 (Partial), 6 pages

U.S. Department of Labor

Occupational Safety and Health Administration

OSHA REGULATED HAZARDOUS SUBSTANCES

Industrial Exposure and Control Technologies

Government Institutes, Inc.

PUBLISHER'S NOTE

This document was prepared by the Occupational Safety and Health Administration of the U.S. Department of Labor and issued in March 1989 as *Industrial Exposures and Control Technologies for OSHA Regulated Hazardous Substances.* Government Institutes determined that the two-volume document contained information of interest to the regulated community outside OSHA, retitled and reproduced the material in a one-volume format in order to serve those interested.

The OSHA permissible exposure limits for the 600 substances reflect all updates and changes as presented in the January 19, 1989 Federal Register.

Published by

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966 Hungerford Drive, #24
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ACKNOWLEDGEMENTS

Acquiring the data in this database involved the cooperative efforts of many individuals across several Federal Government agencies and the private sector. We would like to express special appreciation to Dr. Bruno Vasta of the National Library of Medicine for his assistance in providing the Hazardous Substances Data Base; Mr. David Sundin and Ms. Doris Sweet of NIOSH for providing the 1982 National Occupational Exposure Survey data and the Registry of Toxic Effects of Chemical Substances; the Chemical Hazard Response Information System was obtained with the cooperation of Dr. Michael Parnorouskus of the U.S. Coast Guard; Mr. John Robinson of the National Oceanographic and Atmospheric Administration provided the CAMEO files. Within OSHA, Mr. Martin Childress was extremely helpful in providing assistance in analyzing OSHA databases and Dr. Daniel Marsick of OSHA's Technical Data Center was invaluable as a source of knowledge on virtually all of the data bases acquired for this project.

The actual assembly of the database and all database management for the project was done by Fu Associates under the direction of Mr. Edward Fu, Mr. Hardee Mahoney and Ms. Leann Weaver. The major effort to validate the accuracy of the data was completed by Ms. Marthe Kent of Meridian Research, Inc. Ms. Marian Harris of Harris Associates assisted in editorial changes and corrections.

This project was undertaken in support of OSHA's 1988 Permissible Exposure Limit (PEL) (CFR 1910.1000) update which proposed major revisions to hazardous substances regulated by the Agency. Members of the PEL Task Force included Charles Adkins (Director of Health Programs), Frank Chalmers (Director of Policy), Hugh Conway (Director of Regulatory Analysis), Raymond Donnelly (Directorate of Policy), Harry Ettinger (Project Director), Regina Flahie (Regulatory Analysis), Charles Gordon (Solicitor), Carol Green (Regulatory Analysis), Joanne Goodell (Directorate of Policy), Steve Mallinger (Deputy Director for Technical Support), John Martonik (Deputy Director of Health Programs), Edward Stein (Health Programs), and John Whalen (NIOSH Liaison).

Directorate of Policy, OSHA
Office of Regulatory Analysis
(202) 523-7283

INTRODUCTION

The information presented in this two-volume publication, includes health, toxicity, economic and technological data and other information on about 600 substances currently regulated, or candidates for regulation, by the Occupational Safety and Health Administration (OSHA). The information, which is also available on computer tape, is intended to serve as a reference for those who are potentially exposed to one or more of these substances in their workplace, and for those who have supervisory or management responsibility for workers potentially exposed. OSHA "permissible exposure limits" (PELs) for the 600 substances reflect all updates and changes as presented in the January 19, 1989 Federal Register.

It should be emphasized that the Agency's official listing of regulated substances is included in Tables Z-1-A, Z-2 and Z-3 of Title 29 Code of Federal Regulations Part 1910.1000. While the effort has been made to ensure that all substances on OSHA's Z Tables are referenced in this two-volume text, there may be inadvertent omissions.

The substances in this text are listed alphabetically. The index at the end of Volume II provides cross references to the substances included by synonym, trade name and Chemical Abstract Service (CAS) number.

1. Data Source Files

The sections which follow contain brief descriptions of the data bases from which information was extracted; the methodology for selecting relevant information from each source; an explanation of source documentation for the information presented for each chemical; and some summary data on the chemical reviewed.

a. IMIS and LABDATA

OSHA's Integrated Management Information System (IMIS) contains compliance inspection information on companies that are covered by OSHA regulations. A typical record contains the name of the establishment, the number of employees, the estimated number of employees exposed to chemicals and actual exposure levels recorded during an OSHA inspection. The exposure data include the OSHA substance code, sample type, exposure type, exposure level, unit of the sample and OSHA permissible exposure limit. Information on recorded violations and the number of citations issued is also included.

OSHA's Salt Lake City Laboratory Data (LABDATA) also contains air monitoring data collected during OSHA workplace compliance inspections. OSHA industrial hygienists obtain samples in the field and send them to the Salt Lake City Laboratory for analysis. The results of the Salt Lake City Laboratory analyses are then sent back to the field inspection

officer for a determination on whether a violation citation should be issued. As distinct from the IMIS file, the LABDATA file also contains analyses for chemicals which were not targeted during the compliance visit; the air samples sent to the Salt Lake City laboratory are tested for other hazardous substances which may be causing an adverse health effect. Results from all tests are kept on file.

It should be noted that these two databases do not provide information on all of the chemicals included in this text. Also, it is difficult to evaluate the representativeness of the IMIS exposure data, since compliance checks are usually performed in response to complaints or allegations of high exposure levels. However, even with these limitations, no other publicly available database contains a comparable amount of hazardous substance exposure data.

b. OCIS

The OSHA Computerized Information System (OCIS) analytical database includes descriptions of current analytical methods to determine the presence of over 750 chemicals commonly encountered in working environments. Additional information includes the IMIS substance code, chemical name, synonyms, Chemical Abstract Service (CAS) numbers, OSHA PELs and ACGIH TLVs and a brief statement of toxicity. Current sampling and analytical methods used by OSHA for determining compliance with OSHA standards are indicated.

c. HAZBATE

The Hazard Abatement File (HAZBATE) is a text descriptive file maintained on the OCIS system. It contains a summary of the effectiveness of engineering controls on reducing employee exposures to hazardous substances. The information contained in this file is based on initial and followup OSHA compliance inspection reports.

d. NOES

The National Occupational Exposure Survey (NOES) database was developed by the National Institute for Occupational Safety and Health (NIOSH) from a 1982 nationwide survey of about 4,500 establishments. The purpose of the NOES survey was to collect representative data for all non-agricultural, non-mining, and non-governmental establishments covered by the Occupational Safety and Health Act in order to quantify potential worker exposure to industrial chemicals. Data containing the number of persons potentially exposed by substance, by SIC, have been summarized from this source. Results from the earlier 1972 NIOSH survey of workplaces are also presented.

e. OHMTADS

The Oil and Hazardous Materials/Technical Assistance Data System (OHMTADS) database was developed by the EPA and is a component of the NIH/EPA Chemical Information System. By mid-1986, over 1,400 chemicals were covered in OHMTADS.

Data abstracted included emergency information for spill-response and trade names for hazardous substances.

f. CHRIS

The Chemical Hazard Response Information System (CHRIS) was developed by the U.S. Coast Guard to provide emergency information needed for responding to spills of hazardous materials. CHRIS contains information on the physical properties of chemicals, health hazards, fire hazards and chemical reactivity for materials frequently transported by water. This database contained information on over 1,000 chemicals.

g. CAMEO

The Computer Aided Management of Emergency Operations (CAMEO) system was developed by the National Oceanographic and Atmospheric Administration to provide information on the use and compatibilities of various substances. This file also contains a considerable amount of emergency response information and atmospheric dispersion models. Among the data sources cited in CAMEO is the Association of American Railroads (C)AAR hazardous materials database prepared by B.D.M. Corporation.

h. HSDB

The Hazardous Substances Data Bank (HSDB) was created, and is maintained, reviewed, and updated on the National Library of

Medicine (NLM) Toxicology Data Network (TOXNET). It contains factual, non-bibliographical data on more than 4,100 potentially hazardous substances.

The information in this file consists of chemical-specific emergency handling procedures, environmental impact, human exposure, detection methods, and regulatory requirements. In addition, there is some coverage on manufacturers, uses, toxicity, trade names, toxicity/health effects and protective equipment. The detail on these variables is considerable, particularly for toxicity and health effects. The information is obtained from standard texts and monographs, government documents, technical reports and primary journal literature. A peer review process is included by NLM to insure that there is a high degree of confidence in the accuracy of these data.

i. RTECS

The Registry of Toxic Effects of Chemical Substances (RTECS) is a NIOSH database that is maintained as part of the NIH/EPA Chemical Information System (CIS). The file contains chemical and toxicity information for more than 66,000 substances compiled from both national and international journals and papers. Most of the information in this file is bibliographic. Data on skin and eye irritation, general toxicity, reproductive effects, carcinogenicity and mutagenicity in animal and human studies are summarized and referenced. These summaries usually contain information on the route of exposure, dose and effects observed.

j. TSCAPP

The Toxic Substances Control Act Plant and Production (TSCAPP) data file contains the results of a 1977 inventory survey of chemical producers. The file contains approximately 53,000 records on chemical production volumes.

k. EPA 402

The EPA 402 List of Toxic Substances (EPA402) file contains information on substances that EPA considers to be extremely hazardous. The information covers physical characteristics, fire/explosion emergency response procedures, health hazards and substance uses.

l. Commercial Files

In certain situations, the most recent (or only) source of data for a field was commercial hardcopy publications. One commercial file that contains much useful information on personal protective equipment was the J.T. Baker Material Substance File.

Other commercial data sources searched included the Meridian Research Inc. Chemical Database, Stanford Research Institute's Chemical Economic Handbook for industry use and production data, and Industrial Process (Cralley and Cralley) for manufacturing processes. Whenever data from a commercial database was exclusively relied upon, the source was identified.

2. Variables Selected

After selecting the files for review, the process of abstracting data was undertaken. Not all of the substances of interest were found in all of the selected files. In addition, the quality of information within a given file was often inconsistent; for example, information on the health effects of a chemical would be good but toxicity data would be poor.

These problems were circumvented by using a hierarchical selection procedure for each of the variables. This procedure helped insure that where there were potential multiple sources for the same type of information, a "best" source was identified based on the professional judgment of industrial hygienists and chemical engineers under contract to OSHA. When the best source had incomplete information on a chemical, then the second best database was used. This process was followed until the field was filled. In situations where there was no clearly superior file for a particular type of information, the field of interest from several files was merged. The resulting field was then edited to minimize redundancy.

3. File Documentation

Each volume on individual chemicals contains the following information for each chemical when available:

Variable Name	Description	Source
NAME	The most widely accepted name for the hazardous substance.	OSHA Z-Table, ACGIH/TLVs
CAS NUMBER	Chemical Abstract Service Identification Number.	OSHA Z-Table, ACGIH/TLVs
SYNONYMS	A listing of the most commonly used synonyms for the hazardous substance.	CAMEO, HSDB, OHMTADS, CHRIS
TRADE NAME	The common trade/product names under which the substance is sold.	OHMTADS
DESCRIPTION OF SUBSTANCES	A brief description of the physical attributes of the substance.	CAMEO
HEALTH EFFECTS	Summary of the most common adverse health effects caused by exposure to the substance.	HSDB, CAMEO
NFPA RATING	National Fire Protection Association hazard rating (0 = none, 1 = slight, 2 = moderate, 3 = severe, 4 = extreme).	HSDB, CAMEO
TOXICITY HAZARD RATING	National Library of Medicine's toxicity rating (1 = none, ... , 6 = supertoxic) and description.	HSDB

Variable Name	Description	Source
IDLH	Immediately Dangerous to Life and Health - that quantity of a substance at which exposure can be fatal.	HSDB
OSHA PEL	1989 OSHA Permissible Exposure Levels shown in ppm and/or mg/m^3. Substances without a PEL were coded as "*".	OSHA Z-Tables
ACGIH/TLV	1987-1988 ACGIH Threshold Limit Values - Substances without a TLV were coded as "*".	ACGIH/TLV
ACGIH TWA	1987-1988 ACGIH Time Weighted Averages - measured in ppm and/or mg/m^3	ACGIH/TLV
USE DATA	Description of the most common uses for the substance.	HSDB, OHMTADS EPA402
NIOSH EXPOSURE ESTIMATES	Summarized results of the 1972 and 1982 NIOSH occupational exposure surveys.	NIOSH
OSHA EXPOSURE DATA	Summarized results of OSHA air monitoring inspection data. Where a value could not be computed due to missing TLVs and/or PELs, a "*" is reported.	IMIS
ENGINEERING CONTROLS	Equipment necessary for the safe manufacture and/or use of a hazardous substance.	OHMTADS, HAZBATE, MERIDIAN
PERSONAL PROTECTIVE EQUIPMENT	Protective equipment that should worn by the employee when working with hazardous substances.	OHMTADS, MERIDIAN
STORAGE	Explanation of special handling and treatment requirements.	MERIDIAN

2022	CHEESE, NATURAL AND PROCESSED	157	9	5.73
3713	TRUCK AND BUS BODIES	5,864	335	5.71
3421	CUTLERY	3,353	190	5.67
2816	INORGANIC PIGMENTS	708	40	5.65
3961	COSTUME JEWELRY	826	46	5.57
3511	STEAM ENGINES AND TURBINES	4,934	271	5.49
5983	FUEL OIL DEALERS	220	12	5.45
3951	PENS AND MECHNICAL PENCILS	1,360	74	5.44
3952	LEAD PENCILS AND ART GOODS	369	20	5.42
3569	GENERAL INDUSTRIAL MACHINERY,	1,844	100	5.42
6531	AGENTS, BROKERS, AND MANAGERS	527	28	5.31
2512	UPHOLSTERED HOUSEHOLD FURNITU	3,074	162	5.27
2131	CHEWING AND SMOKING TOBACCO	477	25	5.24
4226	SPECIAL WAREHOUSING AND STORA	286	15	5.24
3861	PHOTOGRAPHIC EQUIPMENT AND SU	4,462	232	5.20
2751	COMMERCIAL PRINTING, EX LITHO	2,511	130	5.18
3357	NONFERROUS WIRE DRAWING AND I	4,831	248	5.13
3623	WELDING APPARATUS	605	31	5.12

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure of process or worker.

PERSONAL PROTECTIVE EQUIPMENT

Wear protective gloves and goggles. Do not handle broken packages without protective equipment. [(C)AAR, 1986]
Personal safety precautions: mac 2,000 ppm; goggles or glasses. Self-contained breathing apparatus required if intense heat or flame is present. Respiratory protection should be as follows: Up to 10,000 ppm: any supplied-air respirator or self-contained breathing apparatus. Up to 25,000 ppm: any supplied-air respirator operated in a continuous flow mode. Up to 50,000 ppm: any self-contained breathing apparatus with a full facepiece or any supplied-air respirator with a full facepiece; any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode or any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. Escape: any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister, or any appropriate escape-type self contained breathing apparatus. [NIOSH: POCKET GUIDE TO CHEMICAL HAZARDS P. 99, 1987]

STORAGE

NONE

Dichloroethane

1,1-Dichloroethane
(CAS NUMBER: 75-34-3)

SYNONYMS

Dichloromethylmethane/Ethylidene chloride/Ethylidene dichloride/ Aethylidenchlorid (German)/Chlorinated hydrochloric ether/ Chlorure d'ethylidene (French)/Cloruro di etilidene (Italian)/ 1,1-Dichloorethaan (Dutch)/1,1-Dichloraethan (German)/ 1,1-Dicloroetano (Italian)/Asymmetrical dichloroethane

TRADE NAMES

NONE

DESCRIPTION OF SUBSTANCE

1,1-Dichloroethane is a colorless, oily liquid with a chloroform odor. It is soluble in acetone, alcohol, benzene and ether.

HEALTH EFFECTS

Exposure to 1,1-dichloroethane will result in central nervous system depression. It is also indicated as causing liver injury. [PATTY. INDUS HYG & TOX 2ND ED VOL2 1963]
It is irritating to the eyes and the respiratory tract, producing salivation, sneezing, and coughing. In those few cases of intoxication reported, the anticipated anesthetic effects have been observed with associated dizziness, nausea and vomiting. In severe and fatal cases, hepatic and renal injury occur. [HAMILTON. INDUS TOX 3RD ED 1974]

TOXICITY/EXPOSURE LIMITS

NFPA RATING - Flammability - 3 Severe
Health - 2 Moderate
Reactivity - 0 None

TOXICITY HAZARD RATING - Acute and chronic local: skin 3; mucous membranes 3; eyes 3. Acute and chronic systemic: ingestion 3; inhalation 3; skin 3. 3= High: may cause death or permanent injury after exposure to small quantities. [SAX. DANGER PROPS INDUS MATER 6TH ED 1984 P. 1362]
3. 3= Moderately toxic: probable oral lethal dose 1 pint (or 1 l (human): 0.5-5 g/kg, between 1 ounce and 1 pint (or 1 lb) for 70 kg person (150 lbs). [GOSSELIN. CTCP 5TH ED 1984 P. II-162]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - 4000 ppm

OSHA PEL - 100.000 ppm, 400.000 mg/m3;TWA

ADOPTED ACGIH/TLV - 200.000 ppm, 810.000 mg/m3;TWA
250.000 ppm, 1010.000 mg/m3;STEL

NIOSH/REL - NONE

INDUSTRY USE DATA

1,1-Dichloroethane is used as a solvent for plastics, oils and fats; cleaning agent; degreaser; in rubber cementing; as a fumigant and insecticide spray; in fabric spreading; in fire extinguishing; formerly used as an anesthetic. [BROWNING. TOX & METAB INDUS SOLV 1965]
Chemical intermediate for 1,1,1-trichloroethane, a solvent; chemical intermediate for vinyl chloride. [SRI]

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

NONE

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

NONE

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure of process or worker.

PERSONAL PROTECTIVE EQUIPMENT

Wear goggles and self-contained breathing apparatus. [USCG, 1985]
Respiratory protection should be as follows: Up to 1000 ppm: any supplied-air respirator or self-contained breathing apparatus. Up to 2000 ppm: any supplied-air respirator operated in a continuous flow mode. Up to 4000 ppm: any self-contained breathing apparatus with a full facepiece or any supplied-air respirator with a full facepiece. Emergency or planned entry in unknown concentration or IDLH conditions: any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode or any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. Escape: any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister, or

any appropriate escape-type self contained breathing apparatus. [NIOSH: POCKET GUIDE TO CHEMICAL HAZARDS P. 99 (1987) DHEW (NIOSH) PUB NO. 85-114]

STORAGE

NONE

Dichloroethene

solvent (former use). [SRI]

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

NONE

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

NONE

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure of process or worker.

PERSONAL PROTECTIVE EQUIPMENT

Wear and special protective clothing. [EPA, 1986]
Respiratory protection should be as follows: up to 50 ppm: supplied-air respirator or self-contained breathing apparatus. Substance reported to cause eye irritation or damage; may require eye protection. Up to 125 ppm: any supplied-air respirator operated in a continuous flow mode. Substance reported to cause eye irritation or damage: may require eye protection. Up to 250 ppm: any supplied air respirator with a full facepiece or any self-contained breathing apparatus with a full facepiece. Emergency or planned entry in unknown concentration or IDLH conditions: any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode or any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus and operated in pressure-demand or other positive pressure mode. Escape: any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister, or any appropriate escape-type self contained breathing apparatus. [NIOSH: POCKET GUIDE TO CHEMICAL HAZARDS P. 101 (1987) DHEW (NIOSH) PUB NO. 85-114]

STORAGE

Protect against physical damage. Separate from other storage. Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room. [NFPA, P. 49-39, 1986]

1,2-Dichloroethylene
(CAS NUMBER: 540-59-0)

SYNONYMS

Acetylene dichloride/1,2-Dichloroethene/sym-Dichloroethylene/ethylene, 1,2-dichloro-/1,2-Dichlor-aethen (German)/ Dichloro-1,2-ethylene (French)

TRADE NAMES

Dioform.

DESCRIPTION OF SUBSTANCE

1,2-Dichloroethylene is a colorless liquid with a sweet, pleasant odor. It is insoluble in water and soluble in alcohol, ether and most organic solvents. Exposure to light, air and moisture causes 1,2-dichloroethylene to decompose and release irritating hydrogen chloride. [USCG, 1985]

HEALTH EFFECTS

1,2-Dichloroethylene can act as a primary irritant, producing dermatitis and irritation of mucous membranes. Its principal systemic action is as a narcotic. Symptoms of acute exposure include central nervous system depression or, in milder exposures, nausea, vomiting, weakness, tremor, and epigastric cramps. Reversible corneal clouding is described. [GOSSELIN. CTCP 4TH ED 1976]
Renal effects, when they do occur, are transient. [SITTIG, P. 332, 1985]
Dermatitis may result from defatting action on skin. [SAX. DANGER PROPS INDUS MATER 4TH ED 1975]

TOXICITY/EXPOSURE LIMITS

NFPA RATING - Flammability - 3 Severe
Health - 2 Moderate
Reactivity - 2 Moderate

TOXICITY HAZARD RATING - Acute and chronic local: skin 2; mucous membranes 2; eyes 2. Acute and chronic systemic: ingestion 2; inhalation 2; skin 2. 2= Moderate: may involve both irreversible and reversible changes not severe enough to cause death or permanent injury. [SAX. DANGER PROPS INDUS MATER 6TH ED, P. 108, 1984]
3. 3= Moderately toxic: probable oral lethal dose (human) 0.5-5 g/kg; between 1 ounce and 1 pint

(or 1 lb) for 70 kg person (150 lbs) [GOSSELIN. CTCP 5TH ED, P. II-162, 1984]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - 4000 ppm [ENCYC OCCUPAT HEALTH & SAFETY 1983]

OSHA PEL - 200.000 ppm, 790.000 mg/m3;TWA

ADOPTED ACGIH/TLV - 200.000 ppm, 790.000 mg/m3;TWA

NIOSH/REL - NONE

INDUSTRY USE DATA

1,2-Dichloroethylene is used as a solvent for fats, phenol, camphor; retarding fermentation. [MERCK INDEX. 10TH ED 1983]
Solvent for natural rubber; coolant in refrigeration plants; low temperature solvent; special-purpose solvent. [SRI]
Dye extraction; perfumes; lacquers; thermoplastics; organic synthesis. [HAWLEY. CONDENSED CHEM DICTNRY 10TH ED 1981]

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

NONE

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

NONE

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure of process or worker.

PERSONAL PROTECTIVE EQUIPMENT

Wear rubber gloves and safety goggles. [CHRIS. HAZARD CHEM DATA MANUAL. 2 1978]
Respiratory protection should be as follows: Up to 1000 ppm: any powered air-purifying respirator with organic vapor cartridge(s). Substance causes eye irritation or damage: eye protection needed. Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s). Up to 4000 ppm: any supplied-air respirator operated in a continuous flow mode. Substance causes eye irritation or damage: eye protection needed. Any air purifying respirator (gas mask) (front- or back-mounted or chin-style canister) with a full facepiece and an organic vapor cartridge or canister; or any self-contained breathing apparatus with a full facepiece or any supplied-air

respirator with a full facepiece Emergency or unknown concentration or IDLH conditions: any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode or any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. Escape: any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister, or any appropriate escape-type self contained breathing apparatus. [NIOSH: POCKET GUIDE TO CHEMICAL HAZARDS P. 99 (1987) DHEW (NIOSH) PUB NO. 85-114]

STORAGE

Protect against physical damage. Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. [NFPA, P. 49-39, 1986]

ETHYL BENZENE

Ethyl benzene
(CAS NUMBER: 100-41-4)

SYNONYMS

Ethylbenzol/alpha-Methyltoluene/Phenylethane/Aethylbenzol (German)/Ethylbenzeen (Dutch)/Etilbenzene (Italian)/Etylobenzen (Polish)/Phenylethylene

TRADE NAMES

NONE

DESCRIPTION OF SUBSTANCE

Ethyl benzene is a clear, colorless liquid with an aromatic odor. It is only slightly soluble in water at 15 degrees C (14 mg/100 ml) but is miscible with alcohol and ether. [ACGIH, P. 244, 1986]

HEALTH EFFECTS

Ethyl benzene is an eye, skin, and upper respiratory tract irritant. In animals, chronic exposure to concentrations above 400 ppm is associated with liver damage. [ACGIH 1986]
Erythema and inflammation of skin may result from contact of skin with liquid. [SAX. DANGER PROPS INDUS MATER 4TH ED 1975]
Prolonged exposure to vapors may result in functional disorders, increase in deep reflexes, irritation of upper respiratory tract, hematological disorders (leukopenia and lymphocytosis, in particular) and hepatobiliary complaints. [ENCYC OCCUPAT HEALTH & SAFETY 1971]
Aspiration of even a small amount of ethyl benzene may cause severe injury, since its low viscosity and surface tension will cause it to spread over a large surface of pulmonary tissue. [BROWNING. TOX & METAB INDUS SOLV 1965]
Produces an irritant effect from chronic inhalation at 100 ppm (0.492 mg/l) for 8 hours. [PATTY. INDUS HYG & TOX 3RD ED VOL2A,2B,2C 1981-82]
It has been shown that concentration of 1 mg/l and even 0.1 mg/l may be dangerous and may produce functional and organic disturbances (nervous system disorders, toxic hepatitis and upper respratory tract complaints). Concentration as low as 0.01 mg/l may lead to catarrhal inflammation of upper respiratory tract mucosa. [ENCYC OCCUPAT HEALTH & SAFETY 1971]

TOXICITY/EXPOSURE LIMITS

NFPA RATING - Flammability - 3 Severe
Health - 2 Moderate
Reactivity - 0 None

TOXICITY HAZARD RATING - Acute systemic: ingestion 2-1; inhalation 2-1; skin absorption 2-1. Acute local: irritant 2-1. 2= Moderate: may involve both irreversible and reversible canges not severe enough to cause death or permanent injury. 1= Slight: causes readily reversible changes which disappear after end of exposure. [SAX. DANGER PROPS INDUS MATER 6TH ED, P. 1322, 1984]
4. 4= Very toxic: probable oral lethal dose (human) 50-500 mg/kg, between 1 teaspoon and 1 ounce for 70-kg person (150lbs). [GOSSELIN. CTCP 5TH ED, P. II-153, 1984]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - 2000 ppm [NIOSH: POCKET GUIDE TO CHEMICAL HAZARDS P.96 (1978) DHEW(NIOSH) PUB NO 78-210]

OSHA PEL - 100.000 ppm, 435.000 mg/m3;TWA
125.000 ppm, 545.000 mg/m3;STEL

ADOPTED ACGIH/TLV - 100.000 ppm, 435.000 mg/m3;TWA
125.000 ppm, 545.000 mg/m3;STEL

NIOSH/REL - NONE

INDUSTRY USE DATA

Ethyl benzene is used in manufacture of synthetic rubber; as a solvent or diluent, a component of automotive and aviation fuels; in the manufacture of cellulose acetate. [ENCYC OCCUPAT HEALTH & SAFETY 1971]
Chemical intermediate for styrene, solvents-e.g., for alkyd surface coatings, chemical intermediate for diethylbenzene and acetophenone, for ethyl anthraquinone, for ethylbenzene sulfonic acids (o-, m- and p-), for propylene oxide and alpha-methylbenzyl alcohol, unrecovered component of gasoline. [SRI]

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

NONE

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
2879	AGRICULTURAL CHEMICALS, NEC	56	14	25.00

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure of process or worker.

PERSONAL PROTECTIVE EQUIPMENT

Wear boots and goggles. Do not handle broken packages without protective equipment. Wear rubber gloves; clean clothes. [CHRIS. HAZARD CHEM DATA MANUAL. 2 1978]
Employees should be provided with and required to wear impervious clothing, gloves, and face shields (eight-inch minimum). [NIOSH OSHA. OCCUPAT HEALTH GUIDE CHEM HAZARDS. 1981]
Respiratory protection should be as follows: At 5.0 mg/m3: any supplied-air respirator or self-contained breathing apparatus. At 12.5 mg/m3: any supplied air respirator operated in a continuous flow mode. At 25 mg/m3: any self-contained breathing apparatus with a full facepiece; any supplied-air respirator with a full facepiece; or any supplied-air respirator with a tight-fitting facepiece operated in a continuous flow mode. At 100 mg/m3: any supplied-air respirator with a half-mask and operated in a pressure-demand or other positive pressure mode. Emergency or planned entry in unknown concentration or IDLH conditions: any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode or any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. Escape: any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister having a high-efficiency particulate filter or any appropriate escape-type self-contained breathing apparatus. [NIOSH: POCKET GUIDE TO CHEMICAL HAZARDS P. 133 (1987) DHEW (NIOSH) PUB NO. 85-114]

STORAGE

NONE

HEPTANE

Heptane
(CAS NUMBER: 142-82-5)

SYNONYMS

Normal heptane/Dipropylmethane/n-Heptane/Heptyl hydride/Eptan (Italian)/Heptan (Polish)/Heptanen (Dutch)

TRADE NAMES

Skellysolve C; Gettysolve-C;

DESCRIPTION OF SUBSTANCE

Heptane is a volatile, flammable, colorless liquid with a mild gasoline-like odor. It is insoluble in water and soluble in solvents such as alcohol.

HEALTH EFFECTS

Effects of overexposure: inhalation of vapors may cause coughing, chest pains, or nose and throat irritation. Inhalation of vapors may cause nausea and vomiting. Liquid may be irritating to skin, eyes, and mucous membranes. Liquid may cause dermatitis. Ingestion may cause nausea, vomiting, headaches, dizziness, gastrointestinal irritation. Chronic effects of overexposure may include central nervous system depression. Target organs: skin, respiratory system, peripheral nervous system. Medical conditions generally aggravated by exposure: none identified. Routes of entry: inhalation, ingestion, eye contact, skin contact. [CHRIS]
Heptane caused slight veritigo in men exposed six minutes to 1000 ppm (0.1%) and for 4 minutes to 2000 ppm (0.2%). 4 minutes exposure to 5000 ppm (0.5%) caused marked vertigo, inability to walk straight line, hilarity, incoordination. 15 minutes exposure at this concentration produced a state of intoxication and stupor in some individuals. [ENCYC OCCUPAT HEALTH & SAFETY 1971]
Individuals exposed to 5000 ppm for 15 minutes complained of loss of appetite, slight nausea, and taste resembling gasoline for several hours. [ENCYC OCCUPAT HEALTH & SAFETY 1971]
Signs and symptoms of central nervous system involvement occurred in absence of noticeable mucous membrane irritation and were first noticed on entering uncontaminated atmosphere. [ACGIH. TLVS 3RD ED & SUPPL 1971-1979]
Liquid paraffin hydrocarbons are fat solvents and primary skin irritants. Repeated or prolonged skin contact will dry and defat the skin, resulting in irritation and dermatitis. [PATTY. INDUS HYG & TOX 2ND ED VOL2 1963]
In investigation of 382 men and 149 women who had used heptane for 1-5 years in rubber tire process where concentration ranged from 0.75 up to 1000 ppm, principal hematological variation was anemia; slight leukopenia was present in only 2% of women,

slight neutropenia in 9% of men and 12% of women. [BROWNING. TOX & METAB INDUS SOLV 1965]
Although chronic nervous system effects have not been attributed to heptane itself, numerous cases of polyneuritis have been reported following prolonged exposure to petroleum fraction with boiling range between 70 and 100 degrees C. Such fraction would normally contain various isomers of heptane as major ingredientss. [ACGIH. TLVS 3RD ED & SUPPL 1971-1979]

TOXICITY/EXPOSURE LIMITS

NFPA RATING - Flammability - 3 Severe
Health - 1 Slight
Reactivity - 0 None

TOXICITY HAZARD RATING - 3. 3 = Moderately toxic: probable oral lethal dose (human) 0.5-5 gm/kg between 1 ounce and 1 pint (or 1 lb) for 70 kg. person (150 lbs). [GOSSELIN C3TCP 5TH ED, P. II-150, 1984]
Acute and chronic local: skin 3; mucous membranes 3; eyes 3. Acute and chronic systemic: ingestion 3; inhalation 3; skin 3. 3 = High: may cause death or permanent injury after exposure to small quantities. [SAX. DANGER PROPS INDUS MATER 6TH ED, P. 1499, 1984]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - 5,000 ppm [NIOSH 1985]

OSHA PEL - 400.000 ppm, 1600.000 mg/m3;TWA
500.000 ppm, 2000.000 mg/m3;STEL

ADOPTED ACGIH/TLV - 400.000 ppm, 1600.000 mg/m3;TWA
500.000 ppm, 2000.000 mg/m3;STEL

NIOSH/REL - 85.000 ppm, 350 mg/m3;TWA
440.000 ppm, 1800 mg/m3;STEL - 15 minutes

INDUSTRY USE DATA

Heptane finds wide use as a research chemical and as a standard in testing the knock of gasoline engines. [SRI;MERCK INDEX 9TH ED 1976]
It is also used as a solvent and in the production of organic chemicals.

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
2992	LUBRICATING OILS AND GREASES	546	84	15.38
2641	PAPER COATING AND GLAZING	1,618	150	9.27
2833	MEDICINALS AND BOTANICALS	2,347	156	6.65

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
7394	EQUIPMENT RENTAL AND LEASING	139	43	30.94
2893	PRINTING INK	445	72	16.18
5221	PLUMBING & HEATING EQUIPMENT	70	11	15.71
5088	TRANSPORTATION EQUIPMENT & SU	49	7	14.29
1743	TERRAZZO, TILE, MARBLE, MOSAI	129	17	13.18
1752	FLOOR LAYING AND FLOOR WORK	188	21	11.17
3952	LEAD PENCILS AND ART GOODS	369	40	10.84
5014	TIRES AND TUBES	85	9	10.59
5541	GASOLINE SERVICE STATIONS	382	35	9.16
2295	COATED FABRICS, NOT RUBBERIZE	1,244	98	7.88
1799	SPECIAL TRADE CONTRACTORS, NE	1,302	100	7.68
2831	BIOLOGICAL PRODUCTS	7,046	511	7.25
3411	METAL CANS	4,126	291	7.05
3799	TRANSPORTATION EQUIPMENT, NEC	418	27	6.46
3011	TIRES AND INNER TUBES	5,528	335	6.06
2818	INDUSTRIAL ORGANIC CHEMICALS	1,362	82	6.02
5511	NEW AND USED CAR DEALERS	1,669	100	5.99
5531	TIRE, BATTERY, AND ACCESSORY	147	8	5.44

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure of process or worker.

PERSONAL PROTECTIVE EQUIPMENT

Laboratory protective equipment: safety glasses; lab coat; vent hood; proper gloves; class B extinguisher. Respiratory protection should be as follows: Up to 850 ppm: any chemical cartridge respirator with organic vapor cartridge(s); supplied air respirator; or self-contained breathing apparatus. Up to 1000 ppm: any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s) or any powered air purifying respirator with organic vapor cartridge(s). Substance reported to cause eye irritation or damage; may require eye protection. Up to 2125 ppm: any supplied air respirator operated in a continuous flow mode. Up to 4250 ppm: any self-contained breathing apparatus with a full facepiece; any supplied-air respirator with a full facepiece; any supplied-air respirator

ADOPTED ACGIH/TLV - NONE - A2 Suspected human carcinogen - Skin

NIOSH/REL - 0.020 mg/m3;STEL - 60 minutes - Carcinogen

INDUSTRY USE DATA

o-Tolidine is a very sensitive reagent for gold (1:10 million detectable); free chlorine in water. [MERCK INDEX. 10TH ED 1983]
Curing agent for urethane resins. [HAWLEY. CONDENSED CHEM DICTNRY 10TH ED 1981]
Chemical intermediate for azo dyes-e.g., direct oranges, reds, and blues, pigment orange 13, and 3,3'-dimethyl-4,4'-biphenylene diisocyanate. [SRI]

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
8071	MEDICAL LABORATORIES	1,021	176	17.24

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

NONE

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure of process or worker.

PERSONAL PROTECTIVE EQUIPMENT

NIOSH-recommended respiratory protection for carcinogens is as follows: a self-contained breathing apparatus with a full facepiece operated in positive-pressure mode, or a supplied-air respirator with a full facepiece operated in pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. [NIOSH POCKET GUIDE TO CHEMICAL HAZARDS, 1987]

STORAGE

NONE

Toluene
(CAS NUMBER: 108-88-3)

TOLUENE

SYNONYMS

Antisal 1A/CP 25/Methacide/Methylbenzene/Methylbenzol/Phenylmethane/Toluol/Toluen (Dutch)/Toluen (Czech)/Toluolo (Italian)/Tolu-sol/Phenyl methane

TRADE NAMES

NONE

DESCRIPTION OF SUBSTANCE

Toluene is a clear, colorless liquid with a characteristic aromatic odor. It is insoluble in water but miscible with most organic solvents. [ACGIH, P. 578, 1986]

HEALTH EFFECTS

Toluene appears to produce reversible effects upon the liver, kidney, and nervous system. The nervous system appears to be the most sensitive to the effects of toluene. High-level toluene exposures produced incoordination, ataxia, unconsciousness and, eventually, death. Lower level acute exposures in man produce dizziness, exhilaration and confusion. Activity level has been inadequately studied. Schedule controlled behaviors have been reported to produce inverted U-shaped concentration-effect curves on response rate measures. Alterations at levels as low as 150 ppm have been reported when appetitive contingencies are used. Very few studies of the nervous system have been performed at levels below 1000 ppm and most of the results were inconclusive. [BENIGNUS VA; NEUROBEHAV TOXICOL TERATOL 3(4): 407-15 (1981)]
Painters exposed to toluene in concentrations ranging from 100-1100 ppm. Findings include enlargement of liver, macrocytosis, moderate decrease in erythrocyte count and absolute lymphocytosis, but no leukopenia. [ACGIH. TLVS. 4TH ED & SUPPL. 1980]
Toluene causes defatting of skin with subsequent danger of dryness, fissuring and secondary infection. [ENCYC OCCUPAT HEALTH & SAFETY 1971]
Sudden death among "sniffers" may be attributed to lethal cardiac arrhythmias following sensitization of the myocardium. [HAMILTON. INDUS TOX 3RD ED 1974]
Permanent encephalopathy in man who inhaled toluene regularly for over 14 years, is described. [ACGIH. TLVS. 4TH ED & SUPPL. 1980]
Vapors of toluene cause noticeable sensation of irritation to human eyes at 300-400 ppm in air, but even at 800 ppm irritation is slight. In human volunteers exposed to concentrations as high as 800 ppm, dilation of pupils and impairment of reaction in

association with fatigue was noted at end of 8 hours, also slight pallor of fundi. [GRANT. TOX OF THE EYE 1984]
Workers in pharmaceutical plant in France exposed to toluene developed leukopenia and neutropenia. Within the following 6 months, those affected showed increase in coagulation time and decrease in prothrombin level. [PATTY. INDUS HYG & TOX 3RD ED VOL 2A,2B,2C 1981-82]
Peripheral blood lymphocytes from 32 male rotogravure workers showed no significant difference from controls in frequency of chromosome aberrations and sister chromatid exchanges. [MAKI-PAAKKANEN J ET AL; TOLUENE-EXPOSED WORKERS AND CHROMOSOME ABERRATIONS, J TOXICOL ENVIRON HEALTH 6: 775 (1980)]
Three patients with history of recurrent toluene abuse were hospitalized with severe metabolic acidosis, electrolyte abnormalities, hypoalkemia, and muscular weakness. Distal renal tubular acidosis was believed to be present in 2 of 3 patients. [FISCMAN CM, OSTER JR; AM MED ASSOC 241 (16): 1713-1715 (1979) AS CITED IN NRC. ALKYL BENZENES P.284 (1981)]
Dysmenorrhea was reported by 19 of 38 Japanese female shoemakers exposed to 60-100 ppm toluene for an average of 3 years and 4 months. [MATSUSHITA T; IND HLTH 13: 115 (1975)]
Child of solvent-abusing (primarily toluene; 14-year history of abuse) mother showed symptoms of fetal alcohol syndrome. [TOUTANT C, LIppmAN S; LANCET 1 (8130): 1356 (1979)]
A 27-year-old male developed cerebral and cerebellar atrophy over a period of five years of extensive glue sniffing. He also developed bilateral optic atrophy with blindness and severe sensorineural hearing loss. [EHYAI A, FREEMON FR; J NEURAL NEUROSURG PSYCHIATRY 46(4): 349-51 (1983)]
Whole body autoradiography has been modified and applied to distribution studies of toluene. [BERGMAN K; CRC CRIT REVIEW TOXICOL 12(1): 59-118 (1983)]
If aspirated, toluene causes coughing, gagging, distress and rapidly developing pulmonary edema. If ingested, it causes vomiting, gripping, diarrhea, depressed respirations. [CHRIS]

TOXICITY/EXPOSURE LIMITS

NFPA RATING - Flammability - 3 Severe
Health - 2 Moderate
Reactivity - 0 None

TOXICITY HAZARD RATING - Acute and chronic local: skin 3; mucous membranes 3; eyes 3. Acute and chronic systemic: ingestion 3; inhalation 3; skin 3. 3= High: may cause death or permanent injury after exposure to small quantities. [SAX. DANGER PROPS INDUS MATER 6TH ED, P. 2588, 1984] 4. 4= Very toxic: probable oral lethal dose (human) 50-500 mg/kg, between 1 teaspoon and 1 ounce for 70-kg person (150 lbs). [GOSSELIN. CTCP 5TH ED, P. II-153, 1984]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - 2,000 ppm [NIOSH; POCKET GUIDE TO CHEMICAL HAZARDS P. 180 (1981) DHEW (NIOSH) PUB NO 78-210]

OSHA PEL - 100.000 ppm, 375.000 mg/m3;TWA
150.000 ppm, 560.000 mg/m3;STEL

ADOPTED ACGIH/TLV - 100.000 ppm, 375.000 mg/m3;TWA
150.000 ppm, 560.000 mg/m3;STEL

NIOSH/REL - 100.000 ppm, 375.00 mg/m3;TWA
200.000 ppm, 750.00 mg/m3 - 10 minute ceiling

INDUSTRY USE DATA

Toluene is used as a solvent in the extraction of various principles from plants; manufacture of dyes. [MERCK INDEX 9TH ED 1976]
Diluent for photogravure inks. [ENCYC OCCUPAT HEALTH & SAFETY 1971]
In fabric and paper coating, manufacture of artificial leather. [BROWNING. TOX & METAB INDUS SOLV 1965]
Used in cements, spot removers, cosmetics, antifreezes, and inks. [GLEASON MN; CHEM TOX OF COMM PROD, 3RD ED, 1969 AS CITED IN USEPA; HEALTH ASSESSMENT DOCUMENT: TOLUENE (DRAFT) (1982) EPA-600/8-82-008]
Asphalt and naphtha constituent. Detergent manufacture. [USEPA. IDENTIFICATION OF ORGANIC CMPDS IN EFFLUENTS FROM INDUSTRIAL SOURCES, (1975) EPA 560/3-75-002]
Manufacturing caprolactam, saccharin, medicines, and perfumes; diluent and thinner in nitrocellulose lacquers, adhesive solvent in plastic toys and model airplanes. [VERSCHUEREN. HDBK ENVIRON DATA ORG CHEM 1983]
Fuel blending. [ITI. TOX & HAZARD INDUS CHEM SAFETY MANUAL 1982]
Solvent-e.g., for coatings, paints, lacquers and adhesives. [SRI]
Chemical intermediate for benzene; for toluene diisocyanate via dinitrotoluene; for benzoic acid and benzaldehyde; for benzyl chloride and benzol chloride; for cresols, xylenes and vinyl toluene; for toluene sulfonic acids and derivatives; for nitrotoluenes, e.g., trinitrotoluene; for benzotrichloride and chlorotoluenes; for para-tert-butyl benzoic acid; denaturant; and for biphenyl. [SRI]

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
2851	PAINTS AND ALLIED PRODUCTS	2,606	573	21.99

Trichloroethylene
(CAS NUMBER: 79-01-6)

TCE

SYNONYMS

Chlorilen/Chlorylen/Densinfluat/Ethinyl trichloride/Ethylene trichloride/Threthylen/Threthylene /TRI/Trichloran/Trichloren/ Trichloroethene/1,1,2-Trichloroethylene/Trielene/Trielin/ Trieline/Trilen/Trimar / Acetylene trichloride

TRADE NAMES

Algylen; Anamenth; Trilene; Benzinol; Germalygene; Narcogen; Fluate; Narkosoid; Tridene; Blacosolv; Cecolene; Westrosol.

DESCRIPTION OF SUBSTANCE

Trichloroethylene is a clear, colorless, volatile liquid having a chloroform-like odor. It is heavier than water and is slightly soluble in water.

HEALTH EFFECTS

Trichloroethylene is a narcotic, an irritant of skin and mucous membranes, a liver and kidney toxin, and is believed by NIOSH and the EPA to be a potential human carcinogen. In acute inhalation exposures, rapid coma may ensue with eventual death from hepatic or renal failure. An occasional sudden death suggests ventricular fibrillation. Sequelae, which may be more common after inhalation than after ingestion, include liver and kidney lesions, reversible trigeminal (or other nerve) degeneration, and psychic disturbances. [GOSSELIN. CTCP 4TH ED 1976]
Workers exposed at concentrations averaging about 10 ppm complained of headache, dizziness and sleepiness. [ACGIH. TLVS. 4TH ED & SUPPL. 1980]
Trichloroethylene is only mildly irritating to the skin if allowed to evaporate. From continued use of the material in contact with the skin, defatting can take place. [PATTY. INDUS HYG & TOX 3RD E D VOL2A,2B,2C 1981-82]
Fatal hepatic failure has been observed following the use of trichloroethylene as an anesthetic. This effect has occurred in patients with complicating conditions such as malnutrition, toxemias, burns, or those who had received transfusions. [DAFALQUE RJ; CLIN PHARM THER 2: 665 (1961) AS CITED IN USEPA; AMBIENT WATER QUALITY CRITERIA DOCUMENT: TRICHLORDETHYLENE P.C-17 (1980) EPA-440/5/80-007]
A case of severe liver necrosis following a prolonged (4 1/2 hour) use of trichloroethylene as an anesthetic has been reported. [HERDMAN KN; BR MED J (3): 689-690 (1945) AS CITED IN HEALTH AND SAFETY EXECUTIVE MONOGRAPH: TRICHLOROETHYLENE #6 P.14 (1982)]
Following chronic and acute overexposure to trichloroethylene

during operation of a dry cleaning unit, symptoms included symmetrical bilateral VIIIth cranial nerve deafness as well as cerebral cortical dysrhythmia and alterations in the electroencephalogram. The patient recovered after the exposure stopped. [TOMASINI M, SARTORELLI E; MED LAV 62: 277-280 (1971) AS CITED IN USEPA; HEALTH ASSESSMENT DOCUMENT: TRICHLOROETHYLENE (DRAFT) P.5-2 (1983) EPA-600/8-82-006B]
Rats exposed to 37,000, 42,000, and 56,000 mg/cu m of trichloroethylene vapor for two hours exhibited elevated activities of serum glutamic pyruvic transaminase, glutamic oxaloacetic transaminase, and isocitrate dehydrogenase. Hepatotoxicity (indicated by the increased levels of these hepatic enzymes in the serum) was greatly enhanced by pretreatment with 3-methylchloranthrene. [CARLSON GP; RES COMM CHEM PATHOL PHARMACOL 7: 637 (1974) AS CITED IN USEPA; AMBIENT WATER QUALITY DOCUMENT: TRICHLOROETHYLENE P.C-19 (1980) EPA-440/5/80-007]
Some experiments with test animals indicated that this substance may be anticipated to be a carcinogen. Carcinogenicity: NTP: no IARC: no Z List: no OSHA REG: no. Effects of overexposure: inhalation of vapors may cause headache, nausea, vomiting, dizziness, drowsiness, irritation of respiratory tract, and loss of consciousness. Inhalation of vapors may cause pulmonary edema. Contact with skin or eyes may cause irritation. Prolonged exposure may cause dermatitis. Ingestion may cause nausea, vomiting, headaches,dizziness, gastrointestinal irritation, central nervous system depression and hearing loss. Chronic effects of overexposure may include damage to kidneys, liver, lungs, blood, or central nervous system. Target organs: respiratory system, heart, liver, kidneys, central nervous system.

TOXICITY/EXPOSURE LIMITS

NFPA RATING - Flammability - 1 Slight
Health - 2 Moderate
Reactivity - 0 None

TOXICITY HAZARD RATING - Acute and chronic local: skin 3; eye 3. 3= High: may cause death or permanent injury after exposure to small quantities. [SAX. DANGER PROPS INDUS MATER 6TH ED, P. 2621, 1984]
3. 3= Moderately toxic: probable oral lethal dose (human) 0.5-5 gm/kg between 1 ounce and 1 pint (or 1 lb) for 70 kg person (150 lbs). [GOSSELIN CTCP 5TH ED, II-165, 1984]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - None; Potential human carcinogen.

TCE

OSHA PEL - 50.000 ppm, [redacted] mg/m3;TWA
200.000 ppm, 1080.000 mg/m3;STEL

ADOPTED ACGIH/TLV - 50.000 ppm, 270.000 mg/m3;TWA
200.000 ppm, 1080.000 mg/m3;STEL

NIOSH/REL - 25.000 ppm, ****** mg/m3;TWA

INDUSTRY USE DATA

Trichloroethylene is used in degreasing, in dry cleaning; in manufacturing organic chemicals and pharmaceuticals. [MERCK INDEX 9TH ED 1976]
It is also used in gas purification, as a solvent of sulfur and phosphorus. [BROWNING. TOX & METAB IND US SOLV 1965]
It is also used as a refrigerant and heat exchange liquid; a diluent in paints and adhesives; in textile processing; and in aerospace operations (flushing liquid oxygen). [HAWLEY. CONDENSED CHEM DICTNRY 9TH ED 1977]
FDA permits use of trichloroethylene as a solvent in the production of exempt color additives for food, drugs, and cosmetics. [21 CFR 73.3]
It is also used as a chain terminator in production of polyvinyl chloride, a swelling agent in disperse dyeing of polyesters, an agent in removal of basting threads in textile processing, a chemical intermediate for 1,1,2,2-tetrachloroethyl sulfenyl chloride, a solvent in adhesives and paint-stripping formulations, a heat transfer medium-e.g., in case hardening of metals, a solvent base for metal phosphatizing systems, a solvent in characterization test for asphalt, an entrainer for recovery of formic acid, and an extraction solvent-e.g., for caffeine. [SRI]
In veterinary use, it is a disinfectant.

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
3648	LIGHTING EQUIPMENT, NEC	36	16	44.44
2253	KNIT OUTERWEAR MILLS	7,386	2,886	39.07
3496	MISC. FABRICATED WIRE PRODUCTS	800	259	32.37
2891	ADHESIVES AND SEALANTS	832	252	30.29
3622	INDUSTRIAL CONTROLS	4,083	877	21.48
3449	MISCELLANEOUS METAL WORK	89	18	20.22
3552	TEXTILE MACHINERY	1,056	195	18.47
3832	OPTICAL INSTRUMENTS AND LENSES	209	31	14.83
3398	METAL HEAT TREATING	242	26	10.74
3661	TELEPHONE/TELEGRAPH APPARATUS	40,646	3,562	8.76
4583	AIRPORT TERMINAL SERVICES	4,458	367	8.23
2295	COATED FABRICS, NOT RUBBERIZED	480	37	7.71
3822	ENVIRONMENTAL CONTROLS	1,711	126	7.36
3565	INDUSTRIAL PATTERNS	130	9	6.92
3825	INSTR. TO MEASURE ELECTRICITY	18,445	1,228	6.66
3672	CATHODE RAY TV PICTURE TUBES	4,212	280	6.65
3471	PLATING AND POLISHING	1,512	100	6.61
8411	MUSEUMS AND ART GALLERIES	304	20	6.58

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
7694	ARMATURE REWINDING SHOPS	22	13	59.09
7538	GENERAL AUTOMOBILE REPAIR SHO	16	5	31.25
5014	TIRES AND TUBES	85	21	24.71
5252	FARM EQUIPMENT DEALERS	98	18	18.37
3576	SCALES AND BALANCES	95	16	16.84
5719	MISCELLANEOUS HOME FURNISHING	50	8	16.00
2645	DIE CUT PAPER AND BOARD	201	29	14.43
3555	PRINTING TRADES MACHINERY	86	11	12.79
2519	HOUSEHOLD FURNITURE, NEC	104	13	12.50
3585	REFRIGERATION MACHINERY	1,152	143	12.41
3811	ENGINEERING & SCIENTIFIC INST	4,632	516	11.14
3643	CURRENT-CARRYING WIRING DEVIC	3,296	342	10.38
6024	STATE BANKS, NOT FED. RES., N	40	4	10.00
3721	AIRCRAFT	28,401	2,756	9.70
3661	TELEPHONE AND TELEGRAPH APPAR	19,029	1,824	9.59
2793	PHOTOENGRAVING	148	14	9.46
3629	ELECTRICAL INDUSTRIAL APPARAT	188	16	8.51
7391	RESEARCH & DEVELOPMENT LABORA	938	79	8.42
2816	INORGANIC PIGMENTS	708	58	8.19
3914	SILVERWARE AND PLATED WARE	116	9	7.76
3351	COPPER ROLLING AND DRAWING	1,836	134	7.30
2815	CYCLIC INTERMEDIATES AND CRUD	160	11	6.87
1941	SIGHTING AND FIRE CONTROL EQU	792	54	6.82
3471	PLATING AND POLISHING	722	47	6.51
2654	SANITARY FOOD CONTAINERS	1,281	78	6.09
3497	METAL FOIL AND LEAF	50	3	6.00
3554	PAPER INDUSTRIES MACHINERY	718	43	5.99
2095	ROASTED COFFEE	1,572	91	5.79
6513	APARTMENT BUILDING OPERATORS	797	46	5.77
3662	RADIO AND TV COMMUNICATION EQ	7,952	441	5.55
7699	REPAIR SERVICES, NEC	851	46	5.41
7949	AMUSEMENT AND RECREATION, NEC	556	29	5.22
3821	MECHANICAL MEASURING DEVICES	9,670	504	5.21
5081	COMMERCIAL MACHINES AND EQUIP	822	42	5.11
3799	TRANSPORTATION EQUIPMENT, NEC	418	21	5.02

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure

TRIMETHYL BENZENE

Trimethyl benzene
(CAS NUMBER: 25551-13-7)

SYNONYMS

Benzene, trimethyl-/Methylxylene/Trimethylbenzene

TRADE NAMES

NONE

DESCRIPTION OF SUBSTANCE

Trimethyl benzene is a liquid. The three isomers of trimethyl benzene--mesitylene (1,3,5-), pseudocumen (1,2,4-), and hemimellitene (1,2,3-)-- are present in petroleum and coal tar. While both pseudocumen and hemimellitene are soluble in alcohol, benzene, and ether, mesitylene is only miscible with these solvents. All three isomers are practically insoluble in water. [ACGIH, p. 608, 1986]

HEALTH EFFECTS

Harmful effects and symptoms associated with trimethyl benzene exposure include skin irritation; chemical pneumonitis at the site of contact when deposition of the liquid into the lungs occurs; nervousness, tension, anxiety, asthmatic bronchitis; and hypochronic anemia. Conjunctivitis, headache, fatigue, nausea, and narcosis are also reported. [SITTIG, P. 897, 1985]

TOXICITY/EXPOSURE LIMITS

NFPA RATING - Flammibility - 2 Moderate
Health - 0 None
Reactivity - 0 None

TOXICITY HAZARD RATING - Acute and chronic local: skin 3; mucous membranes 3; eyes 3. Acute and chronic systemic: ingestion 3; inhalation 3; skin 3. 3= High: may cause death or permanent injury after exposure to small quantities. [SAX. DANGER PROPS INDUS MATER 6TH ED, P. 2663, 1984]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - NONE

OSHA PEL - 25.000 ppm, 125.000 mg/m3;TWA

ADOPTED ACGIH/TLV - 25.000 ppm, 125.000 mg/m3;TWA

NIOSH/REL - NONE

INDUSTRY USE DATA

NONE

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

NONE

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

NONE

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure of process or worker.

PERSONAL PROTECTIVE EQUIPMENT

Wear chemical goggles, rubber gloves. Use chemical cartridge respirator. [SITTIG, P. 898, 1985]

STORAGE

Store in a cool, dry, well-ventilated, flammable liquids storage area.

Vinyl Chloride

Vinyl chloride
(CAS NUMBER: 75-01-4)

SYNONYMS

Chloroethylene/Chloroethene/Monochloroethylene/Ethylene monochloride/Monochloroethene/Vinyl C monomer/Vinyl chloride monomer/VCM

TRADE NAMES

Trovidur.

DESCRIPTION OF SUBSTANCE

Vinyl chloride is a colorless, highly flammable gas with an ethereal odor. [ACGIH, 1986]

HEALTH EFFECTS

Vinyl chloride is recognized as a human carcinogen by NIOSH, OSHA, IARC, NTP, and the ACGIH. Mice, rats, and guinea pigs exposed to 20, 30, or 40 percent vinyl chloride (volume in air) died, and post-mortem examination revealed pulmonary hyperemia and engorgement. Male and female rats exposed for 7 hours daily to concentrations of 500 ppm for 4.5 months showed micro pathological changes in the liver and kidney. In humans, exposure to vinyl chloride causes narcosis, incoordination, weakness, hepatomegoly, pallor or cyanosis of the extremities, and bleeding of the gastro-intestinal tract, as well as hepatic angiosarcomas and other cancers.

TOXICITY/EXPOSURE LIMITS

NFPA RATING - Flammability - 4 Extreme
Health - 2 Moderate
Reactivity - 1 Moderate

TOXICITY HAZARD RATING - Acute and chronic local: skin 3; mucous membranes 3; eyes 3. Acute and chronic systemic: ingestion 3; inhalation 3; skin 3. 3 = High: may cause death or permanent injury after exposure to small quantities. [SAX. DANGER PROPS INDUS MATER 6TH ED 1984]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - NONE - (Carcinogen)

OSHA PEL - 1 ppm, 2 mg/m3;TWA
5 ppm, Ceiling - 15 minutes See 1910.1017

ADOPTED ACGIH/TLV - 5 ppm, 10 mg/m3;TWA

NIOSH/REL - Lowest detectable limit

INDUSTRY USE DATA

Vinyl chloride is used as a raw material for the manufacture of polyvinyl chloride resins and in the organic synthesis of other chemicals.

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

NONE

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

NONE

OSHA/EXPOSURE DATA

EXPOSURE TYPE	ACGIH TLV	NIOSH REL	UNITS	# OF SAMP	ABOVE TLV #	ABOVE TLV %	ABOVE NIOSH #	ABOVE NIOSH %
TWA	5.0000		ppm	91	91	100.00	****	****
TOTAL				91	91	100.00	****	****

ENGINEERING CONTROLS

Use engineering controls such as isolation or process enclosure to prevent worker exposure.

PERSONAL PROTECTIVE EQUIPMENT

Respiratory protection should be as follows: At any detectable concentration: any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode, any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. Escape: any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back- mounted canister providing protection against the compound of concern, any appropriate escape-type self-contained breathing apparatus.

STORAGE

Protect against physical damage. Outside or detached storage is preferrable. Inside storage should be in a cool, well-ventilated, non-combustible creation, away from all possible sources of ignition. Separate from oxidizing materials.

used as an absorbent for nitroglycerin in dynamite manufacture and as a filler in plastics, linoleum, and paperboard. [SITTIG, P. 930, 1985]

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

NONE

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
6553	CEMETERY SUBDIVIDERS AND DEVE	20	17	85.00
1751	CARPENTERING	441	46	10.43
2421	SAWMILLS AND PLANING MILLS, G	744	41	5.51

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure of process or worker. Where this material is handled or used, provide adequate explosion-proof ventilation to meet TLV requirements. When dusting is excessive, precautions should be taken to avoid generation of explosive levels of wood dust in the air. [MSDS]
Clean up areas where wood dust settles to avoid excessive accumulation of this combustible material.

PERSONAL PROTECTIVE EQUIPMENT

The use of clean body-covering work clothing is recommended to reduce exposure of skin to wood dust. Use chemical goggles to protect the eyes. Follow good housekeeping practices.

STORAGE

NONE

Xylene (o-, m-, and p- isomers)
(CAS NUMBER: 1330-20-7)

XYLENE

SYNONYMS

Dimethylbenzene/Xylol/Ksylen (Polish)/Methyl toluene/Xiloli (Italian)/Xylenen (Dutch)/Xylole (German)

TRADE NAMES

Violet 3; Dilan.

DESCRIPTION OF SUBSTANCE

Xylene is a clear, colorless liquid with a characteristic aromatic hydrocarbon odor. Commercial xylene is a mixture of three isomers, ortho, meta, and para, with the meta form usually the principal component. Six to 15 percent of ethyl benzene may also be present. Pure xylene is a solid below 12.78 degrees C. Xylene is insoluble in water but miscible with absolute alcohol, ether, and organic solvents. [ACGIH, P. 637, 1986]

HEALTH EFFECTS

Xylene vapor is an irritant of the eyes, mucous membranes, and skin; at high concentrations it causes narcosis. The liquid is a skin irritant and causes erythema, dryness, and defatting; prolonged contact may cause the formation of vesicles. [PROCTOR & HUGHES, P. 509, 1978]
Coal-based solvents (e.g., xylene) have been suggested to be possible potent lymphocytic leukemogens based on a limited study of the rubber industry. [FISHBEIN L; SCI TOTAL ENVIRON 43 (1-2): 165-83 (1985)]
In workers exposed to organic solvents (Me2CO, C6H6, PhMe, EtOAc, BuOAc, xylene, gasoline, and turpentine), the incidence of chronic bronchitis was higher, and the volume of expiratory air was lower, than in normal control subjects. The incidence in smokers was higher than in nonsmokers of both groups. Smoking increases risk of chronic bronchitis in organic solvent-exposed subjects. [SYKUT E; PRZEGL LEK 38 (4): 399-402 (1981)]
All of six volunteers were able to detect odor of mixed xylenes at concentration of 60 mg/m3. Four could detect 6 mg/m3, but none could detect 0.6 mg/m3. In a 15 minute exposure period, the only common sign of discomfort at 2,000 mg/m3 (460 ppm) was eye irritation. Some olfactory fatigue occurred with recovery in 10 minutes. [HAYES. PESTICIDES STUDIED IN MAN 1982]
Symptomatology: acute ingestion or inhalation 1. Ingestion causes burning sensation in mouth and stomach, as well as nausea, vomiting, and salivation. Hematemesis may occur. 2. Substernal pain, cough and hoarseness are described. 3. Aspiration into the tracheobronchial tree, either during ingestion or subsequent to vomiting or eructations, is likely to produce a severe hemorrhagic pneumonitis. 4. In vapor exposures,

a transient euphoria is sometimes observed. 5. Headache, giddiness, vertigo, ataxia and tinnitus. 6. Confusion, stupefaction and coma. 7. Often associated with this coma are tremors, motor restlessness, hypertonus and hyperactive reflexes, but frank convulsions rarely occur except in association with terminal asphyxia. 8. Death from respiratory failure or from sudden ventricular fibrillation. 9. Contact with liquid may cause erythema and even blisters if the contact is prolonged. Hemorrhagic inflammatory lesions developing on mucous membranes are most prominent symptoms following contact with liquid. [GOSSELIN. CTCP 5TH ED. 1984]
Three painters working in the confined space of a ship's fuel tank were overcome by xylene vapor, with estimated concentration of 10,000 ppm, from the paint they were using. They were not found until 18.5 hours after they entered the tank. One died shortly after discovery and at autopsy showed pulmonary edema and intra-aveolar hemorrhage. The other two recovered completely in about two days. They both had temporary hepatic impairment (inferred from elevated serum transaminase levels) and 1 had evidence of temporary renal impairment (increased blood urea and reduced endogenous creatinine clearance). [MORLEY R ET AL; BR MED J 3: 442-43 (1970) AS CITED IN NIOSH; CRITERIA DOCUMENT: XYLENE P.46 (1975) DHEW PUB. NIOSH 75-168]
Central nervous system defects were more common in children of mothers exposed to organic solvents and dusts during pregnancy. Hydroencephaly occurred in children whose mothers had been exposed to the solvents toluene, xylene, and white spirit during manufacture of rubber products. [HOLMBERG PC, NURMINEN M; AM J OF INDUST MED 1: 167 (1980)]
Women are liable to suffer from menstrual disorders (menorrhagia, metrorrhagia). It has been reported that female workers exposed to xylene in concentrations which periodically exceeded the exposure limits were also affected by pathological pregnancy conditions (toxicosis, danger of miscarriage, hemorrhage during child birth) and infertility. [ENCYC OCCUPAT HEALTH & SAFETY 1983]
Mixed xylenes at exposures of one to four times TLV (threshold limit value) levels were used. Subjective reports of irritation, as well as polygraph records of eyeblink and respiration rate, were recorded during 30 minute exposures. Psychomotor tests were administered before, during, and after exposure. Both a higher incidence of eye irritation and rate of eyeblink were reported by exposed subjects compared to controls, but the effects were mild. There were no significant differences in respiration rates or in tests of psychomotor function. [HASTINGS GP ET AL; HUMAN SENSORY RESPONSE TO SELECTED PETROLEUM HYDROCARBONS. ADV MOD ENVIRON TOX 6: 255-270 (1984)]

TOXICITY/EXPOSURE LIMITS

NFPA RATING - Flammability - 3 Severe
Health - 2 Moderate
Reactivity - 0 None

TOXICITY HAZARD RATING - Acute and chronic local: skin 3-2-1; mucous membranes 3-2-1; eyes 3-2-1. Acute and chronic systemic: ingestion 3-2-1; inhalation 3-2-1; skin 3-2-1. 3= High: may cause death or permanent injury after exposure to small quantities. 2= Moderate: may involve both irreversible and reversible changes not severe enough to cause death or permanent injury. 1= Slight: causes readily reversible changes which disappear after end of exposure. [SAX. DANGER PROPS INDUS MATER 6TH ED 1984, P. 2739-2740]
4. 4 = Very toxic: probable oral lethal dose (human) 50-500 mg/kg; between 1 teaspoon and 1 ounce for a 70 kg person (150 lbs). [GOSSELIN. CTCP 5TH ED 1984, P. II-154]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - 1000 ppm [NIOSH POCKET GUIDE TO CHEMICAL HAZARDS, SEP 1985]

OSHA PEL - 100.000 ppm, 435.000 mg/m3;TWA
150.000 ppm, 655.000 mg/m3;STEL

ADOPTED ACGIH/TLV - 100.000 ppm, 435.000 mg/m3;TWA
150.000 ppm, 655.000 mg/m3;STEL

NIOSH/REL - 100.000 ppm, 434.000 mg/m3;TWA
200.000 ppm, 868.000 mg/m3;Ceiling - 10 minute

INDUSTRY USE DATA

Xylene is a raw material for production of benzoic acid; as so other organics; sterilizlvent; manufacture dyes and other organics; sterliiz and their dimethyl estering catgut; production of phthalic anhydride, isophthalic and terphthalic acids and their dimethyl esters used in manufacture of polyester fibers; with Canada balsam as oil-immersion in microscopy; cleaning agent in microscope technique. [MERCK INDEX. 10 TH ED 1983]
In aviation gasoline; protective coatings; synthesis of organic chemicals. [HAWLEY. CONDENSED CHEM DICTNRY 10TH ED 1981]
Solvent-e.g., for paints, coatings, adhesives and rubber. [SRI]
Back-blended into gasoline. [SRI]
Unrecovered component of gasoline. [SRI]
Used in manufacture of quartz crystal oscillators, hydrogen peroxide, perfumes, insect repellants, epoxy resins, pharmaceuticals, and in the leather industry. [SITTIG. HANDBOOK TOXIC HAZARD CHEM & CARCINOG 2 ED 85]

[Code of Federal Regulations]
[Title 29, Volume 6, Parts 1910.**1000** to End]
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TITLE 29--LABOR

PART 1910--OCCUPATIONAL SAFETY AND HEALTH STANDARDS (Continued)--Table of Contents

Subpart Z--Toxic and Hazardous Substances

Authority: Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), 9-83 (48 FR 35736), or 6-96 (62 FR 111), as applicable; and 29 CFR part 1911.

All of subpart Z issued under sec. 6(b) of the Occupational Safety and Health Act, except those substances that have exposure limits listed in Tables Z-1, Z-2, and Z-3 of 29 CFR 1910.**1000**. The latter were issued under sec. 6(a) (29 U.S.C. 655(a)).

Section 1910.**1000**, Tables Z-1, Z-2 and Z-3 also issued under 5 U.S.C. 553, Section 1910.**1000** Tables Z-1, Z-2, and Z-3 not issued under 29 CFR part 1911 except for the arsenic (organic compounds), benzene, and cotton dust listings.

Section 1910.1001 also issued under section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 333) and 5 U.S.C. 553.

Section 1910.1002 not issued under 29 U.S.C. 655 or 29 CFR part 1911; also issued under 5 U.S.C. 553.

Sections 1910.1018, 1910.1029 and 1910.1200 are also issued under 29 U.S.C. 653.

Source: 39 FR 23502, June 27, 1974, unless otherwise noted. Redesignated at 40 FR 23072, May 28, 1975.

An employee's exposure to any substance listed in Tables Z-1, Z-2, or Z-3 of this section shall be limited in accordance with the requirements of the following paragraphs of this section.

(a) Table Z-1--(1) Substances with limits preceded by ``C''--Ceiling Values. An employee's exposure to any substance in Table Z-1, the exposure limit of which is preceded by a ``C'', shall at no time exceed the exposure limit given for that substance. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure which shall not be exceeded at any time during the working day.

(2) Other substances--8-hour Time Weighted Averages. An employee's exposure to any substance in Table Z-1, the exposure limit of which is not preceded by a ``C'', shall not exceed the 8-hour Time Weighted Average given for that substance in any 8-hour work shift of a 40-hour work week.

(b) Table Z-2. An employee's exposure to any substance listed in Table Z-2 shall not exceed the exposure limits specified as follows:

(1) 8-hour time weighted averages. An employee's exposure to any substance listed in Table Z-2, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that substance in Table Z-2.

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(2) Acceptable ceiling concentrations. An employee's exposure to a substance listed in Table Z-2 shall not exceed at any time during an 8-hour shift the acceptable ceiling concentration limit given for the substance in the table, except for a time period, and up to a concentration not exceeding the maximum duration and concentration allowed in the column under ``acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift.''

(3) Example. During an 8-hour work shift, an employee may be exposed to a concentration of Substance A (with a 10 ppm TWA, 25 ppm ceiling and 50 ppm peak) above 25 ppm (but never above 50 ppm) only for a maximum period of 10 minutes. Such exposure must be compensated by exposures to concentrations less than 10 ppm so that the cumulative exposure for the entire 8-hour work shift does not exceed a weighted average of 10 ppm.

(c) Table Z-3. An employee's exposure to any substance listed in Table Z-3, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that substance in the table.

(d) Computation formulae. The computation formula which shall apply to employee exposure to more than one substance for which 8-hour time weighted averages are listed in subpart Z of 29 CFR part 1910 in order to determine whether an employee is exposed over the regulatory limit is as follows:

(1)(i) The cumulative exposure for an 8-hour work shift shall be computed as follows:

E = (C<INF>a</INF> T<INF>a</INF>+C<INF>b</INF> T<INF>b</INF>+. .
.C<INF>n</INF> T<INF>n</INF>)<divide>8

Where:

E is the equivalent exposure for the working shift.
C is the concentration during any period of time T where the concentration remains constant.
T is the duration in hours of the exposure at the concentration C.

The value of E shall not exceed the 8-hour time weighted average specified in subpart Z of 29 CFR part 1910 for the substance involved.

(ii) To illustrate the formula prescribed in paragraph (d)(1)(i) of this section, assume that Substance A has an 8-hour time weighted average limit of 100 ppm noted in Table Z-1. Assume that an employee is subject to the following exposure:

Two hours exposure at 150 ppm
Two hours exposure at 75 ppm
Four hours exposure at 50 ppm

Substituting this information in the formula, we have

(2 x 150+2 x 75+4 x 50)<divide>8=81.25 ppm

Since 81.25 ppm is less than 100 ppm, the 8-hour time weighted average limit, the exposure is acceptable.

(2)(i) In case of a mixture of air contaminants an employer shall compute the equivalent exposure as follows:

E<INF>m</INF>=(C<INF>1</INF><divide>L<INF>1</INF>+C<INF>2</INF><divide>L<INF>2</INF>
)+. . .(C<INF>n</INF><divide>L<INF>n</INF>)

Where:

E<INF>m</INF> is the equivalent exposure for the mixture.
C is the concentration of a particular contaminant.
L is the exposure limit for that substance specified in subpart Z of 29 CFR part 1910.

The value of E<INF>m</INF> shall not exceed unity (1).

(ii) To illustrate the formula prescribed in paragraph (d)(2)(i) of this section, consider the following exposures:

Substance	Actual concentration of 8-hour exposure (ppm)	8-hour TWA PEL (ppm)
B	500	1,000
C	45	200
D	40	200

Substituting in the formula, we have:

E<INF>m</INF>=500<divide>1,000+45<divide>200+40<divide>200
E<INF>m</INF>=0.500+0.225+0.200
E<INF>m</INF>=0.925

Since E<INF>m</INF> is less than unity (1), the exposure combination is within acceptable limits.

(e) To achieve compliance with paragraphs (a) through (d) of this section, administrative or engineering controls must first be determined and implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this section. Any equipment and/or technical measures used for this purpose must be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators

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are used, their use shall comply with 1910.134.

(f) Effective dates. The exposure limits specified have been in effect with the method of compliance specified in paragraph (e) of this section since May 29, 1971.

Table Z-1--Limits for Air Contaminants

Substance	CAS No. (c)	ppm (a) \1\	mg/m\3\ (b \1\
Acetaldehyde	75-07-0	200	360
Acetic acid	64-19-7	10	25
Acetic anhydride	108-24-7	5	20
Acetone	67-64-1	**1000**	2400
Acetonitrile	75-05-8	40	70
2-Acetylaminofluorine; see 1910.1014	53-96-3		
Acetylene dichloride; see 1,2-Dichloroethylene.			
Acetylene tetrabromide	79-27-6	1	14

Acrolein	107-02-8	0.1	0.25
Acrylamide	79-06-1	.....	0.3
Acrylonitrile; see 1910.1045	107-13-1		
Aldrin	309-00-2	.....	0.25
Allyl alcohol	107-18-6	2	5
Allyl chloride	107-05-1	1	3
Allyl glycidyl ether (AGE)	106-92-3	(C)10	(C)45
Allyl propyl disulfide	2179-59-1	2	12
alpha-Alumina	1344-28-1		
Total dust		.....	15
Respirable fraction		.....	5
Aluminum, metal (as Al)	7429-90-5		
Total dust		.....	15
Respirable fraction		.....	5
4-Aminodiphenyl; see 1910.1011	92-67-1		
2-Aminoethanol; see Ethanolamine.			
2-Aminopyridine	504-29-0	0.5	2
Ammonia	7664-41-7	50	35
Ammonium sulfamate	7773-06-0		
Total dust		.....	15
Respirable fraction		.....	5
n-Amyl acetate	628-63-7	100	525
sec-Amyl acetate	626-38-0	125	650
Aniline and homologs	62-53-3	5	19
Anisidine (o-, p-isomers)	29191-52-4	.....	0.5
Antimony and compounds (as Sb)	7440-36-0	.....	0.5
ANTU (alpha Naphthylthiourea)	86-88-4	.....	0.3
Arsenic, inorganic compounds (as As); see 1910.1018.	7440-38-2		
Arsenic, organic compounds (as As)	7440-38-2	.....	0.5
Arsine	7784-42-1	0.05	0.2
Asbestos; see 1910.1001	(\4\)		
Azinphos-methyl	86-50-0	.....	0.2
Barium, soluble compounds (as Ba)	7440-39-3	.....	0.5
Barium sulfate	7727-43-7		
Total dust		.....	15
Respirable fraction		.....	5
Benomyl	17804-35-2		
Total dust		.....	15
Respirable fraction		.....	5
Benzene; see 1910.1028	71-43-2		
See Table Z-2 for the limits applicable in the operations or sectors excluded in 1910.1028 ^d			
Benzidine; see 1910.1010	92-87-5		
p-Benzoquinone; see Quinone.			
Benzo(a)pyrene; see Coal tar pitch volatiles..			
Benzoyl peroxide	94-36-0	.....	5
Benzyl chloride	100-44-7	1	5
Beryllium and beryllium compounds (as Be).	7440-41-7		(\2\)
Biphenyl; see Diphenyl.			
Bismuth telluride, Undoped	1304-82-1		
Total dust		.....	15
Respirable fraction		.....	5
Boron oxide	1303-86-2		
Total dust		.....	15
Boron trifluoride	7637-07-2	(C)1	(C)3
Bromine	7726-95-6	0.1	0.7
Bromoform	75-25-2	0.5	5

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Butadiene (1,3-Butadiene); See 29 CFR 1910.1051; 29 CFR 1910.19(l).	106-99-0	1 ppm/5 ppm STEL	.....
Butanethiol; see Butyl mercaptan.			
2-Butanone (Methyl ethyl ketone).....	78-93-3	200	590
2-Butoxyethanol.....	111-76-2	50	240
n-Butyl-acetate.....	123-86-4	150	710
sec-Butyl acetate.....	105-46-4	200	950
tert-Butyl acetate.....	540-88-5	200	950
n-Butyl alcohol.....	71-36-3	100	300
sec-Butyl alcohol.....	78-92-2	150	450
tert-Butyl alcohol.....	75-65-0	100	300
Butylamine.....	109-73-9	(C)5	(C)15
tert-Butyl chromate (as CrO<INF>3</INF>).....	1189-85-1	.....	.....
n-Butyl glycidyl ether (BGE).....	2426-08-6	50	270
Butyl mercaptan.....	109-79-5	10	35
p-tert-Butyltoluene.....	98-51-1	10	60
Cadmium (as Cd); see 1910.1027.....	7440-43-9		
Calcium carbonate.....	1317-65-3		
Total dust.....		.....	15
Respirable fraction.....		.....	5
Calcium hydroxide.....	1305-62-0		
Total dust.....		.....	15
Respirable fraction.....		.....	5
Calcium oxide.....	1305-78-8	.....	5
Calcium silicate.....	1344-95-2		
Total dust.....		.....	15
Respirable fraction.....		.....	5
Calcium sulfate.....	7778-18-9		
Total dust.....		.....	15
Respirable fraction.....		.....	5
Camphor, synthetic.....	76-22-2	.....	2
Carbaryl (Sevin).....	63-25-2	.....	5
Carbon black.....	1333-86-4	.....	3.5
Carbon dioxide.....	124-38-9	5000	9000
Carbon disulfide.....	75-15-0		(\2\)
Carbon monoxide.....	630-08-0	50	55
Carbon tetrachloride.....	56-23-5		(\2\)
Cellulose.....	9004-34-6		
Total dust.....		.....	15
Respirable fraction.....		.....	5
Chlordane.....	57-74-9	.....	0.5
Chlorinated camphene.....	8001-35-2	.....	0.5
Chlorinated diphenyl oxide.....	55720-99-5	.....	0.5
Chlorine.....	7782-50-5	(C)1	(C)3
Chlorine dioxide.....	10049-04-4	0.1	0.3
Chlorine trifluoride.....	7790-91-2	(C)0.1	(C)0.4
Chloroacetaldehyde.....	107-20-0	(C)1	(C)3
a-Chloroacetophenone (Phenacyl chloride)..	532-27-4	0.05	0.3
Chlorobenzene.....	108-90-7	75	350
o-Chlorobenzylidene malononitrile.....	2698-41-1	0.05	0.4
Chlorobromomethane.....	74-97-5	200	1050
2-Chloro-1,3-butadiene; see beta-Chloroprene.			
Chlorodiphenyl (42% Chlorine) (PCB).....	53469-21-9	.....	1
Chlorodiphenyl (54% Chlorine) (PCB).....	11097-69-1	.....	0.5
1-Chloro-2,3-epoxypropane; see Epichlorohydrin.			
2-Chloroethanol; see Ethylene			

Mercury (Z37.8-1971).....	.....	1 mg/10m³.....	
Methyl chloride (Z37.18-1969)..	100 ppm.....	200 ppm.....	300 ppm....
Methylene Chloride: See Sec. 1919.52..			
Organo (alkyl) mercury (Z37.30-1969).	0.01 mg/m³.....	0.04 mg/m<SUP>3</SUP	
Styrene (Z37.15-1969).....	100 ppm.....	200 ppm.....	600 ppm....
Tetrachloroethylene (Z37.22-1967).	100 ppm.....	200 ppm.....	300 ppm....
Toluene (Z37.12-1967).....	200 ppm.....	300 ppm.....	500 ppm....
Trichloroethylene (Z37.19-1967)	100 ppm.....	200 ppm.....	300 ppm....

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^a This standard applies to the industry segments exempt from the 1 ppm 8- standard at 1910.1028.

^b This standard applies to any operations or sectors for which the Cadmiu otherwise not in effect.

Table Z-3--Mineral Dusts

Substance	mppcf ^a	mg/m\3\
Silica:		
Crystalline		
Quartz (Respirable).....	250 ^b	10 mg/m\3\ ^e
	----------	----------
	%SiO<INF>2</INF>+5	% SiO<INF>2
Quartz (Total Dust).....	.....	30 mg/m\3\ ---------- % SiO<INF>2</INF> + 2
Cristobalite: Use \1/2\ the value calculated from the count or mass formulae for quartz		
Tridymite: Use \1/2\ the value calculated from the formulae for quartz		
Amorphous, including natural diatomaceous earth.....	20	80 mg/m\3\ ---------- %SiO<INF>2</INF>
Silicates (less than 1% crystalline silica):		
Mica.....	20	
Soapstone.....	20	
Talc (not containing asbestos).....	20 ^c	
Talc (containing asbestos) Use asbestos limit.....		
Tremolite, asbestiform (see 29 CFR 1910.1001).....		
Portland cement.....	50	
Graphite (Natural).....	15	
Coal Dust:		
Respirable fraction less than 5% SiO<INF>2</INF>.....	.....	2.4 mg/m\3\ ^e