

U.S. Department of
Homeland Security
United States
Coast Guard



Chemical Data Guide for Bulk Shipment by Water



1990
CIM 16616.6A







COMDINST M16616.6A

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COMMANDANT INSTRUCTION M16616.6A

Subj: Chemical Data Guide for Bulk Shipment By Water

1. PURPOSE. This manual has been prepared to assist Coast Guard personnel and others involved in bulk chemical shipment by water.
2. DIRECTIVES AFFECTED. The Chemical Data Guide for Bulk Shipment by Water, dated January 28, 1982, is cancelled.
3. CHANGE. Recommendations, comments, additional data and suggestions for improving this guide are requested by the Commandant (G-MTH-1).

I. D. SIPES
Rear Admiral, U.S. Coast Guard
Chief, Office of Marine Safety,
Security and Environmental Protection

DISTRIBUTION - SDL No. 129

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CHEMICAL DATA GUIDE FOR BULK SHIPMENT BY WATER

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The information in this book was collected from various sources believed to be reliable. However, the Coast Guard makes no claim that these data are either correct or sufficient and assumes no liability for any consequences arising from their use.

The courses of action described in this guide are meant as suggestions only. This guide carries no force of law or regulation except for 46 CFR 150.





PREFACE TO THE SEVENTH EDITION

The first edition of this Guide was issued on 1 June 1965. It contained data on 127 cargoes. This edition contains data on over 300 cargoes. A number of new cargo data sheets have been added, and several obsolete cargo data sheets have been dropped.

Most of the data for the new cargoes were obtained from completed CG-4355 forms. This form, Characteristics of Liquid Chemicals Proposed for Bulk Water Movement, or the International Maritime Organization's equivalent form, BCH/Circ.26, Characteristics of Liquid Chemicals Proposed for Marine Transport in Bulk, or other equivalent data source is required prior to the classification of a bulk cargo.

On 6 April 1987, Annex II of the 1978 Protocol to the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73/78) came into force. This Convention controls operational discharges from chemical tankers and provides additional protection from accidental spills. With the advent of the MARPOL Convention, carriage requirements for chemical cargoes are now determined by evaluation of both their safety and pollution characteristics. This edition of the Guide includes the International Maritime Organization (IMO) Pollution Category, and for domestic carriage, the U.S. Environmental Protection Agency (EPA) Category.

All data have been updated where new data were available including the Threshold Limit Values (TLVs) adopted in the 1989-1990 edition by the American Conference of Governmental Industrial Hygienists (ACGIH). Included with this edition for the first time are the Permissible Exposure Limits (PELs) adopted by the U.S. Occupational Safety and Health Administration (OSHA) in Table Z-1-A, 29 CFR 1910.1000.





INTRODUCTION

The U.S. Coast Guard is vitally concerned with safety at sea. In the interest of safety, the Coast Guard reviews all chemicals proposed for bulk shipment by water. All cargoes classified as dangerous are regulated.

The number and variety of unconventional liquid cargoes being transported in bulk by water continues to steadily increase. Although the transportation hazards of common petroleum products are generally well understood, newer commodities often have unusual fire and explosive properties such as wide flammable range, low ignition temperature and foam incompatibility in addition to other hazards such as toxicity and dangerous reactivity. It became increasingly evident that a convenient reference guide listing properties and emergency procedures for bulk liquid cargoes was needed by Coast Guard personnel concerned with the various aspects of safe transportation (marine inspection, port safety and security, marine environmental response and rescue coordination) and by civilian personnel with similar safety interests. The result of these concerns was this Chemical Data Guide.

This manual was prepared by the Marine Technical and Hazardous Materials Division staff at Headquarters in connection with the regulations governing bulk chemical transportation. The data in this guide were compiled from a number of sources. Too often contradictory data were found, and for many commodities desired data were simply non-existent. However, as additional data become available, appropriate corrections and additions will be made to update and continuously improve this guide.

Although this Chemical Data Guide is intended to be helpful in the initial stages of emergencies and casualties, users should seek more detailed, specific and competent emergency medical services as soon as possible.

This Chemical Data Guide was developed in the interest of safe water movement of bulk chemicals. Hopefully, by providing key chemical information in an easy to use form, this guide can help prevent or at least minimize the harmful effects of chemical accidents on the waterways.



EXPLANATION OF DATA

Format

Data sheets are arranged alphabetically by the most commonly-used chemical name. Following the data pages is a synonym index which shows other names for the products.

A standard form is used for each product to permit rapid reference and to group data in a logical manner. General information on identification and physical properties is given at the top of the page. Data pertaining to the three basic types of hazard (fire, health and reactivity) are given in separate blocks below. Suggested action in the event of a spill or leak is given in the bottom block. Regulatory classifications are included in the top section, while special information is given at the bottom of the page under "Remarks."

This book will be used by personnel with varying degrees of chemical training and experience. For this reason, non-technical terms are used whenever possible.

The guide sheet preceding the data sheets is intended to help interpret and identify the information on the data sheets.

Explanation of Terms

Synonyms:

Alternate and common names are listed. In general, proprietary and trade names are not used.

Formula:

The constituent elements and a simplified structural formula are shown.

Appearance-Odor:

A brief descriptive statement of these properties is given.

Specific Gravity:

This is the ratio of the weight of a volume of the cargo to the weight of an equal volume of water. In the case of liquids of limited solubility, the specific gravity will predict whether the product will sink or float on water; for example, if the specific gravity is greater than 1, the product will sink, and if the specific gravity is less than 1, the product will float.



Chemical Family:

This is a general chemical category which facilitates the use of the compatibility chart for predicting the type of reactions which can be expected.

Pollution Category...USEPA _____ IMO _____:

In the blanks are indicated the category assigned by the U.S. Environmental Protection Agency (USEPA), for domestic user information, and the Noxious Liquid Substance (NLS) Pollution Category (Pol. Cat.) assigned by the International Maritime Organization (IMO) for international shipment on oceangoing vessels.

USEPA

X, A, B, C, D—Category associated with reportable quantities of 1, 10, 100, 1,000, and 5,000 pounds, respectively. See 40 CFR Table 302.4—List of Hazardous Substances and Reportable Quantities.

IMO

A, B, C, D—NLS Category of Annex II of MARPOL 73/78.
III—Appendix III of Annex II (non-NLS cargoes) of MARPOL 73/78.

I—Considered an oil under Annex I of MARPOL 73/78. See page 410 of the Data Guide for the complete list.

#—No determination of NLS status. For shipping on oceangoing vessels, see 46 CFR 153.900(c).

@—The NLS category has been assigned by the U.S. Coast Guard, in absence of one assigned by the IMO. The category is based upon a GESAMP Hazard Profile or by analogy to a closely related product having an NLS assigned.

“gas”—The IMO generally does not assign Pol. Cats to gases as these cargoes present little to no hazard to the aquatic environment.

Applicable Bulk Regulation 46 CFR Subchapter _____:

In the blank is indicated the CFR reference for the carriage of the commodity.

United Nations Number:

The number assigned to a particular cargo by the United Nations.

CHRIS Code:

The three letter designation assigned to every entry in the Chemical Hazard Response Information System.



Boiling Point:

The temperature at which the liquid boils, given in °C and °F at a pressure of 760 mm Hg, one atmosphere or 14.7 psia. Thus, the boiling point is the temperature at which the vapor pressure is 760 mm Hg, one atmosphere or 14.7 psia

Freezing Point:

The temperature in °C and in °F at which the liquid solidifies.

Vapor Pressure:

The equilibrium pressure of the saturated vapor above the liquid, measured in millimeters of mercury (760 mm Hg = 14.7 psia) at 20°C (68°F) unless another temperature is specified. Conversion is done as follows:

$$\text{psi} = \frac{\text{mm Hg}}{760} \times 14.7$$

Reid Vapor Pressure:

Equilibrium pressure exerted by vapor over the liquid at 100°F, expressed as pounds per square inch absolute (psia), defined in 46 CFR 30.10-59.

Vapor Density:

This is actually a specific gravity rather than a true density because it equals the ratio of the weight of a vapor or gas (with no air present) compared to the weight of an equal volume of air at the same temperature and pressure. Values less than 1 indicate that the vapor or gas tends to rise and values greater than 1 indicate that it tends to settle. However, temperature effects must be considered. For example, although methane at 68°F has a vapor density of 0.55, it becomes denser at lower temperatures. At -259°F, the boiling point, the vapor is heavier than air. Vapors from an open container of boiling methane fall rather than rise.

Solubility in Water:

The following terms are used to describe the solubility of the product by weight in cold water:

Negligible	less than 0.1%
Slight	0.1%-1%
Moderate	1%-10%

The % by weight will be given when the solubility is of particular importance; for example, a highly toxic material which is only slightly soluble.



Fire & Explosion Hazard Data

Grade:

The classification assigned by the Coast Guard to flammable or combustible liquids is defined as follows:

- Grade A** Flammable liquid with a Reid vapor pressure of 14 pounds per square inch absolute (psia) or more.
- Grade B** Flammable liquid with a Reid vapor pressure of more than 8½ psia but less than 14 psia.
- Grade C** Flammable liquid with a Reid vapor pressure of 8½ psia or less and a flash point of 80°F or below.
- Grade D** Combustible liquid with a flash point above 80°F, but below 150°F.
- Grade E** Combustible liquid with a flash point of 150°F or above.

Electrical Group:

The electrical group is based on the explosive characteristics of air mixtures of gases or vapors. The 1986 edition of Manual for Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations, NFPA 497M, or the 1982 edition of Classification of Gases, Liquids, and Volatile Solids Relative to Explosion-Proof Electrical Equipment, NMAB 353-5. These publications provide details and list the chemicals by Group. (Both publications were current as of press time of the Data Guide.)

Flash Point:

The lowest temperature at which the vapors of a liquid may be ignited momentarily. Values given in the data sheets are open cup except where designated "(cc)," which indicates the closed cup value. In general the open cup value is about 10° to 15°F higher than the closed cup value.

Flammable Limits:

The range of gas or vapor concentrations (percent by volume in air) which will burn or explode if an ignition source is present. Limiting concentrations are commonly called the "lower explosive limit" (LEL) and the "upper explosive limit" (UEL). Below the LEL the mixture is too lean to burn, and above the UEL it is too rich to burn.



Autoignition Temperature:

The minimum temperature required to ignite gas or vapor without a spark or flame being present. Values given are only approximate and may change substantially with changes in geometry, gas, or vapor concentrations, presence of catalysts, or other factors.

Extinguishing Media:

A list of firefighting materials suitable for use on the burning material. For certain specific chemicals special formulations are available for extinguishing fires in addition to the standard agents. No mention of these can be made here because of the large number of such media available under various trade names. The firefighting agents listed here are as follows:

- Water fog—a finely divided mist produced by either a high or low velocity fog nozzle. It is used for knocking down flames and cooling hot surfaces.
- Water foam—either mechanical or chemical, produced by a special foam nozzle or by a fixed system. It is used to form a blanket over the surface of burning liquids. It is effective only with liquids which are not appreciably soluble in water.
- Alcohol foam—this material blankets fires in the same manner as conventional foam, but is intended for use with liquids which are soluble in water, such as alcohol and acetone. It must be applied more carefully than regular foam because the mechanical strength of the bubbles is less.
- CO₂—Carbon dioxide gas stored in cylinders. It may be applied through a fixed or semi-fixed system, or from a portable extinguisher. It is useful for inerting a compartment or for putting out small local fires.
- Dry chemical—Sodium or potassium bicarbonate or monosodium phosphate powder, usually available from a semi-fixed or portable extinguisher.

In case of a large-scale chemical fire aboard a vessel, it is probable that water will be the medium used because of its availability. Other agents may be more effective, but their supply is necessarily limited. During such a fire, water should also be used to cool tanks of chemicals which are not burning in order to prevent explosion or tank rupture. The only case in which water would not be used is that of a burning chemical which reacts



violently with water. Precautions should always be observed because of the hazardous properties of many cargoes in a fire. Examples include the formation of toxic combustion products, the reactivity with extinguishing media and the need for protective clothing and breathing apparatus.

General Fire Fighting Procedures:

For flammable liquids and volatile solids having flash points between approximately 100° and 212°F, water fog may be used. For liquids with flash points below 100°F, water may not extinguish, but possibly will control the fire.

Flammable liquids having specific gravities greater than that of water (sp.gr. = 1), and not water soluble, may be extinguished by gentle application of water to blanket the surface.

For flammable liquids with flash points above 212°F, and also for some very viscous materials, the use of water may cause frothing of the burning liquid. Water spray, if carefully applied, however, may be effective.

Generally, foam is a good extinguishing agent for fires in flammable liquids, except for those that are more than slightly soluble in water. These require the use of "alcohol" foam.

Health Hazard Data

Health Hazard Data Ratings are given in the same consecutive order as those given in columns II, III and IV of Table II of the National Academy of Sciences (NAS) Publication 1465 (1973 Revision).

The first rating deals with the hazard presented by "irritating vapors" to the skin or to the mucous membranes of the eyes, nose, throat, and lungs. These ratings have the following meanings:

- 0 Chemicals that are nonvolatile, or the vapors from which are nonirritating to the eyes and throat.
- 1 Chemicals that cause a slight smarting of the eyes or respiratory system if present in high concentrations. This effect is temporary.
- 2 Chemical vapors that cause moderate irritation, such that personnel will find high concentrations unpleasant. The effect is temporary.



- 3 Moderately irritating volatile chemicals, such that personnel will not usually tolerate moderate or high vapor concentrations.
- 4 Severe eye or throat irritants, vapors are capable of causing eye or lung injury, and cannot be tolerated even at low concentrations.

The second rating deals with the hazard of "irritation from liquids or solids" with regard to a chemical's tendency to burn or irritate human skin from contact. Ratings have the following meanings:

- 0 No appreciable hazard. These chemicals are practically harmless to the skin. Included are certain very volatile compounds that evaporate quickly from the skin.
- 1 Minimum hazard. Usually includes chemicals which, if spilled on clothing and allowed to remain, will cause smarting and reddening of the skin.
- 2 Chemicals that cause smarting of the skin and first-degree burns on long exposure.
- 3 Fairly severe skin irritants, usually causing pain and second-degree burns after a few minutes' contact.
- 4 Severe skin irritants, causing second and third-degree burns on short contact and very injurious to the eyes.

The third rating deals with the hazard presented due to "chemical poisons" entering the body through inhalation, oral ingestion, or skin penetration causing bodily harm. Ratings have the following meanings:

- 0 No likelihood of producing injury.
- 1 Minimum hazard. Includes most chemicals having threshold limits above 500 ppm.
- 2 Some hazard, typically having threshold limits of 100 to 500 ppm.
- 3 Moderately hazardous chemicals.
- 4 Severely hazardous chemicals usually having threshold limits below 10 ppm.

NAS Publication 1465 (1973 Revision) may be consulted for more detailed information on the guidelines employed in rating each class of hazard. This publication may be obtained as AD 775756:



National Technical Information Service (NTIS)
Telephone: 703-487-4600
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

Odor Threshold:

The smallest concentration, expressed in parts per million (ppm) by volume in air that can be detected by smell by most people. This is not an absolute value. It will vary among individuals and will vary from day to day for any one person. The odor of a potentially dangerous vapor may be hidden by another odor. In addition, certain vapors are likely to produce olfactory fatigue, which is deadening of the sense of smell. For these reasons, the sense of smell alone is not a reliable indicator of the presence or absence of a dangerous vapor.

Permissible Exposure Limits (PEL); Threshold Limit Val. (TLV):

The Permissible Exposure Limit and the Threshold Limit Value refer to an airborne concentration of a product expressed in parts per million (ppm) by volume in air. These are the Time-Weighted Average (TWA) concentrations believed to be safe for the average person during an 8-hour workday and 40-hour workweek for prolonged periods. The susceptibility of individuals will vary.

The values listed are those assigned by the Occupational Safety and Health Administration (OSHA) in Title 29 of the Code of Federal Regulations Part 1910.1000, et. al. (29 CFR 1910.1000), and those accepted by the American Conference of Governmental Industrial Hygienists (ACGIH) as published in *Threshold Limit Values and Biological Exposure Indices for 1989-1990*. In all cases, these values should NOT be used to compare the relative toxicities of different materials.

The equilibrium concentration of a gas which can be produced by a liquid can be calculated as follows:

$$\text{conc. (ppm)} = \text{vapor pressure in mm Hg} \times 1300.$$

"Skin"—the notation used to indicate that the product can be absorbed through the skin, including mucous membranes and eyes. Prevent or reduce exposure to the extent necessary in the cir-



cumstances through the use of gloves, coveralls, goggles, or other appropriate personal protective equipment, engineering controls or work practices.

Short Exposure Tolerance:

Vapor concentration, expressed as parts per million (ppm) by volume in air, which should not be exceeded for the exposure times specified. Other exposure information obtained from sources believed to be reliable is included. In many cases little or no data on human exposure are available.

Exposure Procedures:

First aid procedures recommended by manufacturers and safety organizations. These are emergency procedures only. The victim should be examined by a physician as soon as possible.

Poisons:

Some products are classified for regulatory purposes as poisonous liquids. Definitions are given in 49 CFR Part 173, Subpart D.

Reactivity Data

Stability:

The susceptibility of the products to dangerous reactions when exposed to conditions such as high temperature and shock.

Compatibility:

Structural materials compatible with the cargo are listed; also, structural materials, contaminants and other cargoes which react dangerously with the commodity are given. This list is by no means complete or all inclusive. In some cases a very small quantity of material can act as a catalyst and produce violent reactions such as polymerization, dissociation and condensation. These catalysts, when known, are also listed.

The accidental mixing of one chemical group with another can in some cases be expected to result in a vigorous and hazardous chemical reaction. The generation of toxic gases, the heating, overflow, and rupture of cargo tanks, and fire explosion are possible consequences of such reactions.

The purpose of the Compatibility Chart, which is fully explained the 46 CFR 150 is to show chemical combinations believed to be dangerously reactive in the case of accidental mixing.



Spill or Leak

The information given is intended to be used only as a guide. Many factors must be considered before deciding on a course of action in a particular case.

Remarks

Some special regulations which apply are listed. Other information of particular importance is also listed.



CHRIS CHEMICAL HAZARDS RESPONSE INFORMATION SYSTEM

The Chemical Hazards Response Information System (CHRIS) is an official publication of the U.S. Coast Guard. It consists of the following manuals:

MANUAL 1 COMDTINST M16465.11A *A CONDENSED GUIDE TO CHEMICAL HAZARDS*

Intended for use by response personnel who may be the first to arrive at the site of an accidental discharge or fire to assess the dangers and consider the appropriate large-scale response necessary to safeguard life and property (contains 1100 chemicals).

MANUAL 2 COMDTINST M16465.12A *HAZARDOUS CHEMICAL DATA*

This manual is the cornerstone of CHRIS. It lists the specific chemical, physical and biological data for about 1100 chemicals needed for the preparation and use of other components of the system. It is intended for use primarily by the On-Scene Coordinator (OSC) and by regional and National Response Centers for devising, evaluating and carrying out response plans.

NOTE: Coast Guard offices can obtain CHRIS manuals at no cost through the directives system. All others must purchase the manuals from the Government Printing Office. Please confirm availability and price with GPO before placing your order. (Use order numbers to identify Manuals to GPO).

ORDER FROM:

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ADDITIONAL INFORMATION:

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U.S. Coast Guard
2100 2nd Street, S.W.
Washington, DC. 20593-0001
(202) 267-0440



**MANUAL 1 COMDTINST M16465.11A *A CONDENSED GUIDE
TO CHEMICAL HAZARDS***

CONTENTS order number: 050-012-00224-0

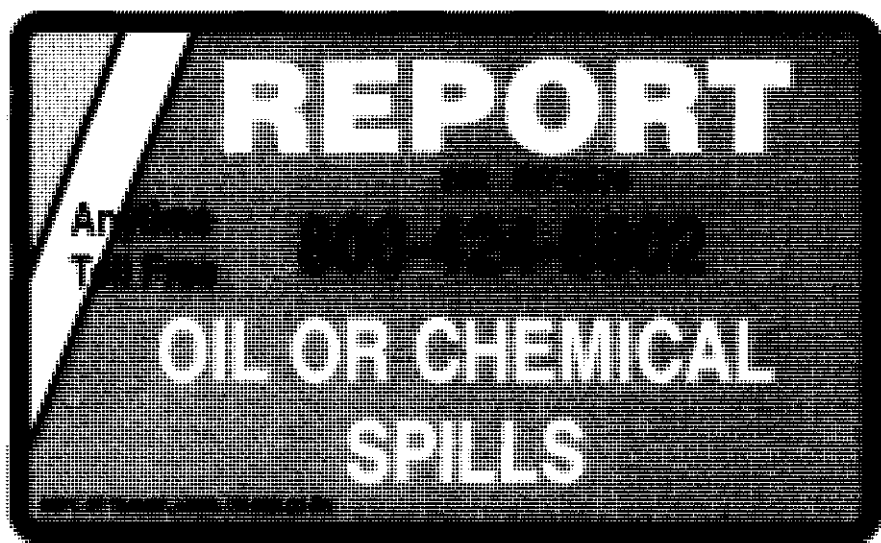
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**MANUAL 2 COMDTINST M16465.12A *HAZARDOUS CHEMICAL
DATA***

CONTENTS order number: 050-012-00215-1







NATIONAL RESPONSE CENTER

LOCATION

U.S. Coast Guard Headquarters, Washington, D.C. 20593.

HOURS OF OPERATION

24 hours a day: 7 days a week.

PERSONNEL

Staffed by Coast Guard Officers trained in the methods and procedures of Pollution Response.

FUNCTION

To received notification of actual or potential oil hazardous chemical incidents and relay these reports to proper authorities for response actions.

CAPABILITIES

A toll free number (800-424-8802) for receiving reports of pollution incidents within the Continental U.S. from any phone in the Continental U.S. (In Washington, D.C. area call (202) 426-2675.)

Continuously manned Communications Center.

Access to environmental and safety information on chemicals.

Contact points with other Government Agencies for access to response to pollution emergencies.



Chemical Data Sheets



MOST COMMONLY USED CHEMICAL NAME

Synonyms—Other chemical names by which known

United Nations Number.....

Formula—Simplified structural formula

Appearance—Odor—

Specific Gravity—Water = 1.0

Chemical Family—

Pollution Category—USEPA _____ IMO _____

Applicable Bulk Reg. 46 CFR Subchapter

CHRIS Code

Boiling Point..... at 14.7 psi _____ °C _____ °F

Freezing Point..... _____ °C _____ °F

_____ °C _____ °F

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia).....

Vapor Pressure 46°C (115°F) (psia).....

Vapor Density (Air = 1.0).....

Solubility in Water

FIRE & EXPLOSION HAZARD DATA

Grade—The classification assigned to liquids which burn, as shown in 46 CFR 30.10–15 and 46 CFR 30.10–22.

Electrical Group—Assigned by Electrical Hazards Panel; NA means "not applicable" if the flash point is above 150°F

General—Unusual fire or explosion hazards and/or special conditions governing the hazard will be mentioned here.

Flash Point (°F)..... Open cup unless otherwise noted.

Flammable Limits..... LEL and UEL.

Autoignition Temp. (°F)..... The temperature at which the vapor will catch fire.

Extinguishing Agents..... Suitable agents are listed.

Special Fire Procedures..... If water is unsuitable or dangerous to use, or if special protective equipment is needed, mention will be made here.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

General—General and specific statements about the hazards to health from exposure to the chemical.

Symptoms—The most common sensations felt by the appearance of a person exposed to the product.

Short Exposure Tolerance—The vapor concentration and exposure times known or reported to cause effects in human beings will be given if available.

Exposure Procedures—First aid measures to be taken immediately. THIS DOES NOT REPLACE MEDICAL ATTENTION BY A PHYSICIAN! Any time a person has experienced respiratory distress or has come into contact with a corrosive or blistering agent, proper medical attention must be given.

REACTIVITY DATA

Stability—The stability of the product and its likelihood of undergoing dangerous reactions under special conditions.

Compatibility—Material: In general, the substances with which the product could react dangerously. This includes materials of construction, impurities and other cargoes.

Cargo: The group number assigned by the compatibility chart is indicated here.

SPILL OR LEAK PROCEDURE

Description of the immediate steps to be taken should the material be released into the air, onto the vessel's structure or into the water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Any special factors and/or qualifying information will be mentioned here.

* 760 mm = 14.7 psi

KEY NOTES

V. Low = Very low
V. High = Very high
NP = Not pertinent

> = Greater than
< = Less than
~ = Approximate(ly)



ACETALDEHYDE

Synonyms—Acetic aldehyde, Aldehyde; Ethanal; Ethyl aldehyde

United Nations Number..... 1089

Formula— CH_3CHO

CHRIS Code..... AAD

Appearance—Odor—Colorless liquid; pungent suffocating odor; fruity odor when diluted.

Boiling Point..... 21°C 70°F
..... $^\circ\text{C}$ $^\circ\text{F}$

Specific Gravity—0.78

Freezing Point..... -121°C -186°F
..... $^\circ\text{C}$ $^\circ\text{F}$

Chemical Family—Aldehyde

Vapor Pressure 20°C (68°F) (mmHg)..... 755

Reid Vapor Pressure (psia)..... 25.6

Vapor Pressure 46°C (115°F) (psia)..... 36.0

Vapor Density (Air = 1.0)..... 1.52

Pollution Category—USEPA C IMO C

Applicable Bulk Reg. 46 CFR Subchapter O

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—C

General—Produces irritating vapor when heated. If pressure is used to unload tank, nitrogen or other inert gas must be used. Air pressure may cause explosive peroxides to form. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point ($^\circ\text{F}$)..... 36 (cc)

Flammable Limits..... 4.0 to 57%

Autoignition Temp. ($^\circ\text{F}$)..... 365

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Avoid exposure to vapors. Wear self-contained breathing apparatus. Use water fog on large fires. Use hose streams at maximum range to cool exposed tanks. Fight fire from a safe distance or from a protected location.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 1, 2

Odor Threshold (ppm)

2.3

PEL/TWA (ppm)

100

TLV/TWA (ppm)

100

General—Suspected carcinogen. Vapor irritating; liquid causes skin and eye burns.

Symptoms—Burning of eyes, nose and throat; headache, rapid heartbeat; possible drowsiness with prolonged exposure.

Short Exposure Tolerance—1100 ppm for 2 hours is severely irritating to mucous membranes; 11,000 ppm for 1–2 hours has been reported as fatal.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Highly reactive. Can form explosive peroxides under air pressure. Slowly polymerizes to paraldehyde. Can react vigorously with oxidizing materials. Explodes when mixed with iodine.

Compatibility—Material: Negligible corrosion to mild steel. May dissolve rubber.

Cargo: Group 19 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear rubber gloves, self-contained breathing apparatus and protective clothing. Cover spill with sodium bisulfite (NaHSO_3). Add small amount of water and mix. Scoop up. Wash site with soap solution. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ACETIC ACID (Glacial)

Synonyms—Acetic acid glacial; Ethanoic acid; Glacial acetic acid; Methane carboxylic acid; Vinegar acid

United Nations Number, 10%-80% 2790
Glacial, >80% 2789

Formula— CH_3COOH

CHRIS Code AAC

Appearance-Odor—Colorless liquid; pungent vinegar-like odor

Boiling Point 118°C 245°F
..... °C °F

Specific Gravity—1.05

Freezing Point 17°C 62°F
..... °C °F

Chemical Family—Organic acid

Vapor Pressure 20°C (68°F) (mmHg) 11.3

Pollution Category—USEPA D IMO D

Reid Vapor Pressure (psia) 0.60

Applicable Bulk Reg. 46 CFR Subchapter D

Vapor Pressure 46°C (115°F) (psia) 0.82

Vapor Density (Air = 1.0) 2.07

Solubility in Water Complete

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid
Electrical Group—D

General—Ignited by heat and by some oxidizing agents. Vapor may explode if ignited in an enclosed area.

Flash Point (°F) 110

Flammable Limits 5.4 to 16% at 212°F

Autoignition Temp. (°F) 1050

Extinguishing Agents CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures Use personal protective equipment when contact with liquid is likely. Skin or clothing contact can cause serious burns. Wear self-contained breathing apparatus. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings
2, 3, 2

Odor Threshold (ppm)
1.0

PEL/TWA (ppm)
10

TLV/TWA (ppm)
10

General—Vapor extremely irritating. Liquid causes severe burns.

Symptoms—Burning of skin in contact with liquid. Irritation of eyes and respiratory system.

Short Exposure Tolerance—40 ppm for 5 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical attention. Wash contaminated clothing, including shoes, before reuse.

REACTIVITY DATA

Stability—Can react vigorously with oxidizing materials. Reacts violently with potassium hydroxide (caustic potash) and sodium hydroxide (caustic soda).

Compatibility—Material: Highly corrosive to metals when dilute. 316 and 316 stainless steels and aluminum are satisfactory construction materials.

Cargo: Group 4 of compatibility chart. See also Appendix I-Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Secure ignition sources. If possible, wear rubber gloves, face shield, and protective clothing. Body shield and self-contained breathing apparatus should be available. Cover spill with soda ash or sodium bicarbonate. Mix, and add water if necessary for mixing. Scoop up slurry. Wash site with soda ash solution. Flush spills with large quantities of water. Usually a spill into a navigable waterway would quickly dilute to a harmless concentration for humans.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Below 62°F the acid may freeze and expand enough to burst its container.



ACETIC ANHYDRIDE

Synonyms: Acetic acid anhydride; Acetic oxide; Acetyl oxide; Ethanoic anhydride

United Nations Number: 1715

CHRIS Code: ACA

Formula: $(CH_3CO)_2O$

Appearance—Odor: Colorless liquid; pungent, highly irritating odor

Specific Gravity: 1.08

Chemical Family: Acid anhydride

Pollution Category—USEPA: D IMO D

Applicable Bulk Reg. 46 CFR Subchapter: D

Boiling Point: 140°C 284°F

Freezing Point: -73°C -100°F

Vapor Pressure 20°C (68°F) (mmHg): 4.0

Reid Vapor Pressure (psia): 0.3

Vapor Pressure 46°C (115°F) (psia): 0.4

Vapor Density (Air = 1.0): 3.5

Solubility in Water: 12% Appreciable

FIRE & EXPLOSION HAZARD DATA

Grade: D: Combustible liquid

Electrical Group: D

General: Reacts violently with water generating dangerous heat and pressure in confined spaces. Ignited by heat. Vapor may explode if ignited in an enclosed space.

Flash Point (°F): 121 (cc)

Flammable Limits: 2.7 to 10%

Autoignition Temp. (°F): 734

Extinguishing Agents: CO₂, alcohol foam, water fog* or dry chemical.

Special Fire Procedures: Cool outside of tanks with water spray. Apply water cautiously. DO NOT contaminate anhydride system with water. Use self-contained respiratory protection and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 3, 3

Odor Threshold (ppm)

0.14

PEL/TWA (ppm)

5

TLV/TWA (ppm)

5

General: Vapor extremely irritating. Liquid causes severe burns.

Symptoms: Coughing; burning sensation in nose and throat. Severe eye and skin burns. Warning properties are good because compound is highly irritating.

Short Exposure Tolerance: Less than 40 ppm for 5 minutes.

Exposure Procedures: Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical attention.

REACTIVITY DATA

Stability: Reacts with water to form acetic acid and produces considerable heat. Reacts violently with potassium hydroxide (caustic potash) and sodium hydroxide (caustic soda).

Compatibility—Material: Highly corrosive to iron and steel when moist. Softens many plastics. Usually stored in aluminum or stainless steel tanks.

Cargo: Group 11 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear full-protective clothing. Body shield and self-contained breathing apparatus should be available. Secure ignition sources. If possible cover spill with soda ash or sodium bicarbonate. Mix and add water if necessary to effect good mixing. Scoop up slurry and wash site with soda ash solution. Usually a spill into a navigable waterway would quickly dilute to a point where it would present little danger to humans.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Avoid getting water into acetic anhydride tanks.



ACETONE

Synonyms—Dimethyl ketone; Ketone propane;
betaketo-Propane; Propanone; 2-Propanone;
Pyroacetic ether

United Nations Number..... 1090

CHRIS Code..... ACT

Formula— CH_3COCH_3

Appearance—Odor—Colorless liquid; sweetish odor

Specific Gravity—0.79

Chemical Family—Ketone

Pollution Category—USEPA D IMO III

Applicable Bulk Reg. 46 CFR Subchapter D

Boiling Point..... 57°C 134°F

Freezing Point..... -95°C -139°F

Vapor Pressure 20°C (68°F) (mmHg)..... 180

Reid Vapor Pressure (psia)..... 7.25

Vapor Pressure 46°C (115°F) (psia)..... 10.0

Vapor Density (Air = 1.0)..... 2.0

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Highly flammable. Flashback along vapor trail may occur. Keep away from heat, sparks, and open flame. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 15

Flammable Limits..... 2.5 to 12.8%

Autoignition Temp. (°F)..... 1040

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed tanks with water. If water is used, large quantities must be applied in order to prevent re-ignition. A solution of 4% acetone and 96% water has a flash point of 129°F.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 0, 0

Odor Threshold (ppm)

200 to 400

PEL/TWA (ppm)

750

TLV/TWA (ppm)

750

General—Irritant to eyes, nose and throat. Anaesthetic effects after high concentration exposures. Prolonged or repeated skin contact may cause defatting of the skin and may produce dermatitis from frequent daily contact.

Symptoms—Drowsiness and throat irritation.

Short Exposure Tolerance—10,000 ppm has been reported as endurable for 30–60 minutes without symptoms.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Will dissolve many plastics and rubber.

Cargo: Group 18 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

If possible: Wear rubber gloves, face shield and protective clothing. Have all-purpose canister mask available. Secure ignition sources. Flush spilled acetone away with water. Do not flush into confined space such as a sewer because of the danger of explosion.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ACETONE CYANOHYDRIN

Synonyms—alpha-Hydroxyisobutyronitrile;
alpha-Hydroxyisobutyronitrile;
2-Hydroxy-2-methylpropanenitrile;
2-Methylacetoneitrile; Propanenitrile,
2-hydroxy-2-methyl

United Nations Number..... 1541

CHRIS Code ACY

Formula—(CH₃)₂C(OH)CN

Boiling Point..Decomposes..... *120°C 248°F

Appearance—Odor—Colorless to straw colored liquid;
almond color

Freezing Point..... -19°C -2°F

Specific Gravity—0.93

Vapor Pressure 20°C (68°F) (mmHg)..... 0.8

Chemical Family—Cyanohydrin

Reid Vapor Pressure (psia)..... 0.3

Pollution Category—USEPA A IMO A

Vapor Pressure 46°C (115°F) (psia)..... 0.4

Applicable Bulk Reg. 46 CFR Subchapter O

Vapor Density (Air = 1.0)..... 2.9

Solubility in Water Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Gives off flammable and poisonous cyanide gas when heated. Vapor may explode if ignited in an enclosed area. Dilution with water causes decomposition with the formation of hydrogen cyanide.

Flash Point (°F)..... 165 (cc)

Flammable Limits..... 2.25 to 11%

Autoignition Temp. (°F)..... 1270

Extinguishing Agents..... CO₂, alcohol foam, water fog**

Special Fire Procedures..... DO NOT USE SODA-ACID EXTINGUISHER! Cool exposed tanks with water.

Apply water cautiously. DO NOT contaminate cargo with water. Respiratory protection required for firefighting personnel. Wear full protective, airtight clothing.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 2, 4

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Vapor very poisonous by inhalation. Liquid poisonous by absorption through the skin. Grade B poison.

Symptoms—Headache, dizziness, nausea; blueness of lips and fingernails.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Keep victim at rest. Get prompt medical attention for liquid or vapor exposure. Wash contaminated clothing, including shoes, before reuse. See Medical Kit Information, Appendix B

REACTIVITY DATA

Stability—When heated, decomposes to form cyanide gas. Must be kept slightly acidified. Dilution with water causes decomposition with formation of hydrogen cyanide.

Compatibility—Material: Aluminum and stainless steel are satisfactory, rubber will swell.

Cargo: Group O of compatibility chart. See also Appendix I—Exception to the Chart

SPILL OR LEAK PROCEDURE

If possible, wear long rubber gloves, self-contained breathing apparatus, and protective clothing. Eliminate all sources of ignition. Evacuate personnel not equipped with respiratory protection. Do not flush spill where humans or animals may contact.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Decomposes at the boiling point.
** Avoid getting water into cargo tank.



ACETONITRILE

Synonyms—Cyanomethane; Ethanenitrile; Ethyl nitrile;
Methyl cyanide

United Nations Number..... 1648

CHRIS Code..... ATN

Formula— CH_3CN

Appearance—Odor—Colorless liquid; aromatic odor

Specific Gravity—0.78

Chemical Family—Nitrile

Pollution Category—USEPA D IMO III

Applicable Bulk Reg. 46 CFR Subchapter..... D

Boiling Point..... 81°C 178°F

.....°C.....°F

Freezing Point..... -40°C -40°F

.....°C.....°F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.51

Raid Vapor Pressure (psia)..... 0.02

Vapor Pressure 46°C (115°F) (psia)..... 0.03

Vapor Density (Air = 1.0)..... 1.41

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Reacts with steam and acids to produce toxic and flammable vapors. Ignited by heat, sparks, or open flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 42

Flammable Limits..... 4.4 to 16.0%

Autoignition Temp. (°F)..... 975

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam

Special Fire Procedures..... Water may be ineffective. Cool exposed tanks with water spray. Care must be taken not to expose fire fighters to the fumes of this material. Any who must enter a contaminated atmosphere must be provided with respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 3

Odor Threshold (ppm)

40*

PEL/TWA (ppm)

40

TLV/TWA (ppm)

40/Skin

General—Highly toxic. Can be absorbed through skin and respiratory tract. Vapor irritating to eyes, nose and throat. Liquid irritating to skin and eyes.

Symptoms—Dizziness, headache, nausea, and blueness of lips and fingernails. Inhalation will cause difficult breathing.

Short Exposure Tolerance—Brief exposure to 500 ppm has produced some nose and throat irritation.

Exposure Procedures—Remove victim to fresh air. Apply artificial respiration if he stops breathing. Get medical attention. If liquid contacts skin, wash off with plenty of water.*

See Medical Kit Information, Appendix B

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Mild steel and stainless steel are compatible.

Cargo: Group 37 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear long rubber gloves, self-contained breathing apparatus, and protective clothing. Avoid contact with liquid. Secure ignition sources. Small spills may be washed away with water. May add excess of strong calcium hypochlorite solution to spill and scoop up slurry. Wash site with soap solution containing some hypochlorite.

If a spill occurs, call the National Response Center, 800-424-9802.

Remarks: * NOTE: Odor threshold is not considered adequate warning of potential dangerous vapor concentrations. High vapor concentrations cause rapid death.



ACRYLAMIDE SOLUTION, 50%

Synonyms—Acrylamide monomer; Acrylic acid amide;
Acrylic amide; Propenamide; 2-Propenamide

United Nations Number..... 2074

CHRIS Code..... AAM

Formula— $\text{CH}_2 = \text{CHCONH}_2$

Appearance—Colorless liquid; odorless

Boiling Point..... 102°C 215°F

°C °F

Freezing Point..... 9°C 48°F

°C °F

Specific Gravity—1.05

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reld Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 1.0

Solubility in Water..... Soluble

Chemical Family—Amides

Pollution Category—USEPA 0 IMO 0

Applicable Bulk Reg. 46 CFR Subchapter..... 0

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable

Electrical Group—NA Note: Acrylamide is not flammable or combustible. It is shipped dissolved in water (50% by weight). Acrylamide will polymerize in the water solution if heated.

General—Toxic oxides of nitrogen may be formed in fire.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents.....

Special Fire Procedures..... Wear full protective clothing, self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 1, 3

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

0.3 mg/m³/Skin

TLV/TWA (ppm)

0.3 mg/m³/Skin

General—Vapor irritating to eyes, nose and throat. Liquid will burn skin and eyes.

Symptoms—Muscular weakness, ataxia, incoordination, tremors, hallucinations. Attacks central nervous system.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Remove to fresh air. Administer artificial respiration or oxygen as necessary. Flush eyes with plenty of water. Remove contaminated clothing and shoes and flush with water. If swallowed and conscious, give water or milk, induce vomiting.

REACTIVITY DATA

Stability—Stable with inhibitor (oxygen). May polymerize violently on melting.

Compatibility—Incompatible with oxidizing agents, reducing agents, acids, bases, and vinyl polymerization initiators.

Charge: Group 10 of compatibility chart.

SPILL OR LEAK PROCEDURE

Cover with inert absorbent or flush with water. Do not allow spill to dry. Wear full protective clothing, self-contained breathing apparatus, rubber gloves.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 19 mmHg at 25°C.

† Unavailable



ACRYLIC ACID

Synonyms—Acroleic acid; Ethylene carboxylic acid;
2-Propenic acid; 2-Propenoic acid; Propenoic acid;
Vinyl formic acid

United Nations Number..... 2218

Formula— C_3H_4COOH

CHRIS Code..... ACB

Appearance—Odor—Colorless liquid; acrid odor

Boiling Point..... 141°C 285°F

Specific Gravity—1.05

Freezing Point..... 9°C 48°F

Chemical Family—Organic acid

Vapor Pressure 20°C (68°F) (mmHg)..... 3.1

Reid Vapor Pressure (psia)..... 0.2

Vapor Pressure 46°C (115°F) (psia)..... 0.4

Vapor Density (Air = 1.0)..... 2.49

Solubility in Water..... Complete

Pollution Category—USEPA..... IMO D

Applicable Bulk Reg. 46 CFR Subchapter..... Q

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Presents no special fire or explosion hazard because of its relatively high flash point and low vapor pressure. Poisonous gases may be produced in a fire.

Flash Point (°F)..... 130

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 835

Extinguishing Agents..... Water, dry chemical, alcohol foam, CO_2

Special Fire Procedures..... Use of CO_2 where it could blanket the vapor space of a container is not recommended. A fire involving a spill outside of tanks could be extinguished with dry chemical. Wear full protective clothing, eye protection and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

3, 3, 2

Unavailable

10/Skin

10*

General—Acrylic acid, when in contact with skin or eyes, may result in a burn upon short contact. Vapors may present an inhalation hazard from single exposures; irritating to eyes, nose and throat.

Symptoms—Vapors are capable of causing definite skin or eye irritation, nasal irritation and lachrymation.

Short Exposure Tolerance—0.5 ppm

Exposure Procedures—If contact with skin or eyes occurs, immediately flush with plenty of water for at least 15 minutes. Get medical attention promptly. Immediately remove contaminated clothing and shoes.

REACTIVITY DATA

Stability—Polymerizes readily. Should be inhibited to insure safety and stability during storage or handling.

Compatibility—Material: Severely corrodes iron and steel. Glass, low carbon content stainless steel and high purity aluminum are recommended for containment in order stated.

Cargo: Group 4 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

If possible, wear rubber gloves, face shield, protective clothing. Body shield and self-contained breathing apparatus should be available. If possible, cover contaminated surfaces and spill with large quantities of soda ash or sodium bicarbonate. Mix and add water if needed for good mixing. Scoop up slurry. Wash site with soda ash solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Proposed change in TLV to 2 ppm, with "Skin" notation.



ACRYLONITRILE

Synonyms—An; Cyanoethylene; Propenenitrile;
2-Propenenitrile; Vinyl cyanide

United Nations Number..... 1083

CHRIS Code..... ACN

Formula—CH₂CHCN

Appearance—Odor—Colorless liquid; resembles that of
peach seed
Specific Gravity—0.81

Chemical Family—Nitrile

Pollution Category—USEPA B IMO B
Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 77°C 171°F
Freezing Point..... -85°C -121°F

Vapor Pressure 20°C (68°F) (mmHg)..... 83
Reid Vapor Pressure (psia)..... 3.5
Vapor Pressure 46°C (115°F) (psia)..... 5.0
Vapor Density (Air = 1.0)..... 1.8
Solubility in Water..... Moderate

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid
Electrical Group—D

General—When heated this material may evolve toxic cyanide gas, or explode, or both. Flashback along vapor trail may occur. Fire may cause violent rupture of tank.

Flash Point (°F)..... 32
Flammable Limits..... 3.0 to 17.0%
Autoignition Temp. (°F)..... 898
Extinguishing Agents..... CO₂, dry chemical, alcohol foam
Special Fire Procedures..... DO NOT use dry chemical for a large, confined fire. Water or foam may cause frothing. Fire parties must wear respiratory protection and full protective clothing including rubber boots. Keep tank cool with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
3, 1, 3	21.6*	29 CFR 1910.1045	2/Skin

General—Suspected carcinogen. Harmful by inhalation and skin absorption. Penetrates leather, liquid in shoes causes delayed burns. Contaminated leather shoes and gloves should be destroyed.

Symptoms—Eye irritation, headache, nausea, blueness of lips and fingertips. Contact with skin may also cause dermatitis.

Short Exposure Tolerance—400 ppm for 30 minutes.

Exposure Procedures—Remove victim to fresh air. If he is not breathing, apply artificial respiration. Remove contaminated clothing and wash chemical from skin with a gentle flow of water. Get medical attention. If patient is unconscious, administer vapor of amyl nitrite.*

See Medical Kit Information, Appendix B

REACTIVITY DATA

Stability—Very reactive; may polymerize explosively in the presence of strong bases. Must be inhibited to prevent polymerization. Polymerization could be initiated by visible light.

Compatibility—Material: Copper and copper alloys are attacked and should not be used. Attacks aluminum in high concentrations.

Charge: Group 15 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

If possible, wear long rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Secure ignition sources. May add excess of strong calcium hypochlorite solution. Scoop up slurry. Wash site of spill with soap solution containing some hypochlorite.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * NOTE: Detectable odor is greater than the TLV. Exposure to potentially dangerous vapor concentrations can occur before the vapor is detected.



ADIPONITRILE

Synonyms—1,4-Dicyanobutane; Tetramethylene cyanide

United Nations Number..... 2205

Formula— $\text{NC}(\text{CH}_2)_4\text{CN}$

Appearance—Odor—Colorless liquid; practically odorless

Specific Gravity—0.95

Chemical Family—Nitrile

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code ADN

Boiling Point 285°C 563°F

Freezing Point 2°C 35°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) Low

Reid Vapor Pressure (psia) Low

Vapor Pressure 46°C (115°F) (psia) Low

Vapor Density (Air = 1.0) 3.73

Solubility in Water Slight

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—On being heated to its flash point this material can decompose to form highly poisonous cyanide gas. Vapor may explode if ignited in an enclosed area.

Flash Point (°F) 199

Flammable Limits LEL = 1.0% at 200°C

Autoignition Temp. (°F) Unavailable

Extinguishing Agents CO₂, dry chemical, alcohol foam or water fog.

Special Fire Procedures Keep tank cool with a water spray. Combustion may produce cyanide gas, so fire parties should wear self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 3

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Harmful by skin contact. Gas from fire is poisonous if inhaled. Liquid or solid is irritating to skin and eyes.

Symptoms—Headache, nausea; blueness of lips and fingertips.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Remove victim to fresh air. Remove contaminated clothing. If breathing stops, give artificial respiration. Wash spill from skin with gentle flow of water. Get medical attention.

See Medical Kit Information, Appendix B

REACTIVITY DATA

Stability—Stable up to temperatures near the flash point.

Compatibility—Material: Compatible with steel, wood, most rubbers.

Cargo: Group 37 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear long rubber gloves and protective clothing. Add an excess of strong calcium hypochlorite solution to the spill. Scoop up slurry. Wash site of spill with soap solution containing some hypochlorite.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ALKYLBENZENESULFONIC ACID

Synonyms—decylbenzenesulfonic acid; Un-, Do-, Tri-, Tetra-, Penta- or Hexa-; Dodecylbenzenesulfonic acid

United Nations Number..... †

Formula— $C_nH_{2n+6}H_7SO_3(n=10-18)$

CHRIS Code..... ABS

Appearance-Odor—White to yellow liquid; odorless

Boiling Point..... °C _____ °F _____

°C _____ °F _____

Specific Gravity—1.0 to 1.4

Freezing Point..... °C _____ °F _____

°C _____ °F _____

Chemical Family—Acids

Vapor Pressure 20°C (68°F) (mmHg)..... †

Reid Vapor Pressure (psia)..... †

Pollution Category—USEPA C IMO C

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... †

Applicable Bulk Reg. 46 CFR Subchapter..... D, O*

Solubility in Water..... Soluble

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Slightly flammable when exposed to heat or flame. Irritating sulfuric acid mist may form in fire. Flammable hydrogen gas may be produced on contact with metals.

Flash Point (°F)..... 395

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Alcohol foam, dry chemical, CO₂

Special Fire Procedures..... Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Liquid is irritating to skin and eyes, corrosive.

Symptoms—Irritation of eyes and skin. Ingestion causes irritation of mouth and stomach, nausea.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Eyes—flush with water for at least 15 minutes. Skin—flush with soap and water. Ingestion—give large amount of water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Attacks metals and gives off flammable hydrogen gas.

Cargo: Unassigned in compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Flush with water, rinse with dilute sodium bicarbonate or soda ash solution. Wear goggles or face shield and rubber gloves. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * 4% or less is regulated by Subchapter D; over 4% is regulated by Subchapter O.

† Unavailable.

‡ Unassigned.



ALLYL ALCOHOL

Synonyms—Propenol; 1-Propenol-3; 1-Propen-3-ol;
2-Propenol; 2-Propen-1-ol; Propenyl alcohol; Vinyl
carbinol

United Nations Number..... 1088

CHRIS Code..... ALA

Formula— $\text{CH}_2 = \text{CHCH}_2\text{OH}$

Appearance—Odor—Colorless liquid; pungent odor

Specific Gravity—0.85

Chemical Family—Substituted allyl

Pollution Category—USEPA B IMO B

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 97°C 208°F

..... °C °F

Freezing Point..... -129°C -200°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 1.70

Reid Vapor Pressure (psia)..... 1.0

Vapor Pressure 46°C (115°F) (psia)..... 1.8

Vapor Density (Air = 1.0)..... 2.0

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C; Flammable liquid

Electrical Group—C

General—Poisonous gases may be produced in a fire. Readily ignited by heat, sparks, or open flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 90 (oc); 70 (cc)

Flammable Limits..... 2.5 to 18%

Autoignition Temp. (°F)..... 713

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Use respiratory, body and eye protective equipment and clothing. Water may be ineffective. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 3

Odor Threshold (ppm)

2 to 5

PEL/TWA (ppm)

2/Skin

TLV/TWA (ppm)

2/Skin

General—Vapor poisonous if inhaled or if skin is exposed. Liquid is poisonous if swallowed or if skin is exposed. Vapor extremely irritating. Lung and eye injury may be delayed. Liquid causes severe burns. Grade B poison.

Symptoms—Vapor exposure—irritation to respiratory tract. Liquid splashed on the skin causes "deep bone ache" if not removed promptly. Disabling irritation and corneal injury to eyes may be delayed.

Short Exposure Tolerance—1000 ppm has been reported as fatal (exposure time not reported); 5 ppm can be tolerated for 30 minutes.

Exposure Procedures—Vapor—Remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—immediately flood affected areas gently with water for at least 15 minutes; remove contaminated clothing and shoes at once. Keep patient at rest and under observation for 24-48 hrs; effects may be delayed. Wash contaminated clothing before reuse, destroy shoes. Get medical help.

REACTIVITY DATA

Stability—Chemically stable.

Compatibility—Material: Swells rubber. Not corrosive to steel.

Cargo: Group 15 of compatibility chart. See also Appendix I-Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

If possible, wear rubber gloves, face shield and protective clothing. Secure ignition sources. Use respiratory protection. Keep unprotected personnel upwind of contaminated area. Flush spill with water. May absorb very small spills with absorbent material (sand, etc.).

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ALLYL CHLORIDE

Synonyms—Chlorallylene; 1-Chloro-2-propene;
3-Chloropropene; 3-Chloro-1-propene;
3-Chloropropylene; alpha-Chloropropylene

United Nations Number..... 1100

CHRIS Code..... ALC

Formula— $\text{CH}_2 = \text{CHCH}_2\text{Cl}$

Boiling Point..... 45°C 113°F

Appearance—Odor—Clear to strawberry colored liquid;
sweetish odor

Freezing Point..... -134°C -209°F

Specific Gravity—0.94

..... °C °F

Chemical Family—Substituted allyl

Vapor Pressure 20°C (68°F) (mmHg)..... 294.3

Reid Vapor Pressure (psia)..... 10.3

Pollution Category—USEPA C IMO B

Vapor Pressure 46°C (115°F) (psia)..... 10.6

Applicable Bulk Reg. 46 CFR Subchapter O

Vapor Density (Air = 1.0)..... 2.64

Solubility in Water..... 0.3%

FIRE & EXPLOSION HAZARD DATA

Grade—B: Flammable liquid

Electrical Group—D

General—Corrosive hydrogen chloride gas formed upon combustion. Becomes more reactive and corrosive when wet. Ignited by heat, sparks or open flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 20 (cc)

Flammable Limits..... 3.3 to 11.9%

Autoignition Temp. (°F)..... 737

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam.

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed tanks with water spray.

Firefighting personnel should be protected against hydrochloric acid fumes by wearing self-contained breathing apparatus and full protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 3

Odor Threshold (ppm)

above 1

PEL/TWA (ppm)

1

TLV/TWA (ppm)

1

General—Suspected carcinogen. Poisonous if inhaled, if swallowed, or if skin is exposed. Vapor extremely irritating. Liquid causes burns. Grade B poison.

Symptoms—Vapors are irritating to eyes and respiratory tract. The liquid irritates the skin.

Short Exposure Tolerance—Inhalation of 100 ppm for 60 minutes has been reported as fatal.

Exposure Procedures—Vapor—remove victim to fresh air. If breathing is difficult, administer oxygen; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical help.

REACTIVITY DATA

Stability—Chemically stable.

Compatibility—Material: Highly corrosive to steel and aluminum. Nickel and monel are suitable materials of construction.

Cargo: Group 15 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus and protective clothing. Avoid contact with liquid. Secure ignition sources. Do not flush spill into confined spaces where flammable vapors can accumulate.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

AMINOETHYLETHANOLAMINE

Synonyms—2-[(2-Aminoethyl)amino]ethanol;

N-(Aminoethyl)ethanolamine;

N-(2-Aminoethyl)ethanolamine;

Hydroxyethylethylenediamine;

N-B-Hydroxyethylethylenediamine;

N-Hydroxyethyl-1,2-ethylenediamine

Formula— $\text{NH}_2\text{CH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{OH}$

Appearance—Clear, colorless liquid with mild

ammoniacal odor

Specific Gravity—1.03

Chemical Family—Amine

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

United Nations Number _____ +

CHRIS Code _____ AEF

Boiling Point _____ 243°C 468°F

_____ °C _____ °F

Freezing Point _____ -78°C -108°F

_____ °C _____ °F

Vapor Pressure 20°C (68°F) (mmHg) _____ LOW

Reid Vapor Pressure (psia) _____ LOW

Vapor Pressure 46°C (115°F) (psia) _____ LOW

Vapor Density (Air = 1.0) _____ 3.59

Solubility in Water _____ Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—No smoking or open lights.

Flash Point (°F) _____ 275

Flammable Limits _____ 15.0 to 27.0%

Autoignition Temp. (°F) _____ 695

Extinguishing Agents _____ Carbon dioxide, dry chemical or alcohol foam

Special Fire Procedures _____ Cool exposed tanks with water. Water or foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 3, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Causes severe eye irritation.

Symptoms—Liquid causes skin irritation with possibility of burns or prolonged contact. Vapor causes mild respiratory irritation.

Short Exposure Tolerance—Unavailable

Exposure Procedures—In case of eye contact, immediately flush eyes with plenty of low-pressure water for 15 minutes. If discomfort persists or reappears, see a physician.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Incompatible with copper, copper alloys, aluminum and zinc.

Cargo: Group 6 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. If possible, wear butyl rubber gloves, face shield, and protective clothing. Cover spill with sodium bisulfite. Spray with water and wash away with large excess of water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ± Unassigned



AMMONIA, ANHYDROUS

Synonyms—Ammonia; Ammonia gas; H_2N ; Liquid ammonia

United Nations Number..... 1005

CHRIS Code..... AMA

Formula— NH_3

Appearance—Odor—Colorless liquid or gas; pungent, highly irritating odor
Specific Gravity—0.77 at 0°C

Boiling Point..... -33°C -28°F
Freezing Point..... -78°C -108°F

Chemical Family—Ammonia

Vapor Pressure 20°C (68°F) (mmHg)..... 6477
Reid Vapor Pressure (psia)..... 211.9
Vapor Pressure 46°C (115°F) (psia)..... 286.0
Vapor Density (Air = 1.0)..... 0.588
Solubility in Water..... Appreciable

Pollution Category—USEPA B IMO gas
Applicable Bulk Reg. 46 CFR Subchapter O

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Compressed Gas (LCG)
Electrical Group—D

General—Fire hazard when in high concentrations and at high temperature. Oil or other combustible vapors increase the fire hazard.

Flash Point (°F)..... Indefinite, below 32°F (sometimes difficult to ignite). Not flammable under conditions likely to be encountered.

Flammable Limits..... 16 to 25%

Autoignition Temp. (°F)..... 1204

Extinguishing Agents..... Stop the flow of gas (lighter than air); cool tanks with water spray.

Special Fire Procedures..... Use respiratory and body protection when approaching ammonia-contaminated atmosphere. Liberal use of water fog, where possible, will reduce vapor concentration.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
4, 2, 2	approx. 50	Unavailable	25

General—Vapor extremely irritating. Liquid causes burns; will cause frostbite.

Symptoms—Coughing; burning sensation, eye irritation or pain. Frozen areas turn white.

Short Exposure Tolerance—A 2500 ppm (0.25%) concentration of ammonia in air may be fatal within 30 minutes.

Exposure Procedures—Remove victim to fresh air. Call a physician at once. If not breathing, apply artificial respiration, oxygen. If breathing is difficult, administer oxygen. Flush affected areas of body with plenty of water for 15 minutes. DO NOT FLUSH FROZEN AREAS. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Remove contaminated clothing and shoes. Get prompt medical attention. Low-velocity fog is effective for decontaminating the atmosphere.

REACTIVITY DATA

Stability—Normally stable. Reacts with acidic materials.

Compatibility—Material: Corrosive to galvanized surfaces, copper and copper alloys. Iron and steel are suitable for the construction of containers, fittings and piping. Forms explosive compounds with mercury.

Cargo: Group 6 of compatibility chart.

SPILL OR LEAK PROCEDURE

Evacuate area in case of large leaks or tank rupture. Shut off leak if without risk. Wear self-contained breathing apparatus. If necessary to enter spill area, wear full protective clothing including boots. Water spray is extremely effective in absorbing ammonia gas and should be used around leaks of gas only. DO NOT PUT WATER ON LIQUID AMMONIA.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



AMMONIUM SULFIDE SOLUTION, 45%

Synonyms—Ammonium monosulfide solution;
Diammonium sulfide solution

United Nations Number..... 2883

CHRIS Code..... ASS

Formula— $(\text{NH}_4)_2\text{S}$

Appearance—Odor—Greenish to reddish yellow solution;
strong ammonia, hydrogen sulfide (rotten eggs)
odor

Bolling Point*..... 38-100°C 100-212°F

Freezing Point..... -18°C 0°F

Specific Gravity—0.993 at 60°F

Chemical Family—Caustics

Vapor Pressure 20°C (68°F) (mmHg)..... †

Reid Vapor Pressure (psia)..... 22.7

Vapor Pressure 46°C (115°F) (psia)..... 26.5

Vapor Density (Air = 1.0)..... †

Pollution Category—USEPA B IMO B

Applicable Bulk Reg. 46 CFR Subchapter Q

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—D

General—Toxic sulfur oxides produced in fire. Liquid solution gives off ammonia and/or hydrogen sulfide gas depending on the pH; vapor evolution rate increases when heated. Flashback along vapor trail may occur. Vapor may explode in an enclosed area.

Flash Point (°F)..... 71.6 (cc)

Flammable Limits..... 4.3 to 46% as hydrogen sulfide

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Water spray, foam, dry chemical, carbon dioxide

Special Fire Procedures..... Wear eye protection, protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings
Unavailable

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
10, as hydrogen sulfide

General—Mildly alkaline and evolves toxic hydrogen sulfide and/or ammonia depending on pH.

Symptoms—Eyes: irritation, conjunctivitis. Skin: irritation, corrosion, dermatitis, chemical burns. Ingestion: nausea, irritation and corrosion of mucous membranes and stomach. Inhalation: irritation, pulmonary edema, pneumonia, bronchitis, tracheitis, respiratory problems

Short Exposure Tolerance—

Exposure Procedures—Call physician. Inhalation: Remove to fresh air; give oxygen or artificial respiration as needed. Ingestion: If conscious, give large amounts of water or milk, but do not induce vomiting. Eyes: Hold eyelids open, flush with water for 15 minutes. Skin: Flush with large amounts of water for 15 minutes.

REACTIVITY DATA

Stability—When heated, toxic hydrogen sulfide and/or ammonia evolve. Reacts with acids to form hydrogen sulfide. Reacts with bases to form ammonia.

Compatibility—Material: Compatible with mild and stainless steel, neoprene, polypropylene. Incompatible with aluminum, brass, bronze, copper, tin, zinc

Cargo: Group 5 of the compatibility chart

SPILL OR LEAK PROCEDURE

Stop release if possible. Wear neoprene apron, gloves, boots, and goggles or full shield, plus self-contained breathing apparatus. Secure ignition sources. Dike large spills, prevent spill from entering sewers and drains, recover liquid, treat ground with diluted hydrogen peroxide. Absorb small spills with earth, sand, or other inert absorbant and properly dispose.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * At 100°F, bubbles of hydrogen sulfide gas form.
† Unavailable

1990

ISO-AMYL ACETATE

Synonyms—Amyl acetate; sec-Amyl acetate; Amylacetate ester; Banana oil; Isoamyl acetate; Isoamyl ethanoate; Isopentyl acetate; 3-Methyl-1-butanol acetate; 2-Methylbutyl ethanoate; Pear oil

United Nations Number..... 1104

CHRIS Code..... IAT

Formula— $\text{CH}_3\text{COO}(\text{CH}_2)_4\text{CH}(\text{CH}_3)_2$

Boiling Point..... 149°C 300°F

Appearance-Odor—Colorless liquid; pleasant fruity, banana-like odor

..... °C °F

Specific Gravity—0.88

Freezing Point..... -70°C -94°F

..... °C °F

Chemical Family—Ester

Vapor Pressure 20°C (68°F) (mmHg)..... 4.0

Reid Vapor Pressure (psia)..... 0.1

Pollution Category—USEPA D IMO C

Vapor Pressure 46°C (115°F) (psia)..... 0.34

Applicable Bulk Reg. 46 CFR Subchapter..... D, O

Vapor Density (Air = 1.0)..... 4.5

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—No smoking or open flames. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed space. Precautions should be taken to prevent the accumulation of static electricity.

Flash Point (°F)..... 100

Flammable Limits..... 1.1 to 7.5%

Autoignition Temp. (°F)..... 714

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water may be ineffective.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
1, 0, 1	7 to 10	100	100

General—Little hazard from inhalation below 500 ppm. It may dry and defat skin.

Symptoms—Headache, dizziness, nausea; irritation of mucous membranes of eyes and respiratory tract, coughing.

Short Exposure Tolerance—500 to 1000 ppm for 30 to 60 minutes will produce definite irritation of eyes, throat, and trachea.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Chemically stable.

Compatibility—Material: This compound will soften, then dissolve, a great many plastic materials, and rubber. Attacks asbestos.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources. Flush minor spills away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



n-AMYL ALCOHOL

Synonyms—Alcohol C-5; 1-Amyl alcohol; primary-n-Amyl alcohol; n-Butylcarbinol; 1-Pentanol; Pentyl alcohol

United Nations Number..... 1105

Formula— $\text{CH}_3(\text{CH}_2)_4\text{OH}$

CHRIS Code..... AAN

Appearance-Odor—Colorless liquid; mild odor

Boiling Point..... 138°C 280°F
°C °F

Specific Gravity—0.82

Freezing Point..... -78°C -110°F
°C °F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Pollution Category—USEPA _____ IMO D

Reld Vapor Pressure (psia)..... 0.2

Applicable Bulk Reg. 46 CFR Subchapter..... D

Vapor Pressure 46°C (115°F) (psia)..... 0.3

Vapor Density (Air = 1.0)..... 3.04

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid
Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. When heated, it emits acrid fumes; can react with oxidizing materials.

Flash Point (°F)..... 118

Flammable Limits..... 1.2 to 10.0%

Autoignition Temp. (°F)..... 572

Extinguishing Agents..... Carbon dioxide, dry chemical or alcohol foam.

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed tanks with water spray. Wear self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 0, 2

Odor Threshold (ppm)
0.12

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Vapor may be irritant to the eyes and the upper respiratory tract.

Symptoms—Vapor inhalation causes psychic stimulation, insomnia, palpitation of heart, headache, and vertigo.

Short Exposure Tolerance—150 ppm for 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops or is very weak, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Very stable.

Compatibility—Material: Can be stored in copper, aluminum, or plain steel tanks.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ANILINE

Synonyms—Aminobenzene; Aminophen; Aniline oil;
Benenamine; Benzenamine; Blue oil; Phenylamine

United Nations Number..... 1547

CHRIS Code..... ANL

Formula— $C_6H_5NH_2$

Appearance-Odor—Oily colorless-to-brown liquid; odor
not unpleasant

Specific Gravity—1.02

Chemical Family—Amine

Pollution Category—USEPA D IMO C

Applicable Bulk Reg. 46 CFR Subchapter D

Boiling Point 184°C 364°F

Freezing Point -6°C 21°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) 2.4

Reid Vapor Pressure (psia) 0.02

Vapor Pressure 46°C (115°F) (psia) 0.04

Vapor Density (Air = 1.0) 3.22

Solubility in Water 3.0%

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Poisonous gas is produced when heated. Vapor may explode if ignited in an enclosed area.

Flash Point (°F) 158 (cc)

Flammable Limits LEL = 1.3%; UEL = 11%

Autoignition Temp. (°F) 1143

Extinguishing Agents CO₂, dry chemical, alcohol foam, water spray

Special Fire Procedures Protect personnel against exposure to either the vapor or liquid; wear full protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 3

Odor Threshold (ppm)

0.5

PEL/TWA (ppm)

2/Skin

TLV/TWA (ppm)

2/Skin

General—Suspected carcinogen. Poisonous by inhalation or skin absorption. It will cause cyanosis, a serious blood condition. Class B poison.

Symptoms—Headache, weakness, irritability, dizziness, bluish discoloration of lips and fingernails, drowsiness, and unconsciousness.

Short Exposure Tolerance—50–100 ppm probably can be tolerated for 60 minutes.

Exposure Procedures—Remove victim to fresh air. Apply artificial respiration if needed. Remove any clothing wet with aniline. Flush exposed skin area thoroughly with water. Get medical attention as soon as possible. Administer oxygen if available. Keep patient at rest. Wash clothing thoroughly with strong soap solution before reuse, or destroy.

REACTIVITY DATA

Stability—Stable. Reacts dangerously with oxidizing agents and inorganic acids.

Compatibility—**Material:** Corrosive to copper and copper alloys. Not corrosive to iron or steel.

Charge: Group 9 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Wear butyl rubber gloves, plastic protective apron and self-contained breathing apparatus. Secure ignition sources. May mix with sand and soda ash mixture (90–10), scoop up into cardboard boxes and pack with excess crumpled paper. Then burn in open pit.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ASPHALT (typical)

Synonyms—Asphalt bitumen; Asphalt cement;
Asphaltum; Bitumen; Judean pitch; Mineral pitch;
Petroleum asphalt; Petroleum pitch; Tars liquid

United Nations Number..... 1999

CHRIS Code..... ASP
ACU

Formula—Mixture of solid or semi-solid hydrocarbons

Boiling Point..... 371°C 694°F

Appearance—Odor—Thick brown to black semisolid; tarry
odor

Freezing Point..... Varies°C Varies°F

Specific Gravity—0.9 to 1.1

Vapor Pressure 20°C (68°F) (mmHg)..... Varies

Chemical Family—Miscellaneous hydrocarbon mixture

Reid Vapor Pressure (psia)..... Varies

Pollution Category—USEPA _____ IMO 1

Vapor Pressure 46°C (115°F) (psia)..... Varies

Applicable Bulk Reg. 46 CFR Subchapter..... D

Vapor Density (Air = 1.0)..... Varies

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—Varies with the composition of the product.

Electrical Group—D

General—There are many grades of asphalt, each with different properties. For example, the flash point may vary from 50°F to over 400°F.

Flash Point (°F)..... 50 to 400 depending on grade of asphalt

Flammable Limits..... Varies

Autoignition Temp. (°F)..... 905

Extinguishing Agents..... CO₂, dry chemical, foam, water fog

Special Fire Procedures..... Water spray or foam may be ineffective because of frothing; apply cautiously.
DO NOT direct a solid stream of water into hot asphalt.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 2, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

5 mg/m³

General—When heated to a liquid state it will cause severe burns. It is not corrosive. There is a possibility of skin poisoning or dermatitis by contact.

Symptoms—Fumes of hot asphalt can cause nausea and dizziness.

Short Exposure Tolerance—Unavailable

Exposure Procedures—If spilled onto skin, flood with water. Do not bind up, and do not try to scrub off adhering materials. Get medical attention.

REACTIVITY DATA

Stability—Most grades are stable.

Compatibility—Material:

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with hot liquid. Wear heavy work gloves, safety goggles or face shield, protective clothing for hot liquid. If asphalt heated above 212°F is spilled into water, persons nearby risk being scalded by the steam or hot water formed. Most grades of asphalt will present little or no problem if spilled.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



BENZENE

Synonyms—Benzol; Benzole; Coal naphtha; Coal tar naphtha; Cyclohexatriene; Phen; Phenyl hydride

United Nations Number..... 1114

Formula— C_6H_6

CHRIS Code..... BNZ

Appearance—Odor—Clear colorless liquid with a typical, pleasant aromatic odor
Specific Gravity—0.88

Bolling Point..... 80°C 178°F
°C °F
Freezing Point..... 6°C 42°F
°C °F

Chemical Family—Aromatic hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 75
Reid Vapor Pressure (psia)..... 3.22
Vapor Pressure 46°C (115°F) (psia)..... 4.5
Vapor Density (Air = 1.0)..... 2.8
Solubility in Water..... Negligible

Pollution Category—USEPA A IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid.

Electrical Group—D

General—Extremely flammable. Ignited by heat, sparks, open flame. Flashback along vapor trail may occur.

Vapor may explode if ignited in an enclosed area. Precautions must be taken to prevent static electricity buildup.

Flash Point (°F)..... 12 (Benzene is solid at 12°F)

Flammable Limits..... 1.4 to 8.0%

Autoignition Temp. (°F)..... 1076

Extinguishing Agents..... CO_2 , dry chemical, foam, water fog

Special Fire Procedures..... Water may be ineffective on a fire. Fire parties must wear respiratory protection and rubber boots. In other respects, fight like a gasoline fire. Explosion hazard is great if ignition has not already occurred and hence civil defense authorities should also be alerted. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
1, 1, 3	4.68	29 CFR 1910.1028	10

General—Benzene is a known carcinogen. Benzene vapors are severely toxic by inhalation. Benzene has a pleasant odor and narcotic effect and thus has poor warning properties.

Symptoms—Dizziness, headache, and drowsiness.

Short Exposure Tolerance—Vapor concentrations: 3000 ppm is endurable for 30–60 minutes (single exposure); 7500 ppm is dangerous in 30–60 minutes (single exposure); 20,000 ppm has been fatal in 5–10 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing is difficult, administer oxygen. If breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical help.

REACTIVITY DATA

Stability—Stable under normal conditions.

Compatibility—Material: Rubber on prolonged exposure to benzene first swells, then softens.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, plastic coated clothing. Wear self-contained breathing apparatus. Approach from upwind side. Avoid contact with liquid. Secure ignition sources. Small spills may be flushed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



BENZENE, TOLUENE, XYLENE MIXTURES

Synonyms—Benzene concentrate; BTX mixtures; Coal tar light oil; Coke oven light oil; Driplene; Light oil; Secondary light oil

United Nations Number..... 1

Formula—Benzenes, toluenes, xylenes and other aromatic hydrocarbons

Appearance—Odor—Yellow to amber liquid; characteristic "gasoline" odor

Specific Gravity—approx. 0.84

CHRIS Code..... BTX

Boiling Point..... °F °C

Freezing Point..... °F °C

Vapor Pressure 20°C (68°F) (mmHg)..... 75

Reid Vapor Pressure (psia)..... 5.8

Vapor Pressure 46°C (115°F) (psia)..... 7.3

Vapor Density (Air = 1.0)..... 2.8

Solubility in Water..... Negligible

Chemical Family—Aromatic hydrocarbon

Pollution Category—USEPA IMO @C

Applicable Bulk Reg. 46 CFR Subchapter..... Q

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid.

Electrical Group—Unassigned (Benzene, D; Toluene, D; Xylene, D)

General—Extremely flammable. Ignited by heat, sparks, open flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Precautions must be taken to prevent static electricity buildup.

Flash Point (°F)..... 80

Flammable Limits..... 2.2 to 11.0%

Autoignition Temp. (°F)..... approximately 1078

Extinguishing Agents..... Confined—CO₂, dry chemical. Open—water, foam.

Special Fire Procedures..... Fire parties must wear respiratory protection and rubber boots. In other respects, fight like gasoline fire. Explosion hazard is great.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 3

Odor Threshold (ppm)

0.01

PEL/TWA (ppm)

*

TLV/TWA (ppm)

see benzene

General—Benzene is a known carcinogen. Mild irritant in contact with skin; avoid repeated or prolonged exposure. Minor injury from ingestion or inhalation—repeated contact may be more hazardous.

Symptoms—Watery eyes, mild skin irritation, dizziness, headache and drowsiness.

Short Exposure Tolerance—Some evidence of carcinogenic behavior to animals has been observed for prolonged skin contact.

Exposure Procedures—Flush skin and eye contact at once with plenty of water. If inhaled, remove to fresh air. No specific antidote is known. Call a doctor.

*Benzene: 29 CFR 1910.1028.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Steel and other metals completely resistant but not copper alloy. All elastomers are attacked and any coatings except baked phenolic are stripped. Most plastics are severely attacked.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, plastic coated clothing. Wear self-contained breathing apparatus. Approach from upwind side. Avoid contact with liquid. Secure ignition sources. Small spills may be flushed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

‡ Unassigned



BENZYL ALCOHOL

Synonyms—Benzene carbinol; alpha-Hydroxytoluene;
Phenyl carbinol; Phenyl methyl alcohol

United Nations Number..... †

CHRIS Code..... BAI

Formula— $C_6H_5CH_2OH$

Appearance—Odor—Colorless liquid; mild pleasant
aromatic odor

Specific Gravity—1.05 at 15°C

Chemical Family—Aromatic alcohols

Pollution Category—USEPA..... IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Boiling Point..... 205°C 401°F

.....°C.....°F

Freezing Point..... -15°C 5°F

.....°C.....°F

Vapor Pressure 20°C (68°F) (mmHg)..... <0.1

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 3.73

Solubility in Water..... 4.4%

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Can give off toxic combustion products in a fire.

Flash Point (°F)..... 220 (oc); 2.3 (cc)

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 817

Extinguishing Agents..... Alcohol foam, dry chemical, carbon dioxide

Special Fire Procedures..... Water and foam may cause frothing. Wear self-contained breathing apparatus,
protective clothing. Use water to keep tanks cool.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

5.5

Unavailable

Unavailable

General—Avoid direct contact with liquid and prolonged exposure to vapor-absorbed through skin.

Symptoms—Irritation to eyes, skin. Vapor irritates upper respiratory tract and produces headache, dizziness,
nausea. Ingestion causes abdominal pain, vomiting, diarrhea.

Short Exposure Tolerance—Must have adequate ventilation or use respiratory protection.

Exposure Procedures—Eye contact: Flush with water for at least 15 minutes; call physician. Skin contact: Wash
with soap and water for 15 minutes. Inhalation: Remove to fresh air, give oxygen if necessary; call
physician. Ingestion: If conscious, give water, induce vomiting, contact physician.

REACTIVITY DATA

Stability—Generally stable. Slowly oxidizes in air and oxygen. Reacts with mineral acids generating heat; reacts
with strong oxidizers.

Compatibility—Carried in stainless steel or phenolic resin lined mild steel tanks. Noncorrosive to steel and most
metals but corrodes aluminum at high temperature. Will attack some non-fluorinated plastics, will not attack
polypropylene.

Cargo: Group 21 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear goggles, face shield. Cover small spills with absorbent (sand, sawdust); dispose. Dike large spills for
pumping to storage tank; dispose or reclaim.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

1990



BENZYL CHLORIDE

Synonyms—Benzene, chloromethyl-; (Chloromethyl) benzene; alpha-Chlorotoluene; omega-Chlorotoluene

United Nations Number..... 1738

Formula— $C_6H_5CH_2Cl$

CHRIS Code..... BCL

Appearance—Odor—Colorless to slightly yellowish liquid; pungent, aromatic, irritating odor
Specific Gravity—1.1 at 25°/25°C

Boiling Point..... 179°C 355°F
Freezing Point..... -39°C -39°F

Chemical Family—Halogenated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 9
Reid Vapor Pressure (psia)..... 0.07
Vapor Pressure 46°C (115°F) (psia)..... 0.09
Vapor Density (Air = 1.0)..... 4.36
Solubility in Water..... Negligible

Pollution Category—USEPA B IMO B
Applicable Bulk Reg. 46 CFR Subchapter..... D

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid
Electrical Group—D

General—Moderate fire hazard. Keep away from open flame or ignition sources. Irritating gases are produced when heated. Decomposes with water to produce hydrogen chloride fumes.

Flash Point (°F)..... 165 (cc)
Flammable Limits..... LEL = 1.1%; UEL—Unavailable
Autoignition Temp. (°F)..... 1085
Extinguishing Agents..... CO_2 , dry chemical, water fog
Special Fire Procedures..... Use complete personal protective clothing. Wear self-contained breathing apparatus for indoor fires. Water mist may be used, but in large quantity to hold down hydrogen chloride fumes and flush away acid.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
4, 2, 4	0.01	1	1

General—Suspected carcinogen. Vapor extremely irritating. Liquid causes burns.

Symptoms—Vapors are irritating to eyes and respiratory tract, causes tears and coughing, possible loss of sight. Liquid causes skin irritation resulting in burns on prolonged contact.

Short Exposure Tolerance—10 ppm for 30 minutes

Exposure Procedures—Vapor—remove victim to fresh air immediately, if breathing stops apply artificial respiration. Skin or eye contact—remove contaminated clothing and flush with large amounts of water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Unstabilization results in rapid condensation reaction in presence of particular metals. Liberates hydrogen chloride from decomposition reaction with water.

Compatibility—Material: Avoid copper, aluminum, iron, zinc, magnesium and tin; violent polymerization will result. Nickel is recommended.

Cargo: Group 36 of compatibility chart

SPIII OR LEAK PROCEDURE

Wear full protective clothing, rubber boots, face shield, eye protection, self-contained breathing apparatus. Immediately flush with large quantities of cold water. Freely ventilate to remove odors. Sodium carbonate or lime can be used if water is unavailable. Remove all contaminated clothing and thoroughly clean.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

BUNKER C

Synonyms—Fuel oil no. 6; Heavy industrial fuel oil;
Residual fuel oil no. 6

United Nations Number..... +

CHRIS Code..... OSX

Formula—Indefinite mixture

Appearance—Odor—Very viscous, dark colored liquid;
fragrant odor.

Specific Gravity—0.92 to 1.07

Chemical Family—Misc. hydrocarbon mixture

Pollution Category—USEPA..... IMO I

Applicable Bulk Reg. 46 CFR Subchapter..... D

Boiling Point..... >24°C >75°F

Freezing Point..... †°C °F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.042

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... 0.149

Vapor Density (Air = 1.0)..... †

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Must be heated to sustain combustion.

Flash Point (°F)..... 150 to 430 (cc)

Flammable Limits..... 1 to 5%

Autoignition Temp. (°F)..... 765

Extinguishing Agents..... Foam, CO₂, dry chemicals

Special Fire Procedures..... Water may be ineffective on fires.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

Unavailable

Unavailable

General—Avoid breathing vapor.

Symptoms—Headache, nausea, dizziness, vertigo, unconsciousness.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Inhalation: Remove victim to fresh air, prevent chilling, and apply artificial respiration if breathing has stopped. Get immediate attention if victim is overcome by vapors.

REACTIVITY DATA

Stability—Very stable.

Compatibility—Material: Compatible with most materials of construction.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Can soak up spill with paper, sawdust, rags, etc.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

‡ Unassigned



BUTADIENE

Synonyms—Bieethylene; Bivinyt; 1,3-Butadiene; alpha, gamma-Butadiene; Divinyt; Erythrene; Pyrrolylene; Vinyl ethylene

United Nations Number..... 1010

CHRIS Code..... BDI

Formula— C_4H_6 , or $CH_2 = CHCH = CH_2$

Boiling Point..... -4°C 24°F

Appearance-Odor—Colorless gas or liquid; mild, aromatic odor

Freezing Point..... -109°C -164°F

Specific Gravity—0.62 at 20°C (a liquid)

Vapor Pressure 20°C (68°F) (mmHg)..... 1799

Chemical Family—Unsaturated hydrocarbon

Reid Vapor Pressure (psia)..... 61

Pollution Category—USEPA _____ IMO 099

Vapor Pressure 46°C (115°F) (psia)..... 75

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Vapor Density (Air = 1.0)..... 1.89

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—B

General—Unless flow of gas can be stopped, extinguishing a butadiene fire may permit accumulation of an explosive concentration of vapor, and subsequent explosion or re-flash. Fire may cause violent rupture of tank.

Flash Point (°F)..... -105

Flammable Limits..... 2.0 to 11.5%

Autoignition Temp. (°F)..... 842

Extinguishing Agents..... Stop flow of gas; CO_2 , dry chemical, water fog

Special Fire Procedures..... Keep burning tank and adjacent tanks cool with a water spray. Wear full protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1,1,1

above 1000

unavailable

1000

General—Suspected carcinogen. Liquid or cold gas may cause skin or eye injury similar to frostbite.

Symptoms—Inhalation: dizziness, headache. Skin contact: frostbitten areas will appear white. Irritating to eyes and respiratory tract.

Short Exposure Tolerance—8,000 ppm was found endurable for 8 hours with only slight irritation of the eyes and upper respiratory tract.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Protect frostbitten areas from abrasions and mechanical damage. DO NOT RUB. Get medical advice or attention.

REACTIVITY DATA

Stability—Must be inhibited to prevent polymerization. Forms unstable peroxides in presence of oxygen and/or iron rust.

Compatibility—Material: Unsafe in contact with acetylide-forming materials such as monel, copper or copper alloys.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing, and self-contained breathing apparatus. Secure ignition sources. The spilled liquid will boil away leaving no residue.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



n-BUTANE

Synonyms—Butane; Diethyl; Methyl ethyl methane

United Nations Number..... 1011

Formula— C_4H_{10}

CHRIS Code..... BUT
 "([iso-, n-])" BMX

Appearance—Odor—Colorless; odorless gas

Boiling Point..... -0.5°C 31°F
°C.....°F

Specific Gravity—0.58 at 0°C (a liquid)

Freezing Point..... -138°C -217°F
°C.....°F

Chemical Family—Saturated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 1530

Pollution Category—USEPA..... IMO 098

R Reid Vapor Pressure (psia)..... 52.4

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

Vapor Pressure 46°C (115°F) (psia)..... 66.0

Vapor Density (Air = 1.0)..... 2.07

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—D

General—Unless the flow of gas can be stopped, extinguishing a butane fire will permit accumulation of an explosive concentration of vapor, and subsequent explosion or re-flash.

Flash Point (°F)..... -78

Flammable Limits..... 1.9 to 8.5%

Autoignition Temp. (°F)..... 761

Extinguishing Agents..... Stop flow of gas; CO_2 , dry chemical, water fog.

Special Fire Procedures..... Keep burning tank and adjacent tanks cool with a water spray. Stop flow of gas.

HEALTH HAZARD DATA

Health Hazard Ratings
 0, 0, 0

Odor Threshold (ppm)
 5000

PEL/TWA (ppm)
 800

TLV/TWA (ppm)
 800

General—Produces drowsiness. Simple asphyxiant. Liquid or cold gas may cause frostbite.

Symptoms—Dizziness and drowsiness.

Short Exposure Tolerance—10,000 ppm (1%) for 10 minutes will cause drowsiness.

Exposure Procedures—Remove victim to fresh air. If breathing has stopped, give artificial respiration. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Stable product.

Compatibility—Material: Non-corrosive to most materials of construction.

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources. The spilled liquid will boil away rapidly, leaving no residue.

If a spill occurs, call the National Response Center, 800-424-8902.

Remarks:



n-BUTYL ACETATE

Synonyms—Acetic acid; butyl ester; Butyl acetate;
normal-Butyl acetate; Butyl ethanoate

United Nations Number..... 1123

Formula— $\text{CH}_3\text{COOC}_4\text{H}_9$

CHRIS Code..... BCN
“(iso-, n-)” BAX

Appearance—Odor—Colorless liquid; pleasant, fruity odor

Boiling Point..... 127°C 260°F
.....°C°F

Specific Gravity—0.88

Freezing Point..... -77°C -107°F
.....°C°F

Chemical Family—Ester

Vapor Pressure 20°C (68°F) (mmHg)..... 8.7

Reid Vapor Pressure (psia)..... 0.5

Vapor Pressure 46°C (115°F) (psia)..... 0.8

Vapor Density (Air = 1.0)..... 4.0

Solubility in Water..... Slight

Pollution Category—USEPA D IMO C
Applicable Bulk Reg. 46 CFR Subchapter..... D.Q

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Volatile, with a low flash point. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed space.

Flash Point (°F)..... 90

Flammable Limits..... 1.4 to 7.6%

Autoignition Temp. (°F)..... 790

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Use of dry chemical where it can get into a tank of n-butyl acetate is not recommended. Fires involving spills outside of tanks can be extinguished with dry chemicals. Water may be ineffective. Cool exposed tanks with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
1, 1, 2	10	150	150

General—Low level of toxicity. Vapor irritating to eyes, nose and throat. Liquid irritating to skin and eyes.

Symptoms—Headache, irritation of respiratory passage and eyes, dizziness, and nausea.

Short Exposure Tolerance—200–300 ppm produces some nose and eye irritation upon brief exposure.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable, however, will hydrolyze (react with water) on standing to form acetic acid and n-butyl alcohol.

Compatibility—Material: Softens and dissolves rubber and many plastics.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



sec-BUTYL ACETATE

Synonyms—Acetic acid, 1-methylpropyl ester; Acetic acid, sec-butyl ester; 2-Butanol acetate; 1-Methylpropylacetate

United Nations Number..... 1123

Formula— $\text{CH}_3\text{COOCH}(\text{CH}_3)\text{C}_2\text{H}_5$

CHRIS Code..... BTA

Appearance—Odor—Colorless liquid; mild, pleasant odor

Boiling Point..... 112°C 234°F

..... °C °F

Specific Gravity—0.89

Freezing Point..... -73°C -100°F

..... °C °F

Chemical Family—Ester

Vapor Pressure 20°C (68°F) (mmHg)..... 20.4

Reid Vapor Pressure (psia)..... 1.0

Vapor Pressure 46°C (115°F) (psia)..... 1.5

Vapor Density (Air = 1.0)..... 4.0

Pollution Category—USEPA D IMO D

Solubility in Water..... Slight

Applicable Bulk Reg. 46 CFR Subchapter..... D

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Volatile with low flash point. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 88

Flammable Limits..... 1.7 to 9.8%

Autolignition Temp. (°F)..... 750 to 800

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Use of dry chemical where it can get into a tank of butyl acetate is not recommended. Fires involving spills outside of tanks can be extinguished with dry chemical. Water may be ineffective. Cool exposed tanks with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

below 200

200

200

General—Vapor irritating to eyes, nose and throat. Liquid irritating to skin and eyes.

Symptoms—Headache, irritation of respiratory passages and eyes, dizziness, and nausea.

Short Exposure Tolerance—300 ppm

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable, however, will hydrolyze (react with water) on standing to form acetic acid and sec-butyl alcohol.

Compatibility—Material: Softens and dissolves rubber and many plastics.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



Iso-BUTYL ACRYLATE

Synonyms—Acrylic acid, iso-butyl ester; Isobutyl acrylate; Isobutyl-2-propenoate; 2-Methyl-1-propyl acrylate

United Nations Number..... 2527

CHRIS Code..... BAI
"iso-, n-)" BAR

Formula— $\text{CH}_2 = \text{CHCOOCH}_2\text{CH}(\text{CH}_3)_2$

Appearance-Odor—Colorless liquid; sharp, fragrant odor

Boiling Point..... 137°C 271°F
°C °F

Specific Gravity—0.88

Freezing Point..... -61°C -78°F
°C °F

Chemical Family—Acrylate

Vapor Pressure 20°C (68°F) (mmHg)..... 10.7

Pollution Category—USEPA _____ IMO B

Rcid Vapor Pressure (psia)..... 0.4

Applicable Bulk Reg. 46 CFR Subchapter..... O

Vapor Pressure 46°C (115°F) (psia)..... 0.6

Vapor Density (Air = 1.0)..... 4.42

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—The main hazard is its very easy polymerization. Ignited by heat and open flame. Fire may cause violent rupture of tank.

Flash Point (°F)..... 86

Flammable Limits..... 1.9 to 8.00%

Autoignition Temp. (°F)..... 644

Extinguishing Agents..... CO₂, water fog, dry chemical, foam

Special Fire Procedures..... Provide fire fighters with breathing apparatus. Keep tank cool with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

10

TLV/TWA (ppm)

Unavailable

General—Vapor irritating. Avoid skin contact with liquid.

Symptoms—Slight redness from skin contact with liquid.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—Skin or eye contact—flush immediately with large quantities of water for at least 15 minutes. If any irritation or injury develops after washing, prompt medical attention should be obtained.

Vapor inhalation—remove victim to uncontaminated area and obtain prompt medical attention if any illness is observed.

REACTIVITY DATA

Stability—Polymerizes readily on heating. Must be inhibited.

Compatibility—Material: Compatible with most materials of construction.

Cargo: Group 14 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, full protective clothing. Have all-purpose canister mask available. Secure ignition sources. Small spills may be flushed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



n-BUTYL ACRYLATE

Synonyms—Acrylic acid, n-butyl ester;
n-Butyl-2-propenoate; 2-Propenoic acid, butyl ester

United Nations Number..... 2348

Formula— $\text{CH}_2 = \text{CHCOOC}_4\text{H}_9$

Appearance—Odor—Colorless liquid; sharp, biting,
ester-like odor.

Specific Gravity—0.90

Chemical Family—Acrylate

Pollution Category—USEPA _____ IMO B

Applicable Bulk Reg. 46 CFR Subchapter _____ Q

CHRIS Code..... BTC
"iso-, n)" BAR

Boiling Point..... 149°C 300°F

..... °C °F

Freezing Point..... -84°C -83°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 3.2

Reid Vapor Pressure (psia)..... 0.2

Vapor Pressure 46°C (115°F) (psia)..... 0.4

Vapor Density (Air = 1.0)..... 4.4

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—The main hazard is its very easy polymerization. Ignited by heat and open flame. Fire may cause violent rupture of tank.

Flash Point (°F)..... 120

Flammable Limits..... 1.5 to 9.9%

Autoignition Temp. (°F)..... 567

Extinguishing Agents..... Carbon dioxide, dry chemical, alcohol foam, water spray.

Special Fire Procedures..... Provide fire fighters with breathing apparatus. Keep tank cool with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

10

TLV/TWA (ppm)

10

General—Vapor and liquid are irritating.

Symptoms—Eye irritation; watering of eyes and salivation when inhaled.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—Skin contact should be washed thoroughly with soap and water. In case of eye contact, flush with water for 15 minutes. Get medical attention or advice.

REACTIVITY DATA

Stability—Polymerizes readily on heating. Must be inhibited.

Compatibility—Material: Compatible with steel, stainless steel or aluminum.

Cargo: Group 14 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, full protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



iso-BUTYL ALCOHOL

Synonyms—Alcohol C-4; Fermentation butyl alcohol; 1-Hydroxymethylpropane; IBA; Isobutanol; Isobutyl alcohol; Isopropylcarbinol; 2-Methyl-1-propanol

United Nations Number..... 1212

CHRIS Code..... IAL

Formula— $(CH_3)_2CHCH_2OH$

Boiling Point..... 107°C 225°F

Appearance—Odor—Colorless liquid; sweet odor

°C °F

Specific Gravity—0.81 at 15°C

Freezing Point..... -108°C -162°F

°C °F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... 8.8

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... 0.9

Vapor Density (Air = 1.0)..... 2.6

Pollution Category—USEPA _____ IMO III

Applicable Bulk Reg. 46 CFR Subchapter..... D

Solubility in Water..... Moderate

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Ignited by heat or open flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 100

Flammable Limits..... 1.7 to 10.9% at 212°F

Autoignition Temp. (°F)..... 825

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water may be ineffective.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 0, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
50

TLV/TWA (ppm)
50

General—Not highly toxic. Eye contact should be prevented, and prolonged or repeated exposure to the vapors should be avoided. Prolonged or repeated skin contact may cause defatting of the skin and may produce dermatitis from daily contact.

Symptoms—Headache and dizziness.

Short Exposure Tolerance—150 ppm

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Compatible with plain steel. Water-free isobutanol reacts with aluminum at temperatures above 120°F.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



n-BUTYL ALCOHOL

Synonyms—Alcohol C-4; Butanol; 1-Butanol; n-Butanol;
Butyl alcohol; Butyric alcohol; 1-Hydroxybutane;
NBA; Propyl carbinol; n-Propyl carbinol

United Nations Number..... 1120

Formula— $\text{CH}_3(\text{CH}_2)_3\text{OH}$

CHRIS Code BAN

Appearance—Odor—Colorless liquid; pungent alcohol
odor

Boiling Point 117°C 243°F

Specific Gravity—0.81

Freezing Point -84°C -120°F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg) 8.8

Reid Vapor Pressure (psia) 0.3

Vapor Pressure 46°C (115°F) (psia) 0.5

Vapor Density (Air = 1.0) 2.6

Pollution Category—USEPA D IMO III

Applicable Bulk Reg. 46 CFR Subchapter D

Solubility in Water Moderate

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Ignited by heat, sparks, or open flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F) 103

Flammable Limits 1.4 to 11.2%

Autoignition Temp. (°F) 690

Extinguishing Agents Dry chemical, CO_2 , foam, water fog

Special Fire Procedures Water and alcohol foam may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

25

50/Skin

50/Skin

General—Causes significant injury to the surface of the eye. Repeated skin contact may have a defatting action on the skin and may produce dermatitis from daily contact. Avoid prolonged and repeated breathing of vapors.

Symptoms—Headache, dizziness and respiratory irritation.

Short Exposure Tolerance—150 ppm

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Recommend carbon steel tanks, valves, and piping. Water-free n-butanol reacts with aluminum at temperatures above 120°F.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-9802.

Remarks:



sec-BUTYL ALCOHOL

Synonyms—Alcohol C-4; 2-Butanol; sec-Butanol;
Butylene hydrate; Ethyl methyl carbinol;
2-Hydroxybutane; Methyl ethyl carbinol; SBA

United Nations Number..... 1120

CHRIS Code..... BAS

Formula— $\text{CH}_3\text{CH}_2\text{CHOHCH}_3$

Appearance—Odor—Colorless liquid; strong, pleasant
odor

Specific Gravity—0.81

Chemical Family—Alcohol

Pollution Category—USEPA _____ IMO III

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Boiling Point..... 99°C 211°F

Freezing Point..... -109°C -165°F

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... 0.2

Vapor Pressure 46°C (115°F) (psia)..... 1.3

Vapor Density (Air = 1.0)..... 2.6

Solubility in Water..... Moderate

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous when exposed to heat or flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 74

Flammable Limits..... 1.7 to 9.8% at 212°F.

Autoignition Temp. (°F)..... 763

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 0, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

100

TLV/TWA (ppm)

100

General—Avoid inhalation of high vapor concentrations. Prolonged or repeated skin contact may cause defatting of the skin and may produce dermatitis from daily contact.

Symptoms—Headache and dizziness.

Short Exposure Tolerance—150 ppm for 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air. Give artificial respiration if breathing stops. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 min. Get medical help.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 31 mmHg at 32°C.



tert-BUTYL ALCOHOL

Synonyms—Alcohol C-4; tert-Butanol;
2-Methyl-2-propanol; TBA; Trimethyl carbinol

United Nations Number..... 1120

CHRIS Code..... BAT

Formula— $(CH_3)_3COH$

Appearance—Odor—Colorless liquid or crystalline solid;
pungent, camphor-like odor

Specific Gravity—0.78 at 26°C (a liquid)

Boiling Point..... 83°C 191°F

Freezing Point..... 26°C 78°F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... 30.6

Reid Vapor Pressure (psia)..... 1.8

Vapor Pressure 46°C (115°F) (psia)..... 2.8

Vapor Density (Air = 1.0)..... 2.6

Pollution Category—USEPA _____ IMO III

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous when exposed to heat or flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 52 (cc) (tert-Butyl alcohol is solid at 52°F)

Flammable Limits..... 2.4 to 8.0%

Autoignition Temp. (°F)..... 892

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 0, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

100

TLV/TWA (ppm)

100

General—Avoid breathing high vapor concentrations. Prolonged or repeated skin contact may cause defatting of the skin and may produce dermatitis from daily contact.

Symptoms—Headache and dizziness.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air. Give artificial respiration if breathing stops. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



iso-BUTYLAMINE

Synonyms:—1-Amino-2-Methylpropane; isobutylamine;
mono-isobutylamine; 2-Methylpropylamine

United Nations Number..... 1214

Formula— $(CH_3)_2CHCH_2NH_2$

CHRIS Code..... IAM
"all isomers"..... BTY

Appearance-Odor—Colorless liquid with ammonia-like odor.

Boiling Point..... 66°C 151°F

Specific Gravity—0.73

..... °C °F

Freezing Point..... -66°C -123°F

Chemical Family—Alkyl amine

Vapor Pressure 20°C (68°F) (mmHg)..... 218

Reid Vapor Pressure (psia)..... 2.4

Pollution Category—USEPA C IMO C

Vapor Pressure 46°C (115°F) (psia)..... 3.2

Applicable Bulk Reg. 46 CFR Subchapter O

Vapor Density (Air = 1.0)..... 2.5

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid
Electrical Group—D

General—Toxic oxides of nitrogen may be formed in fire. Flammable, high fire risk. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 10

Flammable Limits..... 1.7 to 9.8%

Autoignition Temp. (°F)..... 712

Extinguishing Agents..... Dry chemical, alcohol foam or carbon dioxide.

Special Fire Procedures..... Water may be ineffective, but should be used to keep containers cool.

HEALTH HAZARD DATA

Health Hazard Ratings
2, 3, 0

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
5/Skin*

TLV/TWA (ppm)
5/Skin*

General—Moderately toxic, eye, skin and respiratory irritant.

Symptoms—Loss of consciousness may occur. If taken internally, convulsions may also occur.

Short Exposure Tolerance—10-15 ppm is highly irritating.

Exposure Procedures—Remove clothing and shoes. Flush affected areas with plenty of water. If in eyes flush eyes thoroughly with water. If taken internally, and victim is conscious, have him drink water. If victim is unconscious, do nothing except keep him warm. Call a doctor.

REACTIVITY DATA

Stability—Stable. Keep separated from heat and oxidants.

Compatibility—Material: Store in carbon steel, aluminum, stainless steel for purity. Copper and its alloys should NOT be used.

Charge: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, protective clothing and self-contained breathing apparatus. Avoid contact with liquid. Secure ignition sources. Cover spills with sodium bisulfate and spray with large amounts of water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * PEL and TLV based upon n-Butylamine.



n-BUTYLAMINE

Synonyms—1-Aminobutane; 1-Butanamine; Butylamine;
Mono-n-butylamine; Norvalamine

United Nations Number..... 1125

Formula— $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$

Appearance—Odor—Colorless liquid with a pungent,
ammonia-like odor
Specific Gravity—0.74

Chemical Family—Alkyl amine

Pollution Category—USEPA C IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... Q

CHRIS Code..... BAM
"all isomers" BTY

Boiling Point..... 78°C 172°F

.....°C.....°F

Freezing Point..... -50°C -58°F

.....°C.....°F

Vapor Pressure 20°C (68°F) (mmHg)..... 82

Reid Vapor Pressure (psia)..... 1.39

Vapor Pressure 46°C (115°F) (psia)..... 2.7

Vapor Density (Air = 1.0)..... 2.5

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Toxic oxides of nitrogen may be formed in fire. Flammable, dangerous fire risk. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 10

Flammable Limits..... 1.7 to 9.8%

Autoignition Temp. (°F)..... 594

Extinguishing Agents..... Confined-dry powder, CO_2 , open-water, polar solvent foam.

Special Fire Procedures..... Keep tanks cool with water spray. Provide fire fighters with protective clothing and self-contained breathing apparatus against toxic fumes.

HEALTH HAZARD DATA

Health Hazard Ratings
4, 4, 4

Odor Threshold (ppm)
1 to 2

PEL/TWA (ppm)
5/Skin

TLV/TWA (ppm)
5/Skin

General—Poisonous if inhaled or if skin is exposed to the vapor. Irritation of eyes and respiratory tract, severe damage after contact of short to moderate periods.

Symptoms—Severe damage to skin or eyes by liquid, irritation of upper respiratory tract and eyes, mild headaches and flushing of skin of face, cumulative effects have not been observed.

Short Exposure Tolerance—Ten to 15 ppm is highly irritating during short exposure; 3100 ppm killed 3 out of 3 rats in 50 min.; whereas rats survived a single 4-hour exposure of 2000 ppm. Hazards unknown for humans.

Exposure Procedures—Flush skin or eyes immediately with large amounts of water for approximately 15 minutes. Remove all contaminated clothing and flush underlying areas with water. In case of eye contact or inhalation of high concentrations of vapor, victim should be immediately placed under physician's care.

REACTIVITY DATA

Stability—Stable, but readily combines with acids, aldehydes, chlorohydrins, and organic sulfur compounds.

Compatibility—Material: Store in carbon steel containers or aluminum or stainless steel for purity. Copper and its alloys should not be used.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, protective clothing, self-contained breathing apparatus. Avoid contact with liquid. Secure ignition sources. Cover spill with sodium bisulfate. Spray with large amounts of water. Burn in open pit after dissolving in waste alcohols or in an incinerator with afterburners and scrubber.

If a spill occurs, call the National Response Center, 800-424-8302.

Remarks:



sec-BUTYLAMINE

Synonyms—2-Aminobutane; 2-Butanamine; 1-Methyl
propylamine

United Nations Number..... 1

Formula— $\text{CH}_3\text{CH}(\text{NH}_2)\text{C}_2\text{H}_5$

CHRIS Code..... BTL
"all isomers" BTY

Appearance—Odor—Colorless liquid; ammonia-like odor.

Boiling Point..... 63°C 148°F

Specific Gravity—0.73

Freezing Point..... -104°C -155°F

Chemical Family—Alkyl amines

Vapor Pressure 20°C (68°F) (mmHg)..... 140

Raid Vapor Pressure (psia)..... 8.1

Pollution Category—USEPA C IMO C

Vapor Pressure 46°C (115°F) (psia)..... 8.0

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Vapor Density (Air = 1.0)..... 2.52

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Toxic oxides of nitrogen may be formed in fire. Flammable, dangerous fire risk. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 15

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 712

Extinguishing Agents..... Confined-dry powder, CO₂, Open-polar solvent foam, water.

Special Fire Procedures..... Keep tanks cool with water spray. Provide fire fighters with protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings
3, 2, 3

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
5/Skin*

TLV/TWA (ppm)
5/Skin*

General—Moderately toxic.

Symptoms—Coughing, irritation of eyes and mucous membranes, redness or irritation of skin.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Flush skin and eyes immediately with large amounts of water for 15 minutes. In case of eye contact, inhalation of high concentrations, or ingestion, victim should be placed under physician's care.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Carbon steel.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber boots, gloves, protective clothing, self-contained breathing apparatus. Avoid contact with liquid. Secure ignition sources. Cover with sodium bisulfate and wash with plenty of water—or dissolve in waste alcohols and burn. Burn in open pit or in an incinerator with after burners and scrubber.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * PEL and TLV based upon n-Butylamine.

‡ Unassigned



tert-BUTYLAMINE

Synonyms—2-Aminoisobutane;
2-Amino-2-methylpropane; Dimethyl ethylamine;
1,1-Dimethylethylamine; 2-Methyl-2-propanamine;
Trimethylaminomethane

United Nations Number..... 1

Formula— $(CH_3)_3CNH_2$

CHRIS Code..... BUA
"all isomers" BTY

Appearance—Odor—Water white liquid; ammoniacal odor

Boiling Point..... 45°C 113°F
.....°C.....°F

Specific Gravity—0.70

Freezing Point..... -67°C -88°F
.....°C.....°F

Chemical Family—Alkyl amine

Vapor Pressure 20°C (68°F) (mmHg)..... 340

Pollution Category—USEPA C IMO C

Reid Vapor Pressure (psia)..... 11

Applicable Bulk Reg. 46 CFR Subchapter..... O

Vapor Pressure 46°C (115°F) (psia)..... 15

Vapor Density (Air = 1.0)..... 2.5

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—B: Flammable liquid

Electrical Group—D

General—Toxic oxides of nitrogen may form in fire. Vapors form explosive mixtures with air. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... about 50

Flammable Limits..... 1.7 to 9.0%

Autoignition Temp. (°F)..... 612

Extinguishing Agents..... Dry chemical, alcohol foam or CO₂

Special Fire Procedures..... Keep tanks cool with water spray. Provide fire fighters with protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

2, 2, 3

Unavailable

5/Skin*

5/Skin*

General—Causes irreversible damage to eye tissue. Moderately toxic by oral intake. Irritating to eyes, skin, lungs. Not absorbed through skin.

Symptoms—Red or irritated eyes or skin, coughing, irritation of mucous membrane, nausea.

Short Exposure Tolerance—Animal test for liquid eye irritation produced destruction of corneal tissue with 2–3 min. Vapor inhalation for 5 minutes was fatal to test animals.

Exposure Procedures—Flush skin and eyes immediately with large amounts of water for 15 minutes. Remove all contaminated clothing and flush underlying areas with water. In case of eye contact or inhalation of high concentrations of vapor, victim should be immediately placed under physician's care.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Doesn't react with steel, wood, cloth; softens rubber and paint.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber protective clothing, self-contained breathing apparatus. Avoid contact with liquid. Secure ignition sources. Cover with sodium bisulfate and wash with plenty of water. Do not flush spill into confined spaces where flammable vapors can accumulate. Burn in an open pit or an incinerator with afterburners and scrubber.

If a spill occurs, call the National Response Center, 800-424-9802.

Remarks: * PEL and TLV based upon n-Butylamine.

‡ Unassigned

BUTYL BENZYL PHTHALATE

Synonyms—BBP; Benzyl n-butyl phthalate; Phthalic acid, benzyl butyl ether; Santicizer 180

United Nations Number..... 1

Formula— $C_{18}H_{20}COOC_4H_9COOCH_2C_6H_5$, or $C_{18}H_{20}O_4$

CHRIS Code..... BPH

Appearance—Odor—Colorless, oily liquid; slight, characteristic odor.

Boiling Point..... 370°C 688°F
..... °C °F

Specific Gravity—1.12

Freezing Point..... -35°C -31°F
..... °C °F

Chemical Family—Ester

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... Low

Pollution Category—USEPA B IMO A

Vapor Pressure 46°C (115°F) (psia)..... Low

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

Vapor Density (Air = 1.0)..... 10.8

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid
Electrical Group—D

General—Fire hazard slight when exposed to heat or flame. Carbon monoxide, carbon dioxide, and water produced by combustion.

Flash Point (°F)..... 390

Flammable Limits..... LEL=0.26% (calculated) UEL—Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Confined— CO_2 , dry chemical. Open—water, foam.

Special Fire Procedures..... Water or foam may cause extensive frothing.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 0

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—No apparent hazards—low toxicity.

Symptoms—Low toxicity.

Short Exposure Tolerance—Will not cause irritation to skin.

Exposure Procedures—Skin contact—wash affected areas with water. Vapor inhalation—remove victim to fresh air. Call a doctor.

REACTIVITY DATA

Stability—Stable at moderate temperatures; no spontaneous decomposition. Can react with oxidizing materials.

Compatibility—Material: Destructive to rubber and paint. No effects on steel, wood, or cloth. Recommend containers of steel.

Charge: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield. Confine and absorb on suitable material such as sawdust, clay, or filtercel. May be incinerated.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 0.18 mmHg at 150°C.

‡ Unassigned



BUTYLENE

Synonyms—Butene; 1-Butene; alpha-Butylene;
Ethylethylene

United Nations Number..... 1012

CHRIS Code..... BTN

Formula— $\text{CH}_2 = \text{CHCH}_2\text{CH}_3$

Appearance—Odor—Colorless gas; sweetish odor

Boiling Point..... -6°C 21°F

..... $^\circ\text{C}$ $^\circ\text{F}$

Freezing Point..... -186°C -302°F

..... $^\circ\text{C}$ $^\circ\text{F}$

Specific Gravity—0.80 at 20°C (a liquid)

Vapor Pressure 20°C (68°F) (mmHg)..... 1030

Reid Vapor Pressure (psia)..... 62.5

Vapor Pressure 46°C (115°F) (psia)..... 76

Vapor Density (Air = 1.0)..... 1.94

Solubility in Water..... Insoluble

Chemical Family—Olefin

Pollution Category—USEPA..... IMO 098

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—D

General—Unless the flow of gas can be stopped, extinguishing a butene fire will permit accumulation of an explosive concentration of vapor, and subsequent explosion or re-flash.

Flash Point ($^\circ\text{F}$)..... 110 (cc)

Flammable Limits..... 1.6 to 9.3%

Autoignition Temp. ($^\circ\text{F}$)..... 723

Extinguishing Agents..... Stop flow of gas; CO_2 , dry chemical, water fog.

Special Fire Procedures..... Keep burning tank and adjacent tanks cool with a water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

Unavailable

Unavailable

General—May produce anesthetic effects on exposure to high vapor concentrations. Contact with liquid may produce a frostbite.

Symptoms—Breathing high concentrations of gas for some time may cause dizziness. Contact with liquid may cause skin and eye injury similar to frostbite.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Remove to fresh air. If breathing has stopped, give artificial respiration. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material: Noncorrosive to most materials of construction.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources. The spilled liquid will boil away rapidly, leaving no residue.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



BUTYLENE MIXTURES*

Synonyms—No common synonyms.

United Nations Number..... ‡

Formula— C_4H_8

Appearance—Odor—Gas with gasoline-like odor.

Specific Gravity—Unavailable

Chemical Family—Olefins

Pollution Category—USEPA _____ IMO GHS

Applicable Bulk Reg. 46 CFR Subchapter _____ D.O.

CHRIS Code..... ‡

Boiling Point..... °C _____ °F _____

Freezing Point..... °C _____ °F _____

Vapor Pressure 20°C (68°F) (mmHg)..... _____

Reid Vapor Pressure (psia)..... _____

Vapor Pressure 46°C (115°F) (psia)..... _____

Vapor Density (Air = 1.0)..... 1.9

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—A: Liquefied Flammable Gas (LFG)

Electrical Group—Unassigned

General—Unless the flow of gas can be stopped, extinguishing a fire will permit the accumulation of an explosive concentration of vapor, and subsequent explosion or re-flash.

Flash Point (°F)..... —24 approximately

Flammable Limits..... 1.0 to 10.0% (approx.)

Autoignition Temp. (°F)..... 615 to 725 (approx.)

Extinguishing Agents..... Stop flow of gas; CO_2 , dry chemical, water spray

Special Fire Procedures..... Use water to cool containers in order to reduce possibility of rupturing tank.

Try to seal the gas leak. Use water spray to knock down water vapors. Flash back along vapor trail may occur.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 4, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Essentially non-toxic at low concentrations. At higher concentrations, it can act as an anesthetic.

Symptoms—Causes dizziness and difficult breathing. Liquid will cause frostbite.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Remove victim to fresh air. If breathing has stopped, administer artificial respiration. If breathing is difficult, give oxygen. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Will react with acids and alkyl halides.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield and protective clothing. Have all purpose canister mask available. Keep concentration of leaking gas below explosive mixture range by ventilation. Secure ignition sources. Do not flush spill into confined spaces where flammable vapors can accumulate.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Some data are undeterminable because this category considers mixture of butylenes.

‡ Unassigned



1,3-BUTYLENE GLYCOL

Synonyms—Butane-1,3-diol; 1,3-Butanediol;
beta-Butyleneglycol; 1,3-Dihydroxybutane;
Methyltrimethylene glycol

United Nations Number..... 1

CHRIS Code..... BUG

Formula— $\text{CH}_2\text{OHCH}_2\text{CH}(\text{OH})\text{CH}_3$

Appearance—Practically colorless; odorless liquid.

Specific Gravity—1.01

Chemical Family—Glycol

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Boiling Point..... 207°C 406°F

Freezing Point..... 23°C 74°F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.06

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 3.10

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame.

Flash Point (°F)..... 250

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 710

Extinguishing Agents..... Water, carbon dioxide or dry chemical, alcohol foam.

Special Fire Procedures..... Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Not considered toxic under ordinary conditions of handling.

Symptoms—Unavailable

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air. Skin or eye contact—gently flush contaminated areas with water for 15 minutes.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



1,2-BUTYLENE OXIDE

Synonyms—1,2-Butylene oxide, stabilized;
alpha-Butylene oxide; 1,2-Epoxybutane

United Nations Number..... 3022

CHRIS Code..... BTQ

Formula— $H_2COCHCH_2CH_3$

Appearance—Odor—Colorless liquid; sharp, pungent odor

Specific Gravity—0.83

Chemical Family—Alkylene oxide

Pollution Category—USEPA _____ IMO C

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Boiling Point..... 63°C 148°F

..... °C °F

Freezing Point..... -60°C -58°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 207

Reid Vapor Pressure (psia)..... 5.8

Vapor Pressure 46°C (115°F) (psia)..... 7.2

Vapor Density (Air = 1.0)..... 2.49

Solubility in Water..... Moderate

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—B

General—Very flammable and vapors are highly flammable, even explosive. Fire or contamination may cause violent rupture of tanks. Flashback along vapor trail may occur.

Flash Point (°F)..... less than -20

Flammable Limits..... 1.5 to 25.1%

Autoignition Temp. (°F)..... 959

Extinguishing Agents..... Confined—CO₂. Open—Water, foam.

Special Fire Procedures..... Cool tanks with water spray. Use water spray to "knock down" vapor.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Not Listed

Unavailable

Unavailable

400*

General—Irritation of eyes and respiratory tract. Overexposure will cause serious injury. Contact with eyes will cause burn. Contact with uncovered skin produces frostbite. Ingestion will cause serious illness or death.

Symptoms—Coughing, watering eyes, sickness of stomach, frostbitten skin.

Short Exposure Tolerance—Prolonged contact with skin causes frostbite burn.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing has stopped, use oxygen inhalation. If ingested, make victim vomit, at least 2-3 times, and then give victim a tablespoon of Epsom salt in glass of water. Flush eyes immediately for approximately 15 minutes. Remove contaminated clothing or other wearing apparel immediately. Clothing can seldom be decontaminated. Wash skin with soap and water.

REACTIVITY DATA

Stability—Thermodynamically unstable; decomposition is rapid. Polymerization will occur in presence of acids, bases, and certain salts.

Compatibility—Material: Mild steel or stainless steel is unaffected. Storage tanks and other equipment should be absolutely dry and free from air, ammonia, acetylene, hydrogen sulfide, rust, and other contaminants.

Cargo: Group 16 of compatibility chart.

SPILL OR LEAK PROCEDURE

Evacuate area, wear respiratory protective devices as well as impervious clothing (boots, gloves, etc.). Use large amounts of water to dilute to at least 22 parts H₂O to 1 part of oxide. Leaking containers should be immersed into large amounts of water if possible. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Use an inert gas to displace the air in the storage of butylene oxide.

* Value obtained from a CG-4355 form; however, this value was not confirmed.



n-BUTYL ETHER

Synonyms—1-Butoxy butane; Butyl ether; Dibutyl ether;
Di-n-butyl ether; n-Dibutyl ether; Dibutyl ethers;
Dibutyl oxide; 1,1'-Oxybis(butane)

United Nations Number..... 1149

CHRIS Code..... DBE

Formula— $(C_4H_{10})_2O$

Appearance—Odor—Colorless liquid; mild, pleasant,
ether-like odor
Specific Gravity—0.767

Boiling Point..... 142°C 288°F
°C °F
Freezing Point..... -85°C -140°F
°C °F

Chemical Family—Ethers

Vapor Pressure 20°C (68°F) (mmHg)..... 4.8
Reid Vapor Pressure (psia)..... †
Vapor Pressure 46°C (115°F) (psia)..... 0.4
Vapor Density (Air = 1.0)..... 4.5
Solubility in Water..... Negligible

Pollution Category—USEPA _____ IMO C
Applicable Bulk Reg. 46 CFR Subchapter _____ O

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid
Electrical Group—C

General—Flammable, irritating vapors are produced. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Ground all equipment and personnel

Flash Point (°F)..... 92
Flammable Limits..... 1.5 to 7.6%
Autoignition Temp. (°F)..... 382
Extinguishing Agents..... Dry chemical, alcohol foam, CO₂
Special Fire Procedures..... Containers may explode in fire. Water may be ineffective. Cool exposed containers with water. Secure ignition sources. Wear goggles or face shield, rubber gloves.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
Unavailable	Unavailable	Unavailable	Unavailable

General—Vapor irritating to eyes, nose, and throat. Liquid irritating to skin and eyes.

Symptoms—Inhalation causes irritation of nose and throat. Liquid irritates eyes and irritates skin or prolonged contact.

Short Exposure Tolerance—Data not available.

Exposure Procedures—Remove to fresh air, administer artificial respiration or oxygen as necessary. Remove contaminated clothing. Flush areas with large amounts of water. If conscious, induce vomiting. Get medical attention. SPEED IS OF PRIMARY IMPORTANCE.

REACTIVITY DATA

Stability—Stable. However, when anhydrous (dry), tends to form explosive peroxides in air.

Compatibility—Material: iron, aluminum, stainless steel, tin, polyethylene, porcelain, glass and enamel are suitable for containers.

Cargo: Group 41 of compatibility chart.

SPILL OR LEAK PROCEDURE

Mechanically contain material and remove. Stay upwind. Wear face shield and rubber gloves, protective clothing. Beware of flashback along vapor trail. Secure ignition sources. Ground all equipment and personnel

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

BUTYL METHACRYLATE

Synonyms—Butyl 2-methacrylate; n-Butyl methacrylate;
n-Butyl alpha-methacrylate; Butyl
2-methyl-2-propenoate; Methacrylic acid, butyl ester

United Nations Number..... 2227

CHRIS Code..... BMN

Formula— $\text{CH}_2 = \text{C}(\text{CH}_3)\text{COOC}_4\text{H}_9$

Appearance—Odor—Clear, colorless liquid with a typical
acrylate odor

Specific Gravity—0.88

Boiling Point..... 155°C 311°F
°C °F

Freezing Point..... -33°C -28°F
°C °F

Chemical Family—Acrylate (monomer)

Vapor Pressure 20°C (68°F) (mmHg)..... 3.5

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... 0.29

Vapor Density (Air = 1.0)..... 4.9

Solubility in Water..... 0.4%

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ O

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid
Electrical Group—D

General—Heat will increase generation of toxic fumes.

Flash Point (°F)..... 105

Flammable Limits..... 2 to 8% (estimated)

Autoignition Temp. (°F)..... 562

Extinguishing Agents..... Carbon dioxide, dry chemical or foam

Special Fire Procedures..... Use water spray to cool fire exposed tanks.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 2

Odor Threshold (ppm)
less than 50

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Mild skin irritant. Can be absorbed through skin and lungs. Ingestion may cause serious permanent damage or death.

Symptoms—Skin—mild irritation and reddening of skin. Inhalation—irritation of mucous membranes and respiratory tract.

Short Exposure Tolerance—1100 ppm for one hour.

Exposure Procedures—Skin—wash affected areas with plenty of water. Eyes—wash with cool water for 15 minutes. Inhalation—remove victim to fresh air. Administer artificial respiration if necessary, and then oxygen. In all cases call a doctor.

REACTIVITY DATA

Stability—Butyl methacrylate is relatively stable if properly inhibited. Exposure to oxidizers will initiate polymerization.

Compatibility—Material: Stainless steel is acceptable.

Cargo: Group 14 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure all ignition sources. Clean up liquid with paper towels and burn under hood.

If a spill occurs, call the National Response Center, 800-424-5902.

Remarks:



ISO-BUTYRALDEHYDE

Synonyms—iso-Butyl aldehyde; isobutanol;
Isobutylaldehyde; Isobutyraldehyde; Isobutyric
aldehyde; 2-Methylpropanal

United Nations Number..... 2045

CHRIS Code..... BAD

Formula— $(CH_3)_2CHCHO$

Appearance—Odor—Colorless liquid; pungent odor

Specific Gravity—0.79

Chemical Family—Aldehyde

Pollution Category—USEPA _____ IMO C

Applicable Bulk Reg. 46 CFR Subchapter _____ Q

Boiling Point..... 64°C 147°F

Freezing Point..... -66°C -87°F

Vapor Pressure 20°C (68°F) (mmHg)..... 115

Reid Vapor Pressure (psia)..... 5.0

Vapor Pressure 46°C (115°F) (psia)..... 8.0

Vapor Density (Air = 1.0)..... 2.48

Solubility in Water..... 10.0%

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—Fires are difficult to control because of the ease with which the vapors reignite. These vapors are readily ignited by static sparks of relatively low energy. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... -40

Flammable Limits..... 1.6 to 10.6%

Autoignition Temp. (°F)..... 433

Extinguishing Agents..... CO₂, dry chemical, water fog, alcohol foam.

Special Fire Procedures..... Keep tanks adjacent to fire cool with a water spray. Wear eye protection and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 1, 2

Odor Threshold (ppm)

0.047

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Irritation and burns of the skin and eyes follow contact of short duration.

Symptoms—Coughing, watering of eyes, and burning sensation in throat and nose. Drowsiness, incoordination, headache.

Short Exposure Tolerance—Animal experiments have shown that large doses produce depression of the central nervous system and anesthesia.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, when administered by trained personnel, is helpful. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Undergoes rapid oxidation to butyric acid in air.

Compatibility—Material: Mild steel is unsatisfactory because of corrosive action of butyric acid.

Cargo: Group 19 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Secure ignition sources. If possible, cover spill with sodium bisulfite. Add small amount of water and mix. Scoop up and wash away with a large excess of water, after one hour. Wash the site with soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

n-BUTYRALDEHYDE

Synonyms—Butaldehyde; Butanal; n-Butanal; Butyl aldehyde; n-Butyl aldehyde; Butyraldehyde; Butyric aldehyde

United Nations Number..... 1129

Formula— $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$

CHRIS Code..... BTR

Appearance—Colorless liquid; pungent odor.

Boiling Point..... 76°C 169°F

Specific Gravity—0.82

Freezing Point..... -99°C -148°F

Chemical Family—Aldehyde

Vapor Pressure 20°C (68°F) (mmHg)..... 91.5

Reid Vapor Pressure (psia)..... 4.8

Vapor Pressure 46°C (115°F) (psia)..... 8.0

Vapor Density (Air = 1.0)..... 2.48

Pollution Category—USEPA _____ IMO B

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Solubility in Water..... 8.5%

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—Fires are difficult to control because of the ease with which the vapors reignite. These vapors are readily ignited by static sparks of relatively low energy. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 20 (cc)

Flammable Limits..... 2.47 to 10.6%

Autoignition Temp. (°F)..... 446

Extinguishing Agents..... CO_2 , dry chemical, water fog, alcohol foam

Special Fire Procedures..... Fire parties should wear body and respiratory protection to guard against both inhalation and liquid contact. Keep tank cool with water spray. Fight fire from a safe distance, or from a protected location.

HEALTH HAZARD DATA

Health Hazard Ratings
2, 1, 2

Odor Threshold (ppm)
0.0048

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Irritation and burns of the skin and eyes follow contact of short duration.

Symptoms—Coughing, watering of eyes, and burning sensation in throat and nose.

Short Exposure Tolerance—Animal experiments have shown that large doses produce depression of the central nervous system and anesthesia.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, when administered by trained personnel, is helpful. Skin or eye contact—remove contaminated clothing and gently flush affected area with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Oxidizes to butyric acid readily.

Compatibility—Material: Mild steel is corroded by butyric acid formed in presence of air.

Cargo: Group 19 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Secure ignition sources. If possible, cover spill with sodium bisulfite. Add small amount of water and mix. Scoop up. Wash the site with soap solution. Rags used to wipe up small spills should be immersed in water or removed to a safe area without delay otherwise they may ignite spontaneously.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



n-BUTYRIC ACID

Synonyms—Butanic acid; Butanoic acid; Butyric acid;
Ethylacetic acid; Propanecarboxylic acid;
Propylformic acid

United Nations Number..... 2820

Formula— $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$

Appearance-Odor—Colorless liquid; pungent, putrid odor

Specific Gravity—0.96

Chemical Family—Organic acid

Pollution Category—USEPA D IMO D

Applicable Bulk Reg. 46 CFR Subchapter..... O

CHRIS Code..... BBA

Boiling Point..... 164°C 327°F

..... °C °F

Freezing Point..... -5°C 23°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 0

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... 0.07

Vapor Density (Air = 1.0)..... 3.04

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame. Yields flammable vapors which form explosive mixtures.

Flash Point (°F)..... 175

Flammable Limits..... 2 to 10%

Autoignition Temp. (°F)..... 846

Extinguishing Agents..... Dry chemical, alcohol foam or carbon dioxide

Special Fire Procedures..... Water may be ineffective. Wear eye protection and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 3, 0

Odor Threshold (ppm)

0.001

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Skin contact may be severely irritating or may cause moderate burns. Eyes are seriously injured by liquid contact.

Symptoms—Vapor: eye, throat, skin irritation. Liquid contact: severely irritating with moderate burns.

Short Exposure Tolerance—Eyes are seriously injured by a five percent solution of the acid.

Exposure Procedures—Contact with skin or eyes: immediately flush with plenty of clear running water, wash eyes for 15 minutes and get medical care; remove contaminated clothing. Inhalation: move to fresh air; if breathing is difficult, give oxygen. Get medical attention.

REACTIVITY DATA

Stability—Can react with oxidizing material.

Compatibility—Material: Storage tanks and piping can be of stainless steel or aluminum.

Cargo: Group 4 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Body shield and self-contained breathing apparatus should be available. Eliminate all sources of ignition. If possible, cover spill with large quantities of soda ash or sodium bicarbonate. Mix and add water if needed for good mixing. Scoop up slurry. Wash site with soda ash solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



CAMPHOR OIL

Synonyms—Gum camphor; Impure camphor; Light camphor oil; Liquid camphor; White camphor oil

United Nations Number..... 1130

Formula— $C_{10}H_{16}O$

CHRIS Code..... CPO

Appearance—Oily liquid, colorless, brown or blue; penetrating camphor odor.
Specific Gravity—0.87 to 1.04

Boiling Point..... ~200°C ~392°F
Freezing Point..... NP°C °F

Chemical Family—Ketone

Vapor Pressure 20°C (68°F) (mmHg)..... 392
Reid Vapor Pressure (psia)..... †
Vapor Pressure 46°C (115°F) (psia)..... †
Vapor Density (Air = 1.0)..... NP
Solubility in Water..... Slight

Pollution Category—USEPA..... IMO B

Applicable Bulk Reg. 46 CFR Subchapter..... Q

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid
Electrical Group—D

General—Moderate fire hazard when exposed to heat. The solid often evaporates without first melting.

Flash Point (°F)..... 117 (cc)
Flammable Limits..... Unavailable
Autoignition Temp. (°F)..... 466°C
Extinguishing Agents..... Foam, carbon dioxide or dry chemical
Special Fire Procedures..... Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
0, 1, 1	Unavailable	Unavailable	Unavailable

General—Vapors are nonirritating to the eyes and throat. If spilled on clothing and allowed to remain, smarting and reddening of the skin may result.

Symptoms—After swallowing, nausea and vomiting; headache, confusion; jerky movements.

Short Exposure Tolerance—Reliable data unavailable.

Exposure Procedures—In case of contact, flush skin or eyes with plenty of low-pressure water. Get medical attention for eye contact.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material:

Cargo: Group 18 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Avoid contact with liquid. Secure ignition sources. Shut-off leak. Flush area with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



CAPROLACTAM SOLUTION, 80%

Synonyms—Aminocaproic lactam; epsilon-Caprolactam;
2-Ketohexamethylenimine; 2-Oxohexamethylenimine

United Nations Number..... 1

Formula— $C_6H_{11}NO$

CHRIS Code..... CLS

Appearance—Odor—Clear light yellow, liquid; odorless

Boiling Point..... 110°C 230°F
°C °F

Specific Gravity—1.06

Freezing Point..... 13°C 56°F
°C °F

Chemical Family—Cyclic amide

Vapor Pressure 20°C (68°F) (mmHg)..... 10

Reid Vapor Pressure (psia)..... 0.45

Vapor Pressure 46°C (115°F) (psia)..... 0.70

Vapor Density (Air = 1.0)..... 3.9

Pollution Category—USEPA..... IMO 0

Applicable Bulk Reg. 46 CFR Subchapter..... 0

Solubility in Water..... 80% by weight

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Toxic oxides of nitrogen may be formed in fire. Negligible hazard polymerization below 200°F.

Flash Point (°F)..... 230

Flammable Limits..... LEL = 1.84% UEL—Unavailable

Autoignition Temp. (°F)..... Greater than 284

Extinguishing Agents..... Water, dry chemical, foam, CO_2

Special Fire Procedures.....

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

0, 0, 4

0.3 mg/m³

5

5

General—Slight hazard, however, toxic vapors result from thermal decomposition above 400°F. Possibility of thermal burns from hot liquid if carried at elevated temperature.

Symptoms—Inhalation causes coughing or mild irritation.

Short Exposure Tolerance—Not pertinent.

Exposure Procedures—Inhalation—remove patient to fresh air. Eyes—wash with water for 15 minutes.
Skin—wash with soap and water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Non-corrosive to steel, wood, rubber, paint, cloth, or other common materials.

Cargo: Group 22 of compatibility chart.

SPILL OR LEAK PROCEDURE

Secure ignition sources. Spills may be flushed with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



CARBON DISULFIDE

Synonyms—Carbon bisulfide; Carbon bisulphide;
Carbon disulphide; Dithiocarbonic anhydride

United Nations Number..... 1131

CHRIS Code..... CBB

Formula—CS₂

Appearance—Odor—Colorless liquid; strong disagreeable
odor

Specific Gravity—1.26

Chemical Family—Sulfide

Pollution Category—USEPA B IMO B

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 46°C 115°F

..... °C °F

Freezing Point..... -111°C -167°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 287

Reid Vapor Pressure (psia)..... 10.3

Vapor Pressure 46°C (115°F) (psia)..... 10.5

Vapor Density (Air = 1.0)..... 2.64

Solubility in Water..... 0.22%

FIRE & EXPLOSION HAZARD DATA

Grade—B: Flammable liquid

Electrical Group—No electrical equipment allowed.

General—Highly flammable liquid with unusually low autoignition temperature; contact with steam line or hot, bare electric light bulb can cause ignition. Burning releases irritating and toxic sulfur dioxide gas (SO₂).

Flash Point (°F)..... -22 (cc)

Flammable Limits..... 1.3 to 44%

Autoignition Temp. (°F)..... 212

Extinguishing Agents..... CO₂ or dry chemical

Special Fire Procedures..... A self-contained breathing apparatus is recommended. When burning, carbon disulfide produces sulfur dioxide, which is toxic and highly irritating. Wear full protective clothing. Fight fire from a safe distance or from a protected location.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 2, 3

Odor Threshold (ppm)

0.21

PEL/TWA (ppm)

4/Skin

TLV/TWA (ppm)

10/Skin

General—Vapor harmful. Avoid skin contact with liquid.

Symptoms—Light-headedness, dizziness; prolonged contact with skin may cause burns.

Short Exposure Tolerance—1,100 ppm for 1/2 hour may cause severe symptoms and unconsciousness; 4,815 ppm for 1 hour has been reported as fatal.

Exposure Procedures—Remove to fresh air. Give artificial respiration if unconscious. Get medical attention as soon as possible. If breathing is difficult, administer oxygen.

REACTIVITY DATA

Stability—Cargo tanks should be isolated from high temperature fluids. Under conditions encountered on tankships and barges, carbon disulfide is not dangerously reactive. Must be shipped with pad of inert gas.

Compatibility—Material: May be slightly corrosive to metals of construction due to impurities. Softens rubber and many plastics.

Cargo: Group 38 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, safety glasses, protective clothing and self-contained breathing apparatus. Have carbon dioxide fire extinguisher available. Eliminate flammables and all sources of ignition. Note the low autoignition temperature (212°F).

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



CARBON TETRACHLORIDE

Synonyms—Benzinoform; Carbon tet; Methane, tetrachloro-; Nectatorina; Perchloromethane; Tetrachloromethane

United Nations Number..... 1846

Formula—CCl₄

CHRIS Code..... CBT

Appearance—Odor—Colorless liquid; sweetish odor

Boiling Point..... 78°C 168°F
°C °F

Specific Gravity—1.59

Freezing Point..... -23°C -9°F
°C °F

Chemical Family—Halogenated hydrocarbons

Vapor Pressure 20°C (68°F) (mmHg)..... 90.9

Reid Vapor Pressure (psia)..... 3.8

Vapor Pressure 46°C (115°F) (psia)..... 5.4

Vapor Density (Air = 1.0)..... 5.49

Solubility in Water..... Insoluble

Pollution Category—USEPA A IMO B

Applicable Bulk Reg. 46 CFR Subchapter..... Q

FIRE & EXPLOSION HAZARD DATA

Grade—Nonflammable; hazardous liquid

Electrical Group—NA

General—Does not burn. Liquid or vapor in contact with hot metal can form poisonous phosgene gas.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... Wear self-contained breathing apparatus. Cool tanks near fire with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 1, 4

Odor Threshold (ppm)

50*

PEL/TWA (ppm)

2

TLV/TWA (ppm)

5/Skin

General—Suspected carcinogen. Breathing vapor in closed space can cause serious illness. The odor threshold is not considered adequate warning of potentially dangerous vapor concentration. Prolonged or repeated skin contact may cause defatting of the skin.

Symptoms—Drowsiness followed by unconsciousness and by respiratory failure if exposure is prolonged.

Short Exposure Tolerance—Little or no injury from single exposure to 300 ppm for one hour, 90 ppm for 4 hours, or 2000 ppm for 6 minutes.

Exposure Procedures—Vapor—remove victim to fresh air. If breathing is difficult administer oxygen. If breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention. DO NOT give victim any preparation containing alcohol, because it could be fatal.*

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Becomes corrosive when in contact with water. Corrosive to most iron and copper base alloys, aluminum and rubber.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, and protective clothing. Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Odor threshold is not considered adequate warning of potentially dangerous vapor concentrations.



CARNAUBA WAX

Synonyms—Brazil wax; Myricyl cerotate

United Nations Number..... ±

Formula— $C_{22}H_{42}COOC_{20}H_{41}$

CHRIS Code..... WCA

Appearance—Odor—Hard, amorphous, light yellow to greenish brown lumps; slight odor
Specific Gravity—1.00

Boiling Point..... †°C °°F
Freezing Point..... 85°C 185°F

Chemical Family—Ester

Vapor Pressure 20°C (68°F) (mmHg)..... Low
Reid Vapor Pressure (psia)..... Low
Vapor Pressure 46°C (115°F) (psia)..... Low
Vapor Density (Air = 1.0)..... †
Solubility in Water..... Negligible

Pollution Category—USEPA..... IMO D
Applicable Bulk Reg. 46 CFR Subchapter..... D

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible
Electrical Group—NA

General—Combustible.

Flash Point (°F)..... 540 (cc)
Flammable Limits..... Unavailable
Autoignition Temp. (°F)..... Unavailable
Extinguishing Agents..... Dry chemical, foam, or carbon dioxide
Special Fire Procedures..... Wear breathing apparatus. Water or foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
0, 1, 0	Unavailable	Unavailable	Unavailable

General—Virtually non-toxic, but possibility of thermal burns from hot liquid.

Symptoms—Low toxicity

Short Exposure Tolerance—Low toxicity.

Exposure Procedures—Treat burns caused by hot liquid.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with hot liquid. Wear goggles or face shield, protective clothing for hot liquid. Scrub, shovel or place into package of paper or other flammable material and burn in incinerator.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Normally transported at elevated temperatures. See 46 CFR 36-Elevated Temperature Cargoes.
† Unavailable
‡ Unassigned



CASTER OIL

Synonyms—Neold; Oil of Palma Christi; Ricinus oil;
Tangantangan oil; Turkey-red oil (sulfated castor oil)

United Nations Number..... 1

CHRIS Code..... OCA

Formula—Not chemically distinguishable

Appearance—Odor—Pale-yellowish or almost colorless
transparent, viscous liquid; faint mild odor

Specific Gravity—0.94 to 0.97

Chemical Family—Esters

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Boiling Point..... 312°C 584°F
..... °C °F

Freezing Point..... -10°C -14°F
..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 2.04

Reid Vapor Pressure (psia)..... 0.10

Vapor Pressure 46°C (115°F) (psia)..... 0.15

Vapor Density (Air = 1.0)..... 10

Solubility in Water..... Unavailable

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Slight fire hazard when exposed to heat.

Flash Point (°F)..... 445 (cc)

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 840

Extinguishing Agents..... Dry chemical, foam, or carbon dioxide

Special Fire Procedures..... Water or foam may cause frothing. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Non-toxic

Symptoms—Non-toxic

Short Exposure Tolerance—Non-toxic

Exposure Procedures—Non-toxic. Wash thoroughly with soap and water.

REACTIVITY DATA

Stability—Stable at room temperature.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 34 of Compatibility Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, protective clothing and face shield.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



CAUSTIC POTASH SOLUTION

Synonyms—Lye; Potassium hydroxide; Potassium hydroxide solution

United Nations Number..... 1814

Formula—KOH

CHRIS Code..... CPS

Appearance—Colorless or light yellow syrupy liquid; odorless

Boiling Point..... 45% soln. 133°C 271°F
50% soln. 145°C 293°F
Freezing Point*... 45% soln. -29/-33°C -20/-27°F
50% soln. 9/-33°C 48/-27°F

Specific Gravity—up to 1.54 (solid dissolved in water)

Vapor Pressure 20°C (68°F) (mmHg)..... †

Chemical Family—Caustic

Reid Vapor Pressure (psia)..... †

Pollution Category—USEPA C IMO C

Vapor Pressure 46°C (115°F) (psia)..... †

Applicable Bulk Reg. 46 CFR Subchapter O

Vapor Density (Air = 1.0)..... 0.62

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as a corrosive liquid.

Electrical Group—NA

General—Does not burn. It will react with many metals, giving off highly flammable hydrogen gas. If hydrogen is trapped in confined spaces, it can form explosive mixtures with air. See data sheet for hydrogen.

Flash Point (°F)..... None

Flammable Limits..... None

Autoignition Temp. (°F)..... None

Extinguishing Agents..... None

Special Fire Procedures..... Cannot catch fire. Cool exposed tanks with water. Fire parties responding to a fire in the vicinity of caustic solutions should wear protective clothing including full face protection and rubber gloves, boots, and outer clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 4, 1

Odor Threshold (ppm)

No odor

PEL/TWA (ppm)

2 mg/m³**

TLV/TWA (ppm)

2 mg/m³**

General—Causes severe burns of eyes, skin and mucous membranes.

Symptoms—If solution splashes on skin no pain may be felt, but hair and skin in contact with the liquid will begin to dissolve on contact.

Short Exposure Tolerance—No specific data.

Exposure Procedures—DO NOT DELAY! Flush affected part gently with plenty of water for at least 15 minutes. Remove contaminated shoes or clothing. Get medical attention. Wash contaminated clothing, including shoes before reuse.

REACTIVITY DATA

Stability—Considerable heat is generated when water is added to caustic potash; boiling and spattering of hot caustic solution may result.

Compatibility—Material: Practically noncorrosive to iron and rubber at atmospheric temperatures. Attacks clothing and a few metals, such as aluminum, tin, lead, and zinc and alloys containing these metals.

Cargo: Group 5 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves and boots, large face shield and rubber protective clothing. Avoid contact with liquid. Secure ignition sources. Neutralize with weak acid and mop up or at dock flush with excess water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Crystallization temp./Solidifying temp.

** In the form of a fine spray or mist.

† Unavailable



CAUSTIC SODA SOLUTION

Synonyms—Lye; Soda lye; Sodium hydroxide; Sodium hydroxide solution

United Nations Number..... 1824

Formula—NaOH

CHRIS Code..... CSS

Appearance—Odor—Colorless or gray, syrupy liquid; no odor

Boiling Point..... 50% soln. 148°C 288°F

73% soln. 188°C 388°F

Specific Gravity—up to 1.53 (solid dissolved in water)

Freezing Point..... 50% soln. 5°C 41°F

73% soln. 62°C 144°F

Chemical Family—Caustic

Vapor Pressure 20°C (68°F) (mmHg)..... 1-7 at 47%

Reid Vapor Pressure (psia)..... †

Pollution Category—USEPA C IMO D

Vapor Pressure 46°C (115°F) (psia)..... †

Applicable Bulk Reg. 46 CFR Subchapter O

Vapor Density (Air = 1.0)..... NP

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as a corrosive liquid.

Electrical Group—NA

General—Non-flammable. It will react with many metals, giving off highly flammable hydrogen gas. If hydrogen is trapped in confined spaces, it can form explosive mixtures with air. See data sheet for hydrogen.

Flash Point (°F)..... None

Flammable Limits..... None

Autoignition Temp. (°F)..... None

Extinguishing Agents..... None

Special Fire Procedures..... Cannot catch fire. Cool exposed tanks with water. Fire parties responding to a fire in the vicinity of caustic solutions should wear protective clothing including full face protection and rubber gloves, boots, and outer clothing.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 4, 1

Odor Threshold (ppm)
No odor

PEL/TWA (ppm)
2 mg/m³

TLV/TWA (ppm)
2 mg/m³

General—Causes severe damage to the eyes. On contact with the skin, severe burns with deep ulcerations and ultimate scarring may result.

Symptoms—If the solution splashes onto skin no pain may be felt, but hair and skin in contact with caustic will begin to dissolve on contact.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—DO NO DELAY! Flush affected areas gently with plenty of water for at least 15 minutes. Remove contaminated shoes or clothing. Get medical attention. Wash contaminated clothing, including shoes before reuse.

REACTIVITY DATA

Stability—Considerable heat is generated when water is added to caustic soda; boiling and spattering of hot caustic solution may result.

Compatibility—Material: Noncorrosive to rubber at atmospheric temperatures. Slowly corrosive to iron, copper and monel metal. Attacks clothing and a few metals, such as aluminum, tin, lead and zinc, and alloys containing these metals.

Cargo: Group 5 of compatibility charts. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves and boots, large face shield, and rubber protective clothing. Avoid contact with the liquid. Secure ignition sources. Neutralize with weak acid and mop, or, at dock, flush with excess water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * In the form of a fine mist or spray
† Unavailable



NOTE: THIS CARGO IS PERMITTED TO BE SHIPPED IN BULK ON UNMANNED BARGES ONLY.
CHLORINE

Synonyms—No common synonyms.

United Nations Number..... 1017

Formula— Cl_2

CHRIS Code..... CLX

Appearance—Odor—Greenish-yellow gas; irritating,
bleach-like choking odor

Boiling Point..... -34°C -29°F

Specific Gravity—1.47 at $32/39^\circ\text{F}$

Freezing Point..... -101°C -150°F

Chemical Family—Halogen

Vapor Pressure 20°C (68°F) (mmHg)..... 4590

Reid Vapor Pressure (psia)..... 155

Vapor Pressure 46°C (115°F) (psia)..... 180

Pollution Category—USEPA..... IMO GAS

Vapor Density (Air = 1.0)..... 2.4

Applicable Bulk Reg. 46 CFR Subchapter..... O

Solubility in Water..... 1.0% at 60°F

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Compressed Gas (LCG)

Electrical Group—NA

General—Chlorine is non-explosive and non-flammable. However, most combustibles will burn in chlorine, although gas is not flammable. Toxic products are generated when combustibles burn in chlorine.

Flash Point ($^\circ\text{F}$)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. ($^\circ\text{F}$)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... Chlorine tanks exposed to fire should be cooled with a water spray to decrease the buildup of pressure. If leak seems likely, emergency personnel should carry self-contained breathing apparatus so that facepiece may be donned without delay.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
4, 2, 4	3.5	0.5	0.5

General—Gas is primarily a respiratory irritant; severe exposure can be fatal. Liquid or high concentrations of gas in contact with skin or eyes will cause local irritation or burns.

Symptoms—Vapor: coughing, choking, burning sensation in eyes and throat, and shortness of breath. Liquid: severe irritation or blistering. Frostbite can also result.

Short Exposure Tolerance—Exposure to vapor concentration of 1000 ppm for 10 minutes has caused death.

Exposure Procedures—Remove victim to fresh air. If breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, is often helpful. If eyes are effected, wash gently with water for 15 minutes. If liquid chlorine has spilled onto the skin, remove contaminated clothing and flood the exposed area gently with water for 15 minutes. Get medical attention promptly.

REACTIVITY DATA

Stability—Will react with many inorganic and organic compounds, usually with an evolution of heat.

Compatibility—Material: Below 230°F , copper, iron, lead, nickel, platinum, silver, steel and tantalum are chemically resistant to dry chlorine gas or liquid. Certain copper and ferrous alloys, including Hastalloy "C", monel and types 304 and 316 stainless steel also are resistant.

Cargo: Chlorine is unassigned in the compatibility chart. For assistance, call G-MTH-1 (202-267-1577).

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, and protective clothing. Evacuate all downwind personnel not equipped with respiratory protection.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



CHLOROACETIC ACID, 80%

Synonyms—Chloroacetic acid, liquid; MCA;
Monochloroacetic acid

United Nations Number..... 1750

Formula— $\text{CH}_2\text{Cl COOH}$

CHRIS Code..... CHM

Appearance—Odor—Colorless liquid; acidic odor

Boiling Point..... 189°C 372°F
°C °F

Specific Gravity—1.328

Freezing Point..... 15°C 58°F
°C °F

Chemical Family—Organic acid

Vapor Pressure 20°C (68°F) (mmHg)..... 0.04

Reid Vapor Pressure (psia)..... 0.99

Pollution Category—USEPA _____ IMO C

Vapor Pressure 46°C (115°F) (psia)..... †

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Vapor Density (Air = 1.0)..... 3.26

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable

Electrical Group—D

General—Non-flammable, but when heated gives off toxic gases. Decomposes to chlorine and phosgene when heated above its boiling point.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... Keep containers cool with water spray. Fire fighters must wear full protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

4, 4, 4

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Very toxic water solution, can cause permanent injury or death. Always wear protective clothing when handling.

Symptoms—Ingestion: acute systemic intoxication, vomiting, internal burns and perforations. Skin contact: severe, painful burns and irritation; shock. Inhalation: heated vapor painful to lungs, pneumonia, breathing problems.

Short Exposure Tolerance—Mists harmful but vapor not harmful unless liquid heated.

Exposure Procedures—Always call physician. Eyes: flush with water for at least 15 minutes. Skin: remove clothing, flush with large amounts of water. Ingestion: swallow several glasses of water, do not induce vomiting. Inhalation: remove to fresh air.

REACTIVITY DATA

Stability—Reacts with strong bases. Stable at ambient temperature; decomposes, to toxic gases when heated.

Compatibility—Corrodes: mild steel, aluminum, copper, zinc, tin, brass, bronze. Compatible: stainless steel, polyethylene (high density)

Cargo: Group 4 of compatibility chart

SPILL OR LEAK PROCEDURE

Neutralize with sodium carbonate, dilute with water. In case of material being involved, wear full-protective clothing and self-contained breathing apparatus. Spray water on containers to keep them cool. Fight fire with medium appropriate for fuel.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

1990



CHLOROBENZENE

Synonyms—Benzene chloride; Benzene, chloro-;
Chlorobenzol; MCB; Monochlorobenzene; Phenyl
chloride

United Nations Number..... 1134

Formula— C_6H_5Cl

CHRIS Code..... CRB

Appearance—Odor—Colorless liquid; almond-like odor

Boiling Point..... 132°C 270°F
°C °F

Specific Gravity—1.11

Freezing Point..... -45°C -48°F
°C °F

Chemical Family—Halogenated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 10.0

Reid Vapor Pressure (psia)..... 0.5

Pollution Category—USEPA B IMO B

Vapor Pressure 46°C (115°F) (psia)..... 0.8

Applicable Bulk Reg. 46 CFR Subchapter O

Vapor Density (Air = 1.0)..... 3.88

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Burning releases toxic and irritating gases of phosgene and hydrogen chloride. Ignited by heat or open flames. Flashback along vapor trail may occur. Vapor may explode in an enclosed area.

Flash Point (°F)..... 90 (cc)

Flammable Limits..... 1.3 to 7.1%

Autoignition Temp. (°F)..... 1180

Extinguishing Agents..... CO_2 , dry chemical, water fog, foam

Special Fire Procedures..... Supply respiratory protection to fire fighting personnel.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

0, 1, 2

Unavailable

75

75*

General—Vapor irritating to skin, eyes and mucous membranes.

Symptoms—Drowsiness, twitching of extremities, and deep, rapid respiration.

Short Exposure Tolerance—Exposure for 0.5 hours to 6500 ppm or 1.0 hour to 2000 ppm would not be expected to cause death.

Exposure Procedures—Remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected area with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Reacts vigorously with oxidizers. If heated to decomposition, toxic chlorine compounds will be given off.

Compatibility—Material: Relatively non-corrosive. Attacks rubber.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, and protective clothing. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8902.

Remarks: * Proposed change in TLV to 10 ppm.



CHLORODIFLUOROMETHANE

Synonyms—Difluorochloromethane;
Difluoromonochloromethane; Fluorocarbon 22;
Freon 22; Monochlorodifluoromethane; Propellant
22; Refrigerant 22

United Nations Number..... 1018

Formula—CHClF₂

CHRIS Code..... MCF

Appearance-Odor—Colorless gas with a faint ethereal
odor like carbon tetrachloride
Specific Gravity—1.18

Boiling Point..... -41°C -42°F
°C °F
Freezing Point..... -180°C -256°F
°C °F

Chemical Family—Halogenated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 6880
Raid Vapor Pressure (psia)..... 212.6
Vapor Pressure 46°C (115°F) (psia)..... 275
Vapor Density (Air = 1.0)..... 2.98
Solubility in Water..... Slight

Pollution Category—USEPA _____ IMO 098
Applicable Bulk Reg. 46 CFR Subchapter..... Q

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Compressed Gas (LCG)
Electrical Group—NA

General—Decomposition gases are toxic and irritating. Weakly flammable gas.

Flash Point (°F)..... Non-flammable
Flammable Limits..... Non-flammable
Autoignition Temp. (°F)..... 1170
Extinguishing Agents..... Water, carbon dioxide, dry powder
Special Fire Procedures..... Shut off supply of gas. Tanks exposed to fire should be kept cool with a continuous spray of water. Firefighters should wear self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
0, 0, 1	Unavailable	1000	1000

General—Suspected carcinogen. Liquid may cause skin or eye injury similar to frostbite. Breathing vapor may cause unconsciousness without warning because of lack of oxygen.

Symptoms—Inhalation—asphyxiation causing drowsiness with or without nausea. Skin contact—frostbite.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Eye contact—flush eye gently with clean sea or clean fresh water for at least 15 minutes. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Very stable. Decomposes slowly in presence of rust and moisture.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources. Evacuate all unprotected personnel. Flush spill with large quantities of water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



CHLOROFORM

Synonyms—Formal trichloride; Methane, trichloro;
Methenyl trichloride; Trichloromethane

United Nations Number..... 1888

Formula—CHCl₃

CHRIS Code..... CRF

Appearance—Odor—Colorless liquid; sweet odor

Boiling Point..... 61°C 142°F

Specific Gravity—1.48

Freezing Point..... -63°C -82°F

Chemical Family—Halogenated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 153

Reid Vapor Pressure (psia)..... 6.39

Pollution Category—USEPA A IMO B

Vapor Pressure 46°C (115°F) (psia)..... 9.09

Applicable Bulk Reg. 46 CFR Subchapter Q

Vapor Density (Air = 1.0)..... 4.25

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Will burn only after prolonged exposure to flame or high temperatures. When heated or exposed to a flame, chloroform decomposes to form phosgene, which is highly poisonous.

Flash Point (°F)..... None

Flammable Limits..... None

Autoignition Temp. (°F)..... 1155

Extinguishing Agents..... None

Special Fire Procedures..... Keep fire exposed tanks cool with water spray. Wear eye protection, self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

2, 1, 2

200 to 300

2

10

General—Suspected carcinogen. Breathing vapor in enclosed area can cause loss of consciousness. Odor threshold is higher than the TLV. Exposure to potentially dangerous vapor concentrations can occur before the product can be detected by smell.

Symptoms—Irritation of mucous membranes and skin; drowsiness.

Short Exposure Tolerance—Inhalation of 400 to 600 ppm for 30 minutes or less can prove fatal.

Exposure Procedures—Remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Decomposes in the presence of excess water or a high temperature to give phosgene and hydrogen chloride, which are very toxic; can become explosive in the presence of strong alkalis and water.

Compatibility—Material: Non-corrosive at normal atmospheric temperatures when free of moisture. In contact with water and at high temperatures it becomes corrosive. Corrodes iron and certain other metals.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, and protective clothing. Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

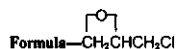
Remarks:



CHLOROHYDRINS (crude)

Synonyms—crude Epichlorohydrin

United Nations Number..... @ 2023



Appearance—Odor—Light yellow turbid liquid; pungent, garlic odor

Specific Gravity—1.20

Chemical Family—Epichlorohydrin

Pollution Category—USEPA _____ IMO 0

Applicable Bulk Reg. 46 CFR Subchapter _____ Q

CHRIS Code _____ CHD

Boiling Point 38–260°C 100–500°F
°C °F

Freezing Point <–18°C <0°F
°C °F

Vapor Pressure 20°C (68°F) (mmHg) 5.1

Reid Vapor Pressure (psia) 0.3

Vapor Pressure 46°C (115°F) (psia) 0.5

Vapor Density (Air = 1.0) †

Solubility in Water 6.0%

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Ignited by heat and open flame. Burning releases hydrochloric acid fumes. Containers may explode in fire because of polymerization.

Flash Point (°F) 90 to 100

Flammable Limits 3.8 to 21%

Autoignition Temp. (°F) 804

Extinguishing Agents Water, CO₂, alcohol foam and dry chemical

Special Fire Procedures Wear self-contained breathing apparatus and full protective clothing. Cool exposed tanks with water. Avoid use of dry chemical if fire occurs in container with confined vent.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
3, 3, 4	<10	2/Skin*	2/Skin*

General—*Vapor extremely irritating. Lung injury may be delayed. Liquid causes severe burns. Absorbed by leather and causes delayed burns. NOTE: Related cargo, epichlorohydrin, is a suspected carcinogen.

Symptoms—Eye, nose, and throat irritation; headaches, nausea, vomiting.

Short Exposure Tolerance—10 ppm for 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical attention as soon as possible.

REACTIVITY DATA

Stability—Unavailable

Compatibility—Material: Dissolves most paints, causes rubber to swell. The wet product will pit carbon steel.

Cargo: Group 17 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Evacuate personnel not equipped with protective clothing and respiratory protection. Shut off all ignition sources. Flush area with water spray.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * PEL and TLV based upon Epichlorohydrin.

† Unavailable



o-CHLORONITROBENZENE

Synonyms—1-Chloro-2-nitrobenzene;
2-Chloro-1-nitrobenzene; Chloronitrobenzenes;
o-Nitrochlorobenzene

United Nations Number..... 1578

Formula— $C_6H_4ClNO_2$

CHRIS Code..... CNO

Appearance—Yellow solid; aromatic odor

Boiling Point..... 245°C 473°F

Specific Gravity—1.4

Freezing Point..... 32°C 90°F

Chemical Family—Nitrocompounds

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... 5.4

Solubility in Water..... Insoluble

Pollution Category—USEPA _____ IMO B

Applicable Bulk Reg. 46 CFR Subchapter _____ Q

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—Unavailable

General—Slight hazard when exposed to heat or flame. Toxic vapors of nitric oxides (NO_x), hydrogen chloride (HCl), and carbon dioxide (CO_2) are given off by high temperatures or combustion.

Flash Point (°F)..... 261

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... greater than 300

Extinguishing Agents..... Water spray, CO_2 , dry chemical, foam

Special Fire Procedures..... Water or foam may cause frothing. Wear self-contained breathing apparatus, eye protection and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings
3, 2, 4

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
1 mg/m³

General—Very toxic via inhalation, ingestion. Possibility of thermal burns from hot liquid. The molten liquid is irritating to the skin. Class B poison.

Symptoms—Headache, weakness, anemia, shallow respiration, convulsions, coma, cyanosis.

Short Exposure Tolerance—2 mg/m³. The effects of this poison are cumulative.

Exposure Procedures—Remove from exposure. If indicated give artificial respiration. Flush eyes with large amounts of water for at least 15 minutes. Wash skin with soap and water. If swallowed, give emetic, gastric lavage.

REACTIVITY DATA

Stability—Stable. Toxic vapors of NO_x , HCl, CO_2 are given off by high temperatures of combustion. Reacts with caustics.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 42 of compatibility chart.

SPILL OR LEAK PROCEDURE

Soak up with a mixture of sand and soda ash (9:1). Scoop up and place in cartons and burn. Wear butyl rubber gloves, self-contained breathing apparatus, protective clothing and safety shoes.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Shipped in the molten state at 40°C.

† Unavailable



CHLOROSULFONIC ACID

Synonyms—Chlorosulfuric acid; Chlorosulfonic acid;
Chlorosulfonic acid; Sulfuric chlorohydrin

United Nations Number..... 1754

Formula— HOSO_2Cl , or $\text{SO}_3\cdot\text{HCl}$

CHRIS Code CSA

Appearance—Odor—Colorless to light liquid; pungent
odor

Boiling Point 152°C 305°F

Specific Gravity—1.79

Freezing Point -80°C -112°F

Chemical Family—Inorganic acid

Vapor Pressure 20°C (68°F) (mmHg) <1.0

Reid Vapor Pressure (psia) 0.03

Vapor Pressure 46°C (115°F) (psia) 0.08

Pollution Category—USEPA C IMO C

Vapor Density (Air = 1.0) 4.0

Applicable Bulk Reg. 46 CFR Subchapter O

Solubility in Water

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as corrosive liquid.

Electrical Group—B (based upon possible hydrogen gas (H_2) generation should a leak or spill occur)

General—Non-flammable, but it may cause ignition by contact with combustible materials. Dangerously reactive.

Explosive concentrations of hydrogen gas can accumulate inside metal tanks containing this acid. Spill in confined space may produce explosive concentration of hydrogen. See data sheet for hydrogen.

Flash Point (°F) Non-flammable.

Flammable Limits Non-flammable.

Autoignition Temp. (°F) Non-flammable.

Extinguishing Agents Non-flammable.

Special Fire Procedures DO NOT USE WATER. Wear full protective clothing, including self-contained breathing apparatus. Cool adjacent tanks with water spray from a distance.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
4, 4, 4	3	Unavailable	1

General—Vapor: inhalation may cause loss of consciousness with serious damage to lung tissue. Liquid causes severe irritation and watering of the eyes.

Symptoms—Contact of liquid with the skin can cause severe burns. Breathing the vapors will cause severe irritation and watering of the eyes.

Short Exposure Tolerance—30 ppm for 10 minutes; 10 ppm for 60 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, is often helpful. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Violently reacts with water forming sulfuric and hydrochloric acids.

Compatibility—Material: Dangerously reactive. In addition to attacking many metals, the acid is a strong oxidizing agent and will react with water and organic materials with evolution of heat and large quantities of dense fumes.

Cargo: Chlorosulfonic acid is unassigned in the compatibility chart. For compatibility assistance, call G-MTH-1 (202-267-1577).

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with spilled liquid. From a distance carefully flush the spill away with water. Great care must be taken as water and chlorosulfonic acid react violently forming toxic HCl fumes and sulfuric acid. Consequently, clean-up personnel should work with the wind at their backs. If water is not available or if inversion conditions prevail, apply dry sand, vermiculite ashes or powdered clay to absorb the spill.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Reacts violently forming hydrochloric and sulfuric acids.



COAL TAR

Synonyms—Coal tar distillate; Crude coal tar; High temperature coal tar; Tar; Tar, liquid

United Nations Number..... 1136

CHRIS Code COR

Formals—Mixture

Appearance-Odor—Dark viscous liquid; aromatic odor

Specific Gravity—1.2

Chemical Family—Aromatic hydrocarbon

Pollution Category—USEPA _____ IMO A

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 38-479°C 100-895°F

Freezing Point..... 0°C 0°F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.2-1.0

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... >1.0

Solubility in Water..... Below 0.2%

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when heated.

Flash Point (°F)..... 250 (varies according to composition)

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Water spray, foam, CO₂, dry chemical

Special Fire Procedures..... Wear full protective clothing and self-contained breathing apparatus. Remove containers from fire if possible; if not possible, cool containers with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

0.2 mg/m³

General—Prolonged exposure causes cancer in animals. Known carcinogen.

Symptoms—Inhalation: headache, nausea, vomiting; irritation to respiratory tract. Skin contact: highly irritating, dermatitis; sensitizes skin to light. Eyes: vapor exposure irritating. Ingestion: vapor toxic, vomiting, mild convulsions, hypothermia, dizziness

Short Exposure Tolerance—Keep exposures below the TLV/TWA of 0.2 mg/m³.

Exposure Procedures—Eye contact: flush with water for at least 15 minutes. Skin contact: remove contaminated clothing, wash affected areas with soap and water. Inhalation: remove to fresh air. Oxygen or artificial respiration as needed. Ingestion: induce vomiting, give oxygen if respiration shallow; swallow activated charcoal.

REACTIVITY DATA

Stability—Stable. Incompatible with strong oxidizing materials.

Compatibility—Material: Swells and softens rubber.

Cargo: Group 33 of compatibility chart

SPILL OR LEAK PROCEDURE

Wear protective clothing and self-contained breathing apparatus. Remove all ignition sources. Ventilate spill area if enclosed. Collect spilled liquid for proper disposition. Use absorbents for small spills; dike spill area for large spills. After spill removal, wash down spill site. Material is a serious pollution hazard.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

1990



COAL TAR NAPHTHA

Synonyms—Crude solvent coal tar naphtha; Hight solvent naphtha; Naphtha

United Nations Number..... 2553

CHRIS Code..... NCT

Formula—Mixture

Appearance—Odor—Colorless to pale yellow liquid with a benzene-like odor

Specific Gravity—0.86 to 0.88

Chemical Family—Petroleum oils

Pollution Category—USEPA _____ IMO B

Applicable Bulk Reg. 46 CFR Subchapter _____ Q

Boiling Point..... 83-260°C 200-500°F

Freezing Point..... 0°C 32°F

Vapor Pressure 20°C (68°F) (mmHg)..... 3

Reid Vapor Pressure (psia)..... 0.12

Vapor Pressure 46°C (115°F) (psia)..... 0.20

Vapor Density (Air = 1.0)..... †

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Flammable, moderate fire risk.

Flash Point (°F)..... 100 to 107

Flammable Limits..... 0.8 to 6.0%

Autoignition Temp. (°F)..... above 530

Extinguishing Agents..... Confined area—CO₂, dry chemical. Open area—foam.

Special Fire Procedures..... Fire parties must wear respiratory protection and rubber boots. In other respects, fight like gasoline fire. Cool exposed tanks with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

5

100

100

General—Suspected carcinogen. Main hazard is vapor inhalation.

Symptoms—Dizziness, headache, drowsiness, vomiting, irritated skin, watery eyes.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing is difficult, administer oxygen. If breathing stops, apply artificial respiration. Skin or eye contact—flush affected areas for 15 minutes with water. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Compatible with steel; certain rubbers and plastics are incompatible.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, plastic coated protective clothing. Wear self-contained breathing apparatus. Approach from up-wind side. Avoid contact with liquid. Secure ignition sources. Small spills may be flushed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



COTTONSEED OIL

Synonyms—No common synonyms.

United Nations Number.....†

Formula—Mixture of C-14 to C-16 fatty acids.

Appearance—Odor—Pale yellow or yellowish-brown to dark ruby red; odorless liquid when pure
Specific Gravity—0.92

Chemical Family—Ester

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code OCS

Boiling Point V. High °C _____ °F

Freezing Point °C _____ °F

Freezing Point ~0 °C ~32 °F

Vapor Pressure 20 °C (68 °F) (mmHg) 2.0

Reid Vapor Pressure (psia) 0.1

Vapor Pressure 46 °C (115 °F) (psia) 0.15

Vapor Density (Air = 1.0) †

Solubility in Water Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame.

Flash Point (°F) 486 (cc)

Flammable Limits Unavailable

Autoignition Temp. (°F) 650

Extinguishing Agents Dry chemical, foam, or carbon dioxide.

Special Fire Procedures Water may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 1, 0

Odor Threshold (ppm)
None

PEL/TWA (ppm)
None

TLV/TWA (ppm)
None

General—Non-toxic

Symptoms—Non-toxic

Short Exposure Tolerance—Non-toxic

Exposure Procedures—Non-toxic. If accidentally splashed into eyes, wash eyes thoroughly with copious amounts of water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves and face shield. Clean up excess amounts and wash residue away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable
‡ Unassigned



CREOSOTE, COAL TAR

Synonyms—Coal tar creosote; Creosote from coal tar;
Creosote oil; Dead oil; Heavy oil; Liquid pitch oil;
Tar oil; Wash oil

United Nations Number..... †

Formula—Unavailable

CHRIS Code..... CCT

Appearance—Odor—Yellowish to dark green-brown;
characteristic tarry, aromatic odor
Specific Gravity—1.07

Boiling Point..... ~200–250°C ~382–482°F

Freezing Point..... †°C °F
..... °C °F

Chemical Family—Hydrocarbon (aromatic) phenol

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... NP

Pollution Category—USEPA X IMO A

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 180

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 637

Extinguishing Agents..... Confined area—CO₂, dry powder. Open area—foam, water spray.

Special Fire Procedures..... Provide fire fighters with breathing apparatus. Water or foam may cause
frothing. Do not direct water directly into a fire.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 3, 2

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Severe neurological disturbances when fumes are inhaled at high concentrations. Moderately toxic,
skin and eye irritant.

Symptoms—Difficulty in thinking, sight impairment, difficulty walking in straight line, stammering or stuttering.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—Inhalation: Immediately remove victim from contaminated atmosphere. If breathing is
interrupted, artificial respiration should be applied immediately. A physician should be called.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Not corrosive to iron or steel.

Cargo: Group 21 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure all
ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

‡ Unassigned



CRESOLS (a mixture of ortho, meta and para cresol)

Synonyms—Cresol (2-, 3-, 4-); Cresylic acid; Cresylol;
Hydroxymethyl benzene; Hydroxytoluene;
Methylphenol (2-, 3-, or 4-); Oxytoluenes; Tar acids;
Toluol (o-, m-, p-); Tricresol

United Nations Number..... 2076

CHRIS Code..... CRS

Formula— $\text{CH}_3\text{C}_6\text{H}_4\text{OH}$

Appearance—Odor—Colorless-to-brown liquid; smells like
"Lysol" disinfectant, sweet, tarry
Specific Gravity—1.03 to 1.05

Boiling Point..... 146-182°C 295-370°F
°C °F

Freezing Point..... 12 to 35°C 54 to 95°F
°C °F

Chemical Family—Phenol

Vapor Pressure 20°C (68°F) (mmHg)..... 0.52

Reid Vapor Pressure (psia)..... 0.63

Vapor Pressure 44°C (111°F) (psia)..... 0.68

Vapor Density (Air = 1.0)..... 3.72

Solubility in Water..... 2.5%

Pollution Category—USEPA C IMO A

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible
Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame. When heated, toxic vapors are given off.

Flash Point (°F)..... 178 to 187 (varies with composition and purity)

Flammable Limits..... LEL=1.1% UEL=unavailable

Autoignition Temp. (°F)..... 1038 to 1195

Extinguishing Agents..... CO_2 , dry chemical, foam, water fog

Special Fire Procedures..... Full body and respiratory protection should be provided. Use water to keep fire exposed tanks cool. Use water spray to disperse vapors.

HEALTH HAZARD DATA

Health Hazard Ratings
2, 3, 2

Odor Threshold (ppm)
1 to 5

PEL/TWA (ppm)
5/Skin

TLV/TWA (ppm)
5/Skin

General—Suspected carcinogens. Causes severe burns. Poisonous by skin absorption. Odor threshold is about the same as the TLV. Exposure to potentially dangerous vapor concentration can occur before the product can be detected by smell.

Symptoms—Burning sensation in throat, nose and eyes. Burning sensation at the site of contact; skin may turn white.

Short Exposure Tolerance—Extensive skin contact may be fatal in a very short time.

Exposure Procedures—Vapor: Remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact: remove contaminated clothing and gently flush affected area with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Not dangerously reactive.

Compatibility—Material: Not considered corrosive to most of the usual materials of construction.

Cargo: Group 21 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, and protective clothing. Avoid contact with the liquid. Do not flush into navigable water or where it may be contacted by human beings or animals.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



CROTONALDEHYDE

Synonyms—2-Butenal; trans-2-Butenal;
Crotonaldehyde; Crotonaldehyde,
stabilized; Crotonic aldehyde; beta-
Methylacrolein; Propylene aldehyde

United Nations Number..... 1149

CHRIS Code CTA

Formula— $\text{CH}_3\text{CH}=\text{CHCHO}$

Boiling Point..... 102°C 218°F

Appearance—Odor—Water white to yellow liquid;
suffocating tarry odor

Freezing Point..... -74°C -102°F

Specific Gravity—0.85

Chemical Family—Aldehyde

Vapor Pressure 20°C (68°F) (mmHg)..... 30

Reid Vapor Pressure (psia)..... 1.5

Pollution Category—USEPA B IMO B

Vapor Pressure 46°C (115°F) (psia)..... 2.0

Applicable Bulk Reg. 46 CFR Subchapter O

Vapor Density (Air = 1.0)..... 2.41

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—At elevated temperatures, polymerization occurs. If the polymerization takes place in a closed container, violent rupture is possible.

Flash Point (°F)..... 55

Flammable Limits..... 2.1% to 15.5%

Autoignition Temp. (°F)..... 450

Extinguishing Agents..... Alcohol foam, carbon dioxide or dry chemical.

Special Fire Procedures..... Cool hot container surfaces with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

3, 3, 3

0.13

2

2

General—Suspected carcinogen. Vapor extremely irritating. Liquid causes severe burns. A lachrymator.

Symptoms—Vapor causes eye irritation and burning skin irritation at high concentrations, and inhalation results in coughing, watering of eyes and burning of nose and throat. Liquid causes severe irritation to eyes and skin.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—In case of skin contact, wash thoroughly with soap and water for at least 15 minutes. In case of eye contact flush with water then obtain medical aid.

REACTIVITY DATA

Stability—May polymerize when mixed with acids or bases.

Compatibility—Material: Compatible with aluminum and stainless steel.

Cargo: Group 19 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Secure ignition sources. Cover with sodium bisulfite (NaHSO_3). Add small amount of water and mix. Scoop up. Wash site with soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

CRUDE OIL

Synonyms—Coal oil; Mineral oil; Petroleum; Petroleum crude oil; Rock oil; Seneca oil

United Nations Number..... 1267

Formula— $C_{12}H_{26-28}$, or CH_2H_{2n-2}

CHRIS Code..... OIL

Appearance—Thick, heavy liquid, yellow to dark reddish-brown or black color; distinct tarry odor.
Specific Gravity—0.85 to 0.85

Boiling Point..... 32-400°C 90-750°F
Freezing Point..... -45°C -50°F

Chemical Family—Hydrocarbon mixture

Vapor Pressure 20°C (68°F) (mmHg)..... 1 to 3
Reid Vapor Pressure (psia)..... ~0.10
Vapor Pressure 46°C (115°F) (psia)..... 0.15
Vapor Density (Air = 1.0)..... above 1
Solubility in Water..... Negligible

Pollution Category—USEPA _____ IMO 1
Applicable Bulk Reg. 46 CFR Subchapter..... D

FIRE & EXPLOSION HAZARD DATA

Grade—C or D depending on flash point
Electrical Group—D

General—When heated to decomposition, it emits toxic fumes. Moderate to severe.

Flash Point (°F)..... -50 to +90
Flammable Limits..... Unavailable
Autoignition Temp. (°F)..... Unavailable
Extinguishing Agents..... CO₂, dry chemical, foam, water fog.
Special Fire Procedures..... Tanks exposed to fire should be kept cool with a water spray. Fire fighters should wear respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
0, 1, 1	Unavailable	Unavailable	Unavailable

General—Liquid causes skin irritation.

Symptoms—Skin contact; skin irritation and burns.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Wipe spilled liquid from skin, remove contaminated clothing, and wash affected areas with soap and water. For eye contact, flush with water for 15 minutes while obtaining medical attention.

REACTIVITY DATA

Stability—Chemically stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



CUMENE

Synonyms—Benzene, 1-methylethyl-; Cumol; Isopropyl benzene; (1-Methylethyl)benzene; 2-Phenyl propane

United Nations Number..... 1918

Formula— $C_6H_5CH(CH_3)_2$

CHRIS Code..... CUM

Appearance—Odor—Colorless liquid; sharp, penetrating aromatic odor

Boiling Point..... 152°C 308°F
°C °F

Specific Gravity—0.86

Freezing Point..... -96°C -141°F
°C °F

Chemical Family—Aromatic hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 8

Reid Vapor Pressure (psia)..... 0.5

Pollution Category—USEPA D IMO B

Vapor Pressure 46°C (115°F) (psia)..... 0.6

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

Vapor Density (Air = 1.0)..... 4.2

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Vapor forms explosive mixtures with air.

Flash Point (°F)..... 102 (cc)

Flammable Limits..... 0.9 to 6.5%

Autoignition Temp. (°F)..... 795

Extinguishing Agents..... CO₂, dry chemical, foam, water fog

Special Fire Procedures..... Use water to keep fire-exposed containers cool.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 1

1.2

50/Skin

50/Skin

General—Vapor and liquid irritation.

Symptoms—Irritation of nose and throat; drowsiness.

Short Exposure Tolerance—Occasional short exposure to concentration of 400 ppm probably would not be harmful.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable. It can react with oxidizing materials.

Compatibility—Material: Attacks rubber.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources. Small spills may be washed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

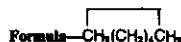
Remarks:



CYCLOHEXANE

Synonyms—Benzene, hexahydride; Benzene, hexahydro-; [Hexahydrobenzene; Hexamethylene; Hexanaphthene

United Nations Number..... 1145



CHRIS Code..... CHX

Appearance-Odor—Colorless mobile liquid; sweetish odor when highly pure, pungent odor otherwise.
Specific Gravity—0.78

Boiling Point..... 81°C 177°F
..... °C °F
Freezing Point..... 7°C 44°F
..... °C °F

Chemical Family—Saturated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... **
Reid Vapor Pressure (psia)..... 3.3
Vapor Pressure 46°C (115°F) (psia)..... 4.5
Vapor Density (Air = 1.0)..... 2.9
Solubility in Water..... Insoluble

Pollution Category—USEPA C IMO C*
Applicable Bulk Reg. 46 CFR Subchapter..... D.O

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid
Electrical Group—D

General—When exposed to heat or flame it can react with oxidizing materials. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... -4
Flammable Limits..... 1.3 to 8.4%
Autoignition Temp. (°F)..... 500
Extinguishing Agents..... Foam, carbon dioxide or dry chemical
Special Fire Procedures..... In unconfined fires, solid hose streams tend to scatter the liquid and spread the fire. Use water spray or high pressure fog to cool a burning surface and exclude air to control or extinguish fire.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
1, 1, 2	300	300	300

General—Undesirable effects may occur from the inhalation of excessive concentrations of cyclohexane vapor, prolonged or repeated skin contact with liquid, and from liquid contamination of eyes.

Symptoms—Dizziness, nausea, vomiting, unconsciousness.

Short Exposure Tolerance—No chronic effects have been observed to occur in workers exposed to vapor concentrations in the range of 800–700 ppm.

Exposure Procedures—If cyclohexane is splashed into the eyes it should be flushed out immediately with copious amount of water. For over-exposure by inhalation to high vapor concentrations, remove patient to fresh air, administer oxygen therapy or artificial respiration if necessary.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Pollution Category C oil-like, 33 CFR 151.49.
** Vapor Pressure: 97.6 mmHg at 25°C.



CYCLOHEXANOL

Synonyms—Cyclohexyl alcohol; Hexahydrophenol;
Hydroxycyclohexane

United Nations Number..... 1

Formula— $\text{CH}_2(\text{CH}_2)_4\text{CHOH}$

CHRIS Code..... CHN

Appearance—Odor—Colorless to pale yellow oily liquid;
camphor-like odor
Specific Gravity—0.94

Boiling Point..... 181°C 322°F
.....°C.....°F
Freezing Point..... 24°C 27°F
.....°C.....°F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... 1.0
Reid Vapor Pressure (psia)..... 0.1
Vapor Pressure 46°C (115°F) (psia)..... 0.2
Vapor Density (Air = 1.0)..... 3.5
Solubility in Water..... Slight

Pollution Category—USEPA..... IMO C
Applicable Bulk Reg. 46 CFR Subchapter..... D, O

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid
Electrical Group—D

General—Moderate fire hazard. When exposed to heat or flame it can react with oxidizing materials.

Flash Point (°F)..... 154 (cc)
Flammable Limits..... Unavailable
Autoignition Temp. (°F)..... 572
Extinguishing Agents..... Alcohol foam, carbon dioxide, dry chemical.
Special Fire Procedures..... Cool exposed tanks with water. Wear self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
1, 2, 1	Unavailable	50/Skin	50/Skin

General—Vapor and liquid irritation. Systemic effects produced.

Symptoms—Vapor—irritation of mucous membranes, headache. Liquid—ulceration, thickening of skin.

Short Exposure Tolerance—3 to 5 minutes exposure to 100 ppm was objectionable, producing nose, eye, and throat irritation.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes; 20 to 30 minutes for eye contact. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



CYCLOHEXANONE

Synonyms—Cyclohexyl ketone; Ketoexamethylene;
Pimelic ketone

United Nations Number..... 1915

Formula— $\text{CH}_2(\text{CH}_2)_4\text{CO}$

CHRIS Code..... CCH

Appearance—Odor—Water-white to pale yellow liquid;
odor reminiscent of peppermint and acetone.
Specific Gravity—0.95

Boiling Point..... 156°C 313°F

Freezing Point..... -31°C -24°F

Vapor Pressure 20°C (68°F) (mmHg)..... 2

Reid Vapor Pressure (psia)..... 0.8

Vapor Pressure 46°C (115°F) (psia)..... 0.20

Vapor Density (Air = 1.0)..... 3.4

Solubility in Water..... Slight

Chemical Family—Ketone

Pollution Category—USEPA D IMO D

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid.

Electrical Group—D

General—Moderate fire hazard, when exposed to heat or flame.

Flash Point (°F)..... 129

Flammable Limits..... 1.1 to 8.1%

Autoignition Temp. (°F)..... 788

Extinguishing Agents..... Alcohol foam, dry chemical, CO_2

Special Fire Procedures..... Wear full protective clothing, self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 1

Odor Threshold (ppm)

0.12

PEL/TWA (ppm)

25/Skin

TLV/TWA (ppm)

25/Skin

General—Vapor inhalation irritating to mucous membranes.

Symptoms—Eye, nose, and throat irritation; narcosis, salivation; depression of body temperature, respiratory rates, heart rates.

Short Exposure Tolerance—50 ppm for 3 to 5 minutes was uncomfortably irritating, particularly to the throat.

Definite eye, nose and throat irritation was reported at 75 ppm.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable. Will attack most paints.

Cargo: Group 18 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear rubber gloves, face shield, and protective clothing. Secure ignition sources. Have all-purpose canister mask available. Keep unprotected personnel upwind of contaminated area. Flush spill with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



CYCLOHEXYLAMINE

Synonyms—Aminocyclohexane; Cyclohexanamine;
Hexahydroaniline

United Nations Number..... 2357

Formula— $(CH_2)_6CHNH_2$

CHRIS Code..... CHA

Appearance—Odor—Colorless liquid; strong
ammonia-like odor
Specific Gravity—0.865

Boiling Point..... 135°C 274°F
Freezing Point..... 18°C 84°F

Chemical Family—Aliphatic amine

Vapor Pressure 20°C (68°F) (mmHg)..... 0.177
Reid Vapor Pressure (psia)..... †
Vapor Pressure 46°C (115°F) (psia)..... 0.619
Vapor Density (Air = 1.0)..... 3.42
Solubility in Water..... Soluble

Pollution Category—USEPA..... IMO C
Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid
Electrical Group—D

General—Dangerous when exposed to heat or fire; gives off toxic fumes. Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed space.

Flash Point (°F)..... 90
Flammable Limits..... Unavailable
Autoignition Temp. (°F)..... 560
Extinguishing Agents..... Foam, CO₂, dry chemical
Special Fire Procedures..... Wear goggles and self-contained breathing apparatus. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
3, 4, 2	Unavailable	10	10

General—Strongly caustic.

Symptoms—Inhalation of vapors, and skin and eyes contact with liquid will cause severe burns.

Short Exposure Tolerance—Unavailable. Acute exposure causes nausea, anxiety, apprehension, slurred speech, pupillary dilation.

Exposure Procedures—Ingestion—do not induce vomiting. Eyes—flush with water for at least 15 minutes, get medical attention immediately. Skin—remove contaminated clothing and flush skin with large amounts of water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Corrosive to copper and its alloys.

Charge: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Keep people away. Wear full protective clothing, self-contained breathing apparatus and rubber overclothing. Try to contain. For large spills disperse and flush. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



p-CYMENE

Synonyms—Cymol; Dolicymene; 4-Isopropyl-1-methyl benzene; Isopropyltoluene; 4-Isopropyl toluene; p-Isopropyltoluene; Methylisopropylbenzene; 1-Methyl-4-isopropylbenzene; Methyl propyl benzene

Formula— $\text{CH}_3\text{C}_6\text{H}_4\text{CH}(\text{CH}_3)_2$

Appearance—Odor—Colorless liquid; benzene-like odor

Specific Gravity—0.86

Chemical Family—Aromatic hydrocarbon

Pollution Category—USEPA _____ IMO C*

Applicable Bulk Reg. 46 CFR Subchapter _____ D, Q

United Nations Number..... 2046

CHRIS Code..... CMP

Boiling Point..... 177°C 351°F

..... °C °F

Freezing Point..... -68°C -90°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... 0.46

Vapor Density (Air = 1.0)..... 4.82

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Slight explosion hazard when in the form of vapor.

Flash Point (°F)..... 117

Flammable Limits..... 0.7 to 5.6%

Autoignition Temp. (°F)..... 817

Extinguishing Agents..... CO_2 , dry chemical, water fog, foam

Special Fire Procedures..... Fight in the same manner as any Grade D petroleum product fire. Water may be ineffective. The vapors of cymene are more toxic than those of petroleum products.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 1, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—High vapor concentrations are intoxicating.

Symptoms—Dizziness, headache, and nausea. The victim may act as if drunk.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Cymene will cause rubber to swell and soften.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Pollution Category C oil-like, 33 CFR 151.49.



iso-DECALDEHYDE

Synonyms—Isodecaldehyde, mixed isomers;
Trimethylheptanols

United Nations Number..... 1

CHRIS Code..... IDA

Formula— $C_{10}H_{18}CHO$, mixture of isomers

Appearance—Odor—Colorless liquid with a pleasant fruity
odor

Specific Gravity—0.83

Chemical Family—Aldehyde

Pollution Category—USEPA _____ IMO @ C

Applicable Bulk Reg. 46 CFR Subchapter _____ D, Q

Boiling Point..... 197°C 387°F

Freezing Point..... -80°C -112°F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.22

Reid Vapor Pressure (psia)..... 0.03

Vapor Pressure 46°C (115°F) (psia)..... 0.06

Vapor Density (Air = 1.0)..... 5.38

Solubility in Water..... insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—This material is more of a health hazard than a fire hazard.

Flash Point (°F)..... 185

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 375

Extinguishing Agents..... Carbon dioxide, foam and dry chemical

Special Fire Procedures..... Cool container surfaces with water.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Vapor irritating to mucous membranes.

Symptoms—Coughing and sneezing, burning and tearing of eyes, salivation. Signs of irritation of the mucous membranes.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Strong concentration on the skin will produce burns. Obtain medical treatment. Weaker solutions may cause discoloration, roughening and hardening. Spills on skin should be washed immediately with soap and water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Compatible with aluminum, steel, stainless steel; not compatible with galvanized iron.

Cargo: Group 19 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Cover spill with sodium bisulfite ($NaHSO_3$). Add small amount of water and mix. Scoop up. Wash site with soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



ISO-DECYL ACRYLATE

Synonyms—Acrylic acid, isodecyl ester; isodecyl acrylate; isodecyl propenoate

United Nations Number..... 1

Formula— $\text{CH}_2=\text{CHCOOC}_{10}\text{H}_{21}$

Appearance—Odor—Water white liquid; pungent odor

Specific Gravity—0.89

Chemical Family—Acrylate

Pollution Category—USEPA _____ IMO A

Applicable Bulk Reg. 46 CFR Subchapter _____ O

CHRIS Code..... IAI

Bolling Point..... 121°C 250°F

Freezing Point..... -100°C -148°F

Vapor Pressure 20°C (68°F) (mmHg)..... <0.01

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 7.3

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—May polymerize to gummy solid. Reaction is not violent.

Flash Point (°F)..... 240

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Foam, dry chemical, CO_2

Special Fire Procedures..... Water might be ineffective. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Liquid causes swelling and redness after about 10 minutes.

Symptoms—Skin contact: Swelling and redness.

Short Exposure Tolerance—8 hour exposure of rats to concentrated vapors approaching saturation in air was not fatal. Inhalation causes mild irritation of nose and throat; vapor mildly irritates eyes.

Exposure Procedures—Vapor—remove victim to fresh air. Give artificial respiration if breathing stops. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable if inhibited.

Compatibility—Material: Will swell and soften certain rubbers and soften and remove certain paints.

Cargo: Group 14 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible wear rubber gloves, face shield, and protective clothing. Have all-purpose canister mask available. Secure ignition sources. Flush away with water. Do not flush into confined space (such as a sewer) because of the danger of explosion.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



n-DECYL ALCOHOL

Synonyms—Alcohol C-10; Capric alcohol; 1-Decanol;
Nonylcarbinol

United Nations Number..... 1

Formula— $\text{CH}_3(\text{CH}_2)_8\text{CH}_2\text{OH}$

CHRIS Code..... DAN
"all isomers"..... DAX

Appearance—Odor—Colorless, water white liquid; sour
odor

Boiling Point..... 233°C 451°F
..... °C °F

Specific Gravity—0.83

Freezing Point..... 7°C 45°F
..... °C °F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reid Vapor Pressure (psia)..... V. Low

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... 5.3

Solubility in Water..... Insoluble

Pollution Category—USEPA..... IMO B

Applicable Bulk Reg. 46 CFR Subchapter..... D.O.

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid.

Electrical Group—D

General—Moderate hazard, when exposed to heat or flame; can react with oxidizing materials.

Flash Point (°F)..... 180

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 550

Extinguishing Agents..... Alcohol foam, carbon dioxide, dry chemical, water spray

Special Fire Procedures..... Not pertinent

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

0, 0, 0

Unavailable

Unavailable

Unavailable

General—Practically non-toxic. Handle as a detergent. Main hazard is liquid contact with eyes.

Symptoms—Skin and eye contact—considerable pain and irritation to eyes; skin irritation.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Eye contact—flush gently with clean water for at least 15 minutes. Skin contact—remove contaminated clothing and wash affected areas with plenty of water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Mild steel is suitable for tanks, pipes, valves.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



DIACETONE ALCOHOL

Synonyms—Diacetone; 4-Hydroxy-4-methyl-2-pentone;
4-Hydroxy-4-methyl pentanone-2;
2-Methyl-2-pentanol-4-one

United Nations Number..... 1148

Formula— $\text{CH}_3\text{COCH}_2\text{C}(\text{CH}_3)_2\text{OH}$

CHRIS Code..... DAA

Appearance—Odor—Colorless to light yellow liquid; faint,
pleasant odor

Boiling Point..... 164°C 328°F

Specific Gravity—0.94

Freezing Point..... -50°C -58°F

Chemical Family—Ketone/Alcohol (exhibits properties
of both)

Vapor Pressure 20°C (68°F) (mmHg)..... 1.0

Pollution Category—USEPA _____ IMO D

Reld Vapor Pressure (psia)..... 0.07

Applicable Bulk Reg. 46 CFR Subchapter..... D

Vapor Pressure 46°C (115°F) (psia)..... 0.1

Vapor Density (Air = 1.0)..... 4.0

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid
Electrical Group—D

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F)..... 126 (cc)

Flammable Limits..... 1.8 to 6.9%

Autoignition Temp. (°F)..... 1118

Extinguishing Agents..... CO₂, dry chemical, water fog, alcohol foam

Special Fire Procedures..... Fire parties should be provided with respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings 1, 2, 0	Odor Threshold (ppm) 25	PEL/TWA (ppm) 50	TLV/TWA (ppm) 50

General—Irritating to eyes and mucous membranes. Narcotic in high concentration. Experimentally has caused anemia and damage to kidneys and liver.

Symptoms—Burning of eyes and nasal passages; dizziness, drowsiness.

Short Exposure Tolerance—150 ppm for 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Relatively stable. Can react with oxidizing materials.

Compatibility—Material: Dissolves or softens many plastics.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



DIBUTYLAMINE

Synonyms—1-Butanamine, N-butyl-;
N-Butyl-1-butanamine; di-n-butylamine;
n-Dibutylamine; di-(n-butyl)amine

United Nations Number..... 2248

CHRIS Code..... DBA

Formula— $(C_4H_9)_2NH$

Boiling Point..... 159°C 318°F

Appearance—Odor—Colorless liquid; ammoniacal odor.

Freezing Point..... -51°C -80°F

Specific Gravity—0.77

Vapor Pressure 20°C (68°F) (mmHg)..... 2

Chemical Family—Alkyl amines

Reid Vapor Pressure (psia)..... 0.0

Pollution Category—USEPA..... IMO C

Vapor Pressure 46°C (115°F) (psia)..... 0.18

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Vapor Density (Air = 1.0)..... 4.46

Solubility in Water..... Appreciable

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—Toxic oxides of nitrogen may form in fires. Flammable, moderate fire risk.

Flash Point (°F)..... 125

Flammable Limits..... LEL = 1.1% UEL—unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Confined space—CO₂, dry chemical

Special Fire Procedures..... Use water to cool fire exposed containers. Water may be ineffective on fire.

Wear goggles and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

4, 3, 3

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Irritation of eyes and respiratory tracts, severe to eyes and moderate to skin after contact of short period of exposure.

Symptoms—Watery, redness, or burning of eyes, irritation of skin, irritation of mucous membranes.

Short Exposure Tolerance—Unavailable

Exposure Procedures—In case of contact with eyes and skin, immediately flush with plenty of water for at least 15 minutes. For eyes get medical attention. Remove contaminated clothing and shoes at once. Call a doctor.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Carbon steel, cast iron, aluminum, stainless steel, phenolic-lined steel, nickel or tinned iron are suitable materials of construction. Do not use copper or copper alloys.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, face-shield, all-purpose canister respirator, protective clothing. Secure ignition sources. Cover with sodium bisulfate and clean up. Flush spill with large quantities of water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



DI-sec-BUTYLAMINE

Synonyms—No common synonyms.

United Nations Number..... 1

Formula— $(CH_3CHCH_2CH_2)_2NH$

Appearance—Odor—Water white liquid; amine odor

Specific Gravity—0.75

Chemical Family—Alkyl amines

Pollution Category—USEPA _____ IMO #

Applicable Bulk Reg. 46 CFR Subchapter _____ O

CHRIS Code..... 1

Boiling Point..... 132-135°C 270-275°F
°C °F

Freezing Point..... -104°C -155°F
°C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 12

Reid Vapor Pressure (psia)..... 7

Vapor Pressure 46°C (115°F) (psia)..... 0.7

Vapor Density (Air = 1.0)..... 4.5

Solubility in Water..... Unavailable

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid.

Electrical Group—C

General—Dangerous fire risk.

Flash Point (°F)..... 75

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Confined space: CO₂, dry chemical.

Special Fire Procedures..... Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings
3, 3, 0

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Irritation of eyes and respiratory tracts, severe to eyes moderate to skin after contact of short period of time.

Symptoms—Irritation of eyes, skin, and mucous membranes.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Flush eyes and skin with water for 15 minutes. Remove contaminated clothing and flush underlying area with water. Call a doctor as soon as possible.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Carbon steel, aluminum, stainless steel, nickel, tinned iron, and phenolic-lined steel are suitable materials of construction. Do not use copper or copper alloys, zinc, or galvanized steel.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, face-shield or all-purpose canister respirator, protective clothing. Secure ignition sources. Cover with sodium bisulfate and clean up. Flush spill with large quantities of water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: # No Determination
† Unavailable
‡ Unassigned



o-DICHLOROBENZENE

Synonyms—Benzene^s, 1,2-dichloro-;
1,2-Dichlorobenzene; o-Dichlorobenzol;
Dowtherm E; Orthodichlorobenzene

United Nations Number..... 1591

CHRIS Code..... DBO

Formula— $C_6H_4Cl_2$

Appearance—Odor—Colorless liquid; pleasant aromatic
odor

Specific Gravity—1.30

Chemical Family—Halogenated compound

Pollution Category—USEPA B IMO B

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 181°C 357°F

Freezing Point..... -18°C -1°F

Vapor Pressure 20°C (68°F) (mmHg)..... 1

Reid Vapor Pressure (psia)..... 0.08

Vapor Pressure 46°C (115°F) (psia)..... 0.1

Vapor Density (Air = 1.0)..... 5.07

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Dangerous. When heated to decomposition, emits highly toxic chloride fumes.

Flash Point (°F)..... 151

Flammable Limits..... 2 to 9%

Autoignition Temp. (°F)..... 1198

Extinguishing Agents..... Water spray, dry chemical, CO_2 , foam.

Special Fire Procedures..... Wear full protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 1, 1

Odor Threshold (ppm)

4

PEL/TWA (ppm)

50

TLV/TWA (ppm)

50/Skin

General—Vapor inhalation causes moderate local irritation of nose and airway.

Symptoms—Drowsiness, unsteadiness, eye irritation, difficulty in breathing.

Short Exposure Tolerance—Painful to some at 60-100 ppm for more than a few minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Most rubbers are not compatible.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear butyl rubber gloves, self-contained breathing apparatus, protective clothing. If possible, absorb or mix with vermiculite, sodium bicarbonate or sand. This may be packaged in cardboard cartons and burned in an open pit. Wash site thoroughly with strong soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

DICHLORODIFLUOROMETHANE

Synonyms—Difluorodichloromethane; F 12; Freon 12;
Halon 122; Methane, dichlorodifluoro-; Propellant
12; Refrigerant 12; Ucon 12

United Nations Number..... 1028

Formula— CCl_2F_2

CHRIS Code..... DCF

Appearance-Odor—Colorless, odorless gas or liquid.

Boiling Point..... -30°C -22°F
..... $^\circ\text{C}$ $^\circ\text{F}$

Specific Gravity—1.35 at 15°C (a liquid)

Freezing Point..... -158°C -252°F
..... $^\circ\text{C}$ $^\circ\text{F}$

Chemical Family—Halogenated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... *

Pollution Category—USEPA D IMO QAS

Reid Vapor Pressure (psia)..... 132

Applicable Bulk Reg. 46 CFR Subchapter..... O

Vapor Pressure 46°C (115°F) (psia)..... 161

Vapor Density (Air = 1.0)..... 4.17

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable

Electrical Group—Unassigned

General—Does not burn. Toxic fumes emitted when heated to decomposition.

Flash Point ($^\circ\text{F}$)..... None

Flammable Limits..... None

Autoignition Temp. ($^\circ\text{F}$)..... None

Extinguishing Agents..... None

Special Fire Procedures..... When heated to decomposition temperature, it emits highly toxic fumes of phosgene and fluorides. Fire fighters must wear self-contained breathing apparatus and full protective clothing. Cool tanks exposed to fire with continuous water spray.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 0, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
1000

TLV/TWA (ppm)
1000

General—Liquid may cause skin or eye injury similar to frostbite. Vapor not toxic but breathing it may cause unconsciousness without warning because of lack of oxygen.

Symptoms—Drowsiness with or without nausea.

Short Exposure Tolerance—Human exposure to 100,000 ppm for a few minutes produces unconsciousness.

Exposure Procedures—Remove victim to fresh air; if he stops breathing, apply artificial respiration. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Noncorrosive.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 3800 mmHg at 16.5° .



1,1-DICHLOROETHANE

Synonyms—Asymmetrical Dichloroethane; Chlorinated hydrochloric ether; Ethane, 1,1-dichloro-; Ethylidene chloride; Ethylidene dichloride; 1,1-Ethylidene dichloride

United Nations Number..... 2362

Formula— $C_2H_4Cl_2$

CHRIS Code..... DCH

Appearance-Odor—Colorless oily liquid; chloroform-like etheral odor

Boiling Point..... 57°C 135°F

Specific Gravity—1.18

..... °C

Freezing Point..... -97°C -143°F

..... °C

Chemical Family—Halogenated compound

Vapor Pressure 20°C (68°F) (mmHg)..... 182

Reid Vapor Pressure (psia)..... 7.35

Vapor Pressure 46°C (115°F) (psia)..... 9.9

Vapor Density (Air = 1.0)..... 3.41

Pollution Category—USEPA C IMO B

Solubility in Water..... Negligible

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—When heated, toxic and highly flammable vapors are given off.

Flash Point (°F)..... 17

Flammable Limits..... 6 to 16%

Autoignition Temp. (°F)..... 856

Extinguishing Agents..... Dry chemical, foam, CO_2

Special Fire Procedures..... Water may be ineffective on fire. Keep exposed tanks cool with water spray.

Provide fire fighters with protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

Unavailable

100

200

General—Vapor irritating. Liquid slightly irritating.

Symptoms—Vapor causes eye irritation, dizziness, intoxication. Liquid causes slight irritation.

Short Exposure Tolerance—4000 ppm in 30 minutes.

Exposure Procedures—Remove victim to fresh air, if breathing stops, apply artificial respiration. Skin or eye contact—flush areas immediately with water for 15 minutes.

REACTIVITY DATA

Stability—Generally stable, but decomposes when heated forming toxic and flammable vapors. Incompatible with strong oxidizers and caustics.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear protective clothing, face shield, goggles, respiratory protection. Secure ignition sources. Water spray may be used to flush spills away.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: This compound is a teratogen; 1,2-Dichloroethane is a suspected carcinogen.



2,2'-DICHLOROETHYL ETHER

Synonyms—Chlorex; Chloroethyl ether;
bis(2-Chloroethyl) ether; bis-beta-Chloroethyl ether;
DCEE; 2,2'-Dichlorodiethyl ether; Dichloroether;
Dichloroethyl ether; beta, beta'-Dichloroethyl ether;
sym-Dichloroethyl ether; Dichloroethyl oxide;
Ethane, 1,1'-oxybis[2-chloro-; 1,1'-oxybis[2-chloro-;
1,1'-Oxybis[2-chloroethane]

Formula— $\text{ClCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{Cl}$

Appearance-Odor—Colorless liquid; chloroform-like odor

Specific Gravity—1.22

Chemical Family—Ether

Pollution Category—USEPA A IMO B

Applicable Bulk Reg. 46 CFR Subchapter Q

United Nations Number 1916

CHRIS Code DEE

Boiling Point 178°C 352°F

°C °F

Freezing Point -50°C -58°F

°C °F

Vapor Pressure 20°C (68°F) (mmHg) 1.2

Reid Vapor Pressure (psia) †

Vapor Pressure 46°C (115°F) (psia) 0.04

Vapor Density (Air = 1.0) 4.9

Solubility in Water Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—When heated to decomposition, it emits highly toxic fumes; it reacts with water or steam to evolve toxic or corrosive fumes.

Flash Point (°F) 131 (cc)

Flammable Limits Unavailable

Autoignition Temp. (°F) 696

Extinguishing Agents Foam, CO₂, dry chemical

Special Fire Procedures Wear full protective clothing and respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 3

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

5/Skin

TLV/TWA (ppm)

5/Skin

General—Vapor is irritant to mucous membranes of eyes and nose. It affects kidneys and liver in varying degrees, and is a mild narcotic.

Symptoms—Nausea, irritation of eyes and nose.

Short Exposure Tolerance—500-1000 ppm causes severe irritation of the eyes and nose after brief exposure. 100 ppm produces slight nausea and irritation.

Exposure Procedures—Remove victim to fresh air. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable until heated to decomposition. Will react with water or steam, and can react vigorously with oxidizing materials.

Compatibility—Material: Unavailable.

Cargo: Group 41 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, large heavy face shield, self-contained breathing apparatus. Secure ignition sources. Flush with large quantities of water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



2,2'-DICHLOROISOPROPYL ETHER

Synonyms—bis(2-Chloroisopropyl)ether;
Dichloroisopropyl ether; Ether,
bis(2-chloro-1-methylethyl); Propane,
2,2'-oxybis[2-chloro

United Nations Number..... 2490

CHRIS Code..... DCI

Formula—[ClCH₂C(CH₃)H]₂O

Appearance-Odor—Colorless liquid

Specific Gravity—1.11

Chemical Family—Ethers

Pollution Category—USEPA C IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Boiling Point..... 187°C 369°F

..... °C °F

Freezing Point..... -97°C -143°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.10

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 5.90

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Liberates hydrogen chloride vapors when combustion occurs.

Flash Point (°F)..... 185

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Water, foam, CO₂, dry chemical

Special Fire Procedures..... Water to blanket fire. Wear self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

0.32 mg/l

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Skin and eye irritation by direct contact.

Symptoms—Strong respiratory tract irritation and damage to liver and kidneys.

Short Exposure Tolerance—The lower lethal concentration for rats in 5 hours was 700 ppm.

Exposure Procedures—Remove immediately to fresh air. Administer artificial respiration or oxygen as necessary.
For ingestion, provide immediate hospitalization.

REACTIVITY DATA

Stability—Stable. Reacts with oxidizing materials.

Compatibility—Material: Incompatible with aluminum, copper, epoxy coatings.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear self-containing breathing apparatus, full protective clothing and rubber gloves.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



DICHLOROMETHANE

Synonyms—Methylene bichloride; Methylene chloride;
Methylene dichloride

United Nations Number..... 1583

CHRIS Code..... DCM

Formula— CH_2Cl_2

Appearance—Odor—Colorless liquid with a
chloroform-like odor

Specific Gravity—1.34

Chemical Family—Halogenated hydrocarbons

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Boiling Point..... 40°C 104°F

Freezing Point..... -97°C -143°F

Vapor Pressure 20°C (68°F) (mmHg)..... 350

Reid Vapor Pressure (psia)..... 13.9

Vapor Pressure 46°C (115°F) (psia)..... 19.0

Vapor Density (Air = 1.0)..... 3.0

Solubility in Water..... 1.3%

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable

Electrical Group—D

General—No flash point by conventional methods, but forms flammable vapor-air mixtures at 212°F and higher.
Evolves phosgene, a poisonous gas, and hydrogen chloride gas when heated.

Flash Point (°F)..... None

Flammable Limits..... 12 to 19%

Autoignition Temp. (°F)..... 1033

Extinguishing Agents..... Water, foam, dry chemical CO_2

Special Fire Procedures..... Wear self-contained breathing apparatus. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 1, 2

Odor Threshold (ppm)

214

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

50

General—Suspected carcinogen. Vapor causes anesthetic effects at high concentrations. Liquid causes skin and eye irritation. Prolonged or repeated skin contact may cause defatting of the skin and may produce dermatitis from daily contact.

Symptoms—Lightheadedness, mental confusion, nausea, vomiting and headache.

Short Exposure Tolerance—Not well established, possibly in the range of 10,000 to 20,000 ppm by volume in air. However, incoordination, dizziness and slight nausea begin after a half-hour exposure to approximately 1000 ppm.

Exposure Procedures—Give artificial respiration if breathing has stopped. If the eyes are involved, flush and then irrigate with large amounts of water for at least 15 minutes. If ingestion has occurred, obtain medical attention.

REACTIVITY DATA

Stability—Stable; but contact with open flame causes decomposition.

Compatibility—Material: Corrosive to aluminum and magnesium; corrosive to steel when wet.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



2,4-DICHLOROPHENOL

Synonyms—Chlorophenols, liquid; Dichlorophenol;
Phenol, 2,4-dichloro-

United Nations Number..... 2021

CHRIS Code..... DCP

Formula— $C_6H_4Cl_2OH$

Appearance—Odor—White to tan solid needles; colorless
liquid; strong medicinal odor

Specific Gravity—1.4 at 140°F (liquid)
1.4 at 59°F (solid)

Chemical Family—Phenols

Pollution Category—USEPA B IMO A

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 215°C 419°F

..... °C °F

Freezing Point..... 42°C 108°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.10

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 5.8

Solubility in Water..... 4.5 g/l

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame. May decompose in a fire, releasing toxic products including hydrogen chloride.

Flash Point (°F)..... 237

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Water fog, alcohol foam, carbon dioxide, dry chemical.

Special Fire Procedures..... Water and foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

0.02

Unavailable

Unavailable

General—Will irritate skin and burn eyes on short exposure. Possibility of thermal burns from hot liquid.

Symptoms—Irritation, burning, nausea, vomiting, diarrhea, hyperactivity, and/or convulsions.

Short Exposure Tolerance—Inhalation: Dust and vapor toxic; 15 ppm very irritating.

Exposure Procedures—Get medical attention. Inhalation: Remove to fresh air, rest, mouth to mouth resuscitation or oxygen if needed. Ingestion: Do not induce vomiting. Give large amounts of milk or water. Skin: Wash with water for 15 to 30 minutes. Eyes: Flush with water for at least 30 minutes.

REACTIVITY DATA

Stability—Stable below 200°C. Reacts with acids and caustic and alkali solutions.

Compatibility—Material: Rapidly corrodes aluminum, slowly corrodes zinc, tin, brass, bronze, copper. Use stainless or mild steel with nitrogen pad (to keep dry). Linings are generally unsuitable.

Cargo: Group 21 of the compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact, wear goggles, body covering clothing including rubber or neoprene gloves, gauntlets, and boots. Use self-contained breathing apparatus. For solid spills prevent entry into sewers or natural waterways; shovel into clean dry containers. For liquid spills, dike and let freeze, shovel into dry containers. Do not use water. Material is a serious pollution hazard.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

1990

1,2-DICHLOROPROPANE

Synonyms—Dichloropropane; Propane, 1,2-dichloro-;
Propylene chloride; Propylene dichloride

United Nations Number..... 1279

CHRIS Code..... DPP

Formula— $\text{CH}_3\text{CHClCH}_2\text{Cl}$

Appearance—Odor—Colorless liquid; sweetish,
chloroform-like odor

Specific Gravity—1.16

Chemical Family—Halogenated hydrocarbons

Pollution Category—USEPA C IMO B

Applicable Bulk Reg. 46 CFR Subchapter O

Boiling Point..... 36°C 205°F

Freezing Point..... -80°C -112°F

Vapor Pressure 20°C (68°F) (mmHg)..... 40

Reid Vapor Pressure (psia)..... 1.9

Vapor Pressure 46°C (115°F) (psia)..... 2.5

Vapor Density (Air = 1.0)..... 3.89

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Both the liquid and vapor, on contact with a hot surface or a naked flame, decompose to form phosgene, an extremely poisonous gas. Highly toxic hydrogen chloride gas is a combustion product.

Flash Point (°F)..... 65

Flammable Limits..... 3.4 to 14.5%

Autoignition Temp. (°F)..... 1035

Extinguishing Agents..... CO_2 , dry chemical, foam, water fog

Special Fire Procedures..... Keep exposed tanks cool with water spray. Provide body and respiratory protection for fire parties.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 3

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

75

TLV/TWA (ppm)

75

General—Skin contact can cause dermatitis. Vapor inhalation causes fatty degeneration of the liver and kidneys.

Symptoms—Headache, weakness, nausea, dizziness. Skin contact may cause dermatitis.

Short Exposure Tolerance—Short-term peak exposures of workmen to 400 to 500 ppm were tolerated without apparent ill effects.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention. Symptoms may be delayed several days or longer.

REACTIVITY DATA

Stability—Generally stable. Can react vigorously with oxidizing materials.

Compatibility—Material: Corrodes aluminum.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves and protective clothing. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



1,3-DICHLOROPROPENE

Synonyms—alpha-Chloroallyl chloride;
gamma-Chloroallyl chloride; Dichloropropene;
1,3-Dichloropropylene; alpha,
gamma-Dichloropropylene; 1-Propene, 1,3-dichloro-;
Telone

Formula— $\text{CICH}_2 = \text{CHCH}_2\text{Cl}$

Appearance—Odor—White or yellow liquid; sweet
penetrating odor

Specific Gravity—1.23

Chemical Family—Substituted allyls

Pollution Category—USEPA B IMO B

Applicable Bulk Reg. 46 CFR Subchapter Q

United Nations Number..... 2047

CHRIS Code..... DPU

Boiling Point..... 104°C 219°F

Freezing Point..... -80°C -78°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 103

Reid Vapor Pressure (psia)..... 4.0

Vapor Pressure 46°C (115°F) (psia)..... 5.5

Vapor Density (Air = 1.0)..... 3.84

Solubility in Water..... 0.1%

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Combustion produces toxic vapors of hydrogen chloride, phosgene, and carbon monoxide. Fire may cause violent rupture of tank.

Flash Point (°F)..... 95

Flammable Limits..... 5.3 to 14.5%

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... CO_2 , dry chemical, foam, water fog

Special Fire Procedures..... Fire parties must wear full respiratory protection and, where danger of skin contact exists, full body protection as well.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 2, 3

Odor Threshold (ppm)

1 to 3

PEL/TWA (ppm)

1/Skin

TLV/TWA (ppm)

1/Skin

General—Suspected carcinogen. Liquid is severely irritating to eyes. Vapor is a severe irritant.

Symptoms—Blisters and burns when in contact with skin. Breathing the vapors causes irritation to nose and eyes.

Short Exposure Tolerance—Unavailable. However, it should be noted that the commercial product is a mixture of isomers. The physical properties will vary somewhat depending upon the proportion of each isomer present. The mixture should be handled in the same manner as a Class B poison.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Will cause corrosion of steel if wet or at elevated temperatures; also attacks aluminum and rubber.

Cargo Group 15 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



DICYCLOPENTADIENE

Synonyms—Cyclopentadiene; 1,3-Cyclopentadiene;
1,3-Cyclopentadiene dimer; Dicy; 3a, 4, 7, 7a-;
Dicyclo-1,4-pentadiene;
Tetrahydro-4,7-methanoindene

United Nations Number..... 2048

Formula— $C_{10}H_{12}$

CHRIS Code..... DPT

Appearance—Odor—Colorless crystals or molten liquid;
camphor-like odor

Boiling Point..... 168°C 331°F

Specific Gravity—0.98

Freezing Point..... 33°C 91°F

Chemical Family—Olefin

Vapor Pressure 28°C (68°F) (mmHg)..... 1.5

Reid Vapor Pressure (psia)..... 0.16

Vapor Pressure 46°C (115°F) (psia)..... 0.25

Vapor Density (Air = 1.0)..... 4.55

Pollution Category—USEPA..... IMO B

Applicable Bulk Reg. 46 CFR Subchapter..... D.O.

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible

Electrical Group—C

General—Keep away from heat, sparks and fire.

Flash Point (°F)..... 80 to 100

Flammable Limits..... 0.8 to 6.3%

Autoignition Temp. (°F)..... above 500

Extinguishing Agents..... Foam, carbon dioxide, dry chemical, water spray

Special Fire Procedures..... Water may be ineffective. Keep exposed tanks cool with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

less than 0.003

5

5

General—Liquid causes skin and eye irritation. Avoid prolonged or repeated breathing of vapor. Possibility of thermal burns from hot liquid.

Symptoms—Inhalation—dizziness, drowsiness. Skin contact—dermatitis following prolonged contact.

Short Exposure Tolerance—1 ppm caused slight eye and throat irritation after 7 minutes. Eye irritation resulted after 10 minutes at 5.5 ppm.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 30 compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



DIESEL OIL

Synonyms—Diesel fuel; Fuel oil no. 1-D; Fuel oil no. 2-D; Petroleum oil

United Nations Number..... 1270

CHRIS Code..... ODS

Formals—Not chemically distinguishable.

Appearance—Odor—Brown, slightly viscous liquid; smells like kerosene

Specific Gravity—0.8 to 0.9

Chemical Family—Misc. hydrocarbon mixtures

Pollution Category—USEPA _____ IMO I

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Boiling Point..... 232-425°C 450-800°F

..... °C °F

Freezing Point..... -29°C -20°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... Varies

Vapor Pressure 46°C (115°F) (psia)..... Varies

Vapor Density (Air = 1.0)..... Varies

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—D or E depending on flash point

Electrical Group—D

General—Diesel fuel, due to its elevated flash point, will generally not constitute a fire hazard. Keep away from heat or flame.

Flash Point (°F)..... 110 to 180

Flammable Limits..... 1.3 to 6.0%

Autoignition Temp. (°F)..... 494

Extinguishing Agents..... CO₂, dry chemical, foam, water fog

Special Fire Procedures..... Water or foam may cause frothing. Do not direct water directly into fire.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Inhalation of high concentrations of vapor can cause headache and stupor. Liquid is irritating to the skin.

Symptoms—Ingestion causes irritation of stomach and intestines with nausea and vomiting. Inhalation: headache, stupor.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, protective clothing. Have respiratory protection available. Secure ignition sources. Soak up with rags, paper, or dry vermiculite.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 2.6 mmHg at 50°C.



DIETHANOLAMINE

Synonyms—Diethylamine; 2,2'-Dihydroxydiethylamine;
Di-(2-hydroxyethyl)amine; bis(Hydroxyethyl)amine;
bis(2-Hydroxyethyl)amine; 2,2'-Iminobisethanol;
2,2'-Iminodiethanol

United Nations Number..... +

CHRIS Code..... DEA

Formula—(HOCH₂CH₂)₂NH

Boiling Point..... 288°C 514°F

Appearance—Odor—Thick, colorless liquid; ammonia-like odor

Freezing Point..... 28°C 82°F

Specific Gravity—1.08

Vapor Pressure 20°C (68°F) (mmHg)..... <0.1

Chemical Family—Amine

Reid Vapor Pressure (psia)..... 0.87

Pollution Category—USEPA _____ IMO III

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Applicable Bulk Reg. 46 CFR Subchapter..... O

Vapor Density (Air = 1.0)..... 3.85

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame. Irritating vapors are generated when heated.

Flash Point (°F)..... 280

Flammable Limits..... 1.6% (calculated) to 9.6% (estimated)

Autoignition Temp. (°F)..... 1224

Extinguishing Agents..... CO₂, dry chemical, water fog, alcohol foam

Special Fire Procedures..... Water or foam may cause frothing. Provide fire fighters with self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings
2, 2, 2

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
3

TLV/TWA (ppm)
3

General—Liquid is irritating to skin and highly corrosive to eyes. Avoid inhalation of high vapor concentrations.

Symptoms—Itching or burning at points of contact.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Relatively stable.

Compatibility—Material: Avoid copper and its alloys.

Cargo: Group 8 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, face-shield or all-purpose canister respirator, protective clothing. May cover with sodium bisulfate, spray with large excess of water and wash up.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Since the pure material is solid at ambient temperatures, diethanolamine may be carried in aqueous solution or at elevated temperature to keep it liquid.

‡ Unassigned



DIETHYLAMINE

Synonyms—DEN; N-Ethylethanamine

United Nations Number..... 1154

Formula— $(C_2H_5)_2NH$

Appearance—Odor—Colorless liquid; ammonia-like odor

Specific Gravity—0.71

Chemical Family—Amine

Pollution Category—USEPA B IMO C

Applicable Bulk Reg. 46 CFR Subchapter O

CHRIS Code..... DEN

Boiling Point..... 58°C 132°F

Freezing Point..... -60°C -68°F

Vapor Pressure 20°C (68°F) (mmHg)..... 20.4

Reid Vapor Pressure (psia)..... 0.7

Vapor Pressure 46°C (115°F) (psia)..... 1.0

Vapor Density (Air = 1.0)..... 2.5

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid
Electrical Group—C

General—Extremely flammable. Dangerous when exposed to heat or flame. Vapors are heavier than air and may travel considerable distance to an ignition source and flashback. Irritating vapors are generated when heated.

Flash Point (°F)..... -24

Flammable Limits..... 1.8 to 10.1%

Autoignition Temp. (°F)..... 594

Extinguishing Agents..... CO₂, dry chemical or alcohol foam

Special Fire Procedures..... Provide fire fighters with self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
3, 2, 2	0.14	10	10

General—Liquid very irritating on contact and is toxic by skin absorption. Vapor causes severe irritation of nose and respiratory passages.

Symptoms—Liquid causes eye injury and skin irritation.

Short Exposure Tolerance—100 ppm for 30 minutes.

Exposure Procedures—In case of contact with eyes or skin, immediately flush with plenty of water for at least 15 minutes; for eyes get medical attention. Remove contaminated clothing and shoes at once.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Steel and stainless steel are compatible. Copper and its alloys should not be used.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, face-shield or all-purpose canister respirator, protective clothing. Secure ignition sources. Cover with sodium bisulfate and clean up. Flush spill with large quantities of water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



DIETHYLBENZENE

Synonyms—Diethylbenzene (1,2-, 1,3- or 1,4-);
Diethylbenzene, m- or o- isomers

United Nations Number..... 2049

Formula— $C_8H_{10}(C_2H_5)_2$

CHRIS Code..... DEB

Appearance—Colorless liquid; benzene-like odor

Boiling Point..... 182°C 350°F

Specific Gravity—0.87

Freezing Point..... -43°C -45°F

Chemical Family—Aromatic hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 1

Pollution Category—USEPA..... IMO C

Reid Vapor Pressure (psia)..... 0.05

Applicable Bulk Reg. 46 CFR Subchapter..... D, O

Vapor Pressure 46°C (115°F) (psia)..... 0.08

Vapor Density (Air = 1.0)..... 4.52

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F)..... 133

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 806

Extinguishing Agents..... CO₂, dry chemical, foam, water fog

Special Fire Procedures..... Fight in the same manner as any Grade D petroleum product fire. Firefighter should wear respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Vapor harmful.

Symptoms—Headache, dizziness, nausea

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention. The effects of inhalation may be delayed.

REACTIVITY DATA

Stability—Relatively stable. Can react with oxidizing materials.

Compatibility—Material: Rubber, on long immersion, will first swell, then soften.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Usually shipped as a mixture of isomers; the ortho and para forms will predominate.



DIETHYLENE GLYCOL

Synonyms—DEG; Diglycol; Dihydroxydiethyl ether;
2,2'-Dihydroxyethyl ether; bis(2-Hydroxyethyl)ether;
3-Oxa-1,5-pentanediol; 2,2'-Oxybisethanol;
2,2'-Oxydiethanol

United Nations Number..... 1

CHRIS Code..... DEG

Formula—(CH₂CH₂OH)₂O

Boiling Point..... 244°C 472°F

Appearance-Odor—Colorless, syrupy liquid; slight odor

Freezing Point..... -6°C 21°F

Specific Gravity—1.12

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Chemical Family—Glycol ethers

Reld Vapor Pressure (psia)..... V. Low

Pollution Category—USEPA _____ IMO III

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Applicable Bulk Reg. 46 CFR Subchapter..... D

Vapor Density (Air = 1.0)..... 3.66

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Slight hazard, when exposed to heat or flame; can react with oxidizing materials.

Flash Point (°F)..... 255

Flammable Limits..... 1.6 to 10.8%

Autoignition Temp. (°F)..... 444

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water spray

Special Fire Procedures..... Water or foam may cause frothing. Do not direct water directly into fire.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Under ordinary conditions of handling, not considered toxic.

Symptoms—Skin which has come into contact with the liquid may burn or itch.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—Eye or skin contact—flush affected area gently with water for 15 minutes. For eye contact, or if skin is blistered or peeled, get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Compatible with most materials of construction.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face-shield, protective clothing. Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



DIETHYLENE GLYCOL BUTYL ETHER

Synonyms—Butoxydiethylene glycol; 2-(2-Butoxy ethoxy) ethanol; 2-(2-Butoxy ethoxy) ethanol; Butyl Carbitol; Butyl diglycol; Butyl dioxitol; Diglycol monobutyl ether; Dowanol DB; Ektasolve DB Solvent

United Nations Number..... 1

CHRIS Code..... DME

Formula— $C_{12}H_{22}OCH_2CH_2OCH_2CH_2OH$

Boiling Point..... 231°C 448°F

Appearance—Odor—Colorless liquid; faint pleasant odor.

Freezing Point..... -68°C -90°F

Specific Gravity—0.95

..... °C °F

Chemical Family—Glycol ether

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reid Vapor Pressure (psia)..... V. Low

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... 5.5

Solubility in Water..... Complete

Pollution Category—USEPA IMO III

Applicable Bulk Reg. 46 CFR Subchapter D

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 172

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 442

Extinguishing Agents..... Confined area—CO₂, dry chemical. Open area—polar solvent foam

Special Fire Procedures..... Water spray may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 0, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Slight eye irritation. Low toxicity.

Symptoms—Liquid—slightly painful and irritating to eyes; repeated skin contact causes slight irritation.

Vapor—eye irritation.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Liquid—flush with water. Vapor inhalation—remove victim to fresh air.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Mild steel and stainless steel are suitable. Certain rubbers and plastics are unsuitable.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources. Absorb on paper towel and vermiculite.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



DIETHYLENE GLYCOL ETHYL ETHER

Synonyms—Carbitol solvent; Dowanol DE; Ektasolve
DE Solvent; Ethoxy diglycol;
2-(2-Ethoxyethoxy)ethanol

United Nations Number..... 1

CHRIS Code..... DGE

Formula— $\text{HOCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OC}_2\text{H}_5$

Boiling Point..... 202°C 396°F

Appearance-Odor—Colorless liquid; mild pleasant odor

..... °C °F

Freezing Point..... -76°C -105°F

Specific Gravity—1.03

..... °C °F

Chemical Family—Glycol ether

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... 0.01

Pollution Category—USEPA IMO III

Vapor Density (Air = 1.0)..... 4.62

Applicable Bulk Reg. 46 CFR Subchapter..... D

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Moderate hazard when exposed to heat.

Flash Point (°F)..... 205

Flammable Limits..... LEL = 1.2% UEL = 8.5% (est.)

Autoignition Temp. (°F)..... 400

Extinguishing Agents..... Dry chemical, alcohol foam or carbon dioxide.

Special Fire Procedures..... Coal exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Strong ingestive toxin. Mild local irritant. Under ordinary conditions of handling not considered toxic.

Symptoms—None expected with normal use.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—Vapor—remove victim to fresh air. Skin or eye contact—remove contaminated clothing and gently flush affected area with water for 15 minutes. Get medical advice for eye contact.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources. Absorb on paper towel and vermiculite.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



DIETHYLENE GLYCOL METHYL ETHER

Synonyms—Dowanol DM; Ektasolve DM Solvent;
2-(2-Methoxyethoxy)ethanol; Methyl Carbitol

United Nations Number..... 2

Formula— $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH}$

Appearance—Odor—Colorless liquid with a mild pleasant
odor

Specific Gravity—1.03

Chemical Family—Glycol ether

Pollution Category—USEPA _____ IMO C

Applicable Bulk Reg. 46 CFR Subchapter D, Q

CHRIS Code DGM

Boiling Point 183°C 373°F

Freezing Point -84°C -120°F

Vapor Pressure 20°C (68°F) (mmHg) 0.2

Reid Vapor Pressure (psia) 0.01

Vapor Pressure 46°C (115°F) (psia) 0.02

Vapor Density (Air = 1.0) 4.14

Solubility in Water Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F) 200

Flammable Limits LEL = 1.2% UEL—unavailable

Autoignition Temp. (°F) Unavailable

Extinguishing Agents Water, carbon dioxide, dry chemical, or alcohol foam

Special Fire Procedures Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Not considered toxic under ordinary conditions of handling.

Symptoms—Liquid may irritate eyes.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—Vapor—remove victim to fresh air. Skin or eye contact—remove contaminated clothing and gently flush affected area with water for 15 minutes. Get medical advice for eye contact.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



DIETHYLENETRIAMINE

Synonyms—bis(2-Aminoethyl)amine;
2,2'-Diaminodithylamine

United Nations Number..... 2079

CHRIS Code..... DET

Formula— $\text{NH}_2\text{CH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{NH}_2$

Appearance—Thick yellow liquid; ammonia-like odor.

Specific Gravity—0.85

Chemical Family—Amine

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Boiling Point..... 207°C 404°F

..... °C °F

Freezing Point..... -39°C -38°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... LOW

Relat Vapor Pressure (psia)..... 0.02

Vapor Pressure 46°C (115°F) (psia)..... 0.04

Vapor Density (Air = 1.0)..... 3.48

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—At ambient temperatures the fire hazard is low. Irritating vapors are generated when heated.

Flash Point (°F)..... 215

Flammable Limits..... 1 to 10% (calculated)

Autoignition Temp. (°F)..... 750

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog.

Special Fire Procedures..... Water increases the amount of vapor produced. Fire parties should wear body and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings
2, 2, 2

Odor Threshold (ppm)
10

PEL/TWA (ppm)
1

TLV/TWA (ppm)
1/Skin

General—Liquid causes severe burns. Vapor is irritating.

Symptoms—Throat irritation, nausea, wheezing breath. Liquid contact can cause serious eye and skin burns and severe allergic reactions.

Short Exposure Tolerance—Unknown. No animal deaths followed on 8-hour exposure to saturated vapors at room temperature.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, is helpful. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable. Water dilution will evolve toxic vapors.

Compatibility—Material: Corrodes copper and its alloys.

Cargo: Group 7 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face-shield or all-purpose canister mask, and protective clothing. Avoid contact with the liquid. May cover with sodium bisulfate, spray with large excess of water and washup.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



DIETHYLETHANOLAMINE

Synonyms—DEAE; Diethylaminoethanol; 2-Diethyl amino ethanol; 2-N-Diethylamino ethanol; 2-Diethyl aminoethyl alcohol; beta-Diethylaminoethyl alcohol; N,N-Diethylethanolamine; Diethyl-(2-hydroxyethyl) amine; 2-Hydroxytriethyl amine

United Nations Number..... 2686

Formula— $(C_2H_5)_2NC_2H_4OH$

CHRIS Code..... DAE

Appearance—Odor—Colorless liquid; weak ammonia-like odor

Boiling Point..... 163°C 325°F

Specific Gravity—0.88

Freezing Point..... pour point -78°C -108°F

Chemical Family—Amine

Vapor Pressure 20°C (68°F) (mmHg)..... 1

Pollution Category—USEPA _____ IMO C

Reid Vapor Pressure (psia)..... †

Applicable Bulk Reg. 46 CFR Subchapter O

Vapor Pressure 46°C (115°F) (psia)..... 0.15

Vapor Density (Air = 1.0)..... 4.03

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—Moderate fire hazard when exposed to heat or flame. Toxic and irritating gases may be generated.

Flash Point (°F)..... 126

Flammable Limits..... 7 to 12%

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Dry chemical, CO₂, alcohol foam, water fog

Special Fire Procedures..... Cool exposed tanks with water. Provide fire fighters with self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 3

Odor Threshold (ppm)

0.04

PEL/TWA (ppm)

10/Skin

TLV/TWA (ppm)

10/Skin

General—Vapor irritating to eyes, mucous membranes. Liquid irritating to skin.

Symptoms—Vapors cause nausea, vomiting, respiratory irritation. Liquid causes eye and skin irritation.

Short Exposure Tolerance—500 ppm in 30 minutes; 200 ppm is toxic to central nervous system.

Exposure Procedures—Remove victim to fresh air, if breathing stops administer artificial respiration. Immediately flush with large amounts of water for 15 minutes, get medical attention.

REACTIVITY DATA

Stability—Can react with oxidizers and strong acids.

Compatibility—Material: Incompatible with zinc, galvanized iron, copper, and copper alloys.

Cargo: Group 8 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear protective clothing, goggles, gloves. Secure ignition sources. Cover with sufficient quantities of sodium bisulfate and sprinkle water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



DIETHYL SULFATE

Synonyms—Ethyl sulfate; Sulfuric acid, diethyl ester

United Nations Number..... 1584

Formula— $(C_2H_5)_2SO_4$

CHRIS Code..... DSU

Appearance—Odor—Colorless oily liquid; peppermint odor

Boiling Point..... $^{*}208^{\circ}C$ 406 $^{\circ}F$

Specific Gravity—1.18

Freezing Point..... $-24^{\circ}C$ $-11^{\circ}F$

Chemical Family—Ester

Vapor Pressure $20^{\circ}C$ (68 $^{\circ}F$) (mmHg)..... 0.019

Reid Vapor Pressure (psia)..... V. Low

Pollution Category—USEPA _____ IMO _____ B

Vapor Pressure $46^{\circ}C$ (115 $^{\circ}F$) (psia)..... †

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Vapor Density (Air = 1.0)..... 5.3

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Low hazard when exposed to fire or flame.

Flash Point ($^{\circ}F$)..... 220

Flammable Limits..... 4.1 to 12.4% (estimate)

Autoignition Temp. ($^{\circ}F$)..... 817

Extinguishing Agents..... Alcohol foam, CO_2 , dry chemical

Special Fire Procedures..... Water or foam may cause frothing. Do not direct water directly into fire. Wear self-contained breathing apparatus, gloves.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

General—Highly toxic by ingestion and inhalation. Strong irritant. Decomposition liberates ethyl ether and sulfur oxides.

Symptoms—Highly irritating to skin and mucous membranes. Burns are caused on prolonged contact. Nausea and vomiting.

Short Exposure Tolerance—Animal studies showed the lowest lethal concentration to be 250 ppm for 4 hours. Serious illness may result from prolonged contact.

Exposure Procedures—Remove victim to fresh air. Administer artificial respiration or oxygen as necessary. Irrigate eyes with water. Wash skin with soap and water. Get medical advice or attention.

REACTIVITY DATA

Stability—Decomposes to form ethyl ether; water slowly decomposes substance to form sulfuric acid. Incompatible with strong alkalis.

Compatibility—Materials: Aluminum, zinc, galvanized iron, lead, nickel or copper and its alloys should not be used. Phenolic-lined or stainless steel are suitable.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear protective clothing, self-contained breathing apparatus, gloves. Soak up small spills with absorbent or soda ash. Wash large spills with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Begins to decompose below its boiling point.

† Unavailable



DIISOBUTYLAMINE

Synonyms—N-(2-Methyl propyl)amine;
N,N-bis(2-Methylpropyl)amine; 1-Propanamine,
2-methyl-

United Nations Number..... 2361

Formula— $C_4H_{11}N$

CHRIS Code DBU

Appearance—Odor—Water white liquid; amine odor

Boiling Point 139°C 283°F

Specific Gravity—0.745

Freezing Point -77°C -107°F

Chemical Family—Amines

Vapor Pressure 20°C (68°F) (mmHg) 10

Pollution Category—USEPA IMO C

Reid Vapor Pressure (psia) 0.29

Applicable Bulk Reg. 46 CFR Subchapter Q

Vapor Pressure 46°C (115°F) (psia) >1.0

Vapor Density (Air = 1.0) 4.48

Solubility in Water Slight

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—Highly dangerous when exposed to heat or flame

Flash Point (°F) 84

Flammable Limits Unavailable

Autoignition Temp. (°F) Unavailable

Extinguishing Agents Alcohol foam, CO_2 , dry chemical

Special Fire Procedures Full respiratory protection as well as body protection.

HEALTH HAZARD DATA

Health Hazard Ratings
3, 4, 3

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Liquid causes burns and eye injury.

Symptoms—Irritation of lungs and respiratory tract. Skin-light irritation to burns.

Short Exposure Tolerance—Exposures greater than 100 ppm will produce irritation of respiratory tract. Pulmonary edema may result.

Exposure Procedures—Remove to fresh air. Give artificial respiration or oxygen as necessary. Skin, eyes—flush immediately with water for at least 15 minutes. Remove contaminated clothing at once.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Will dissolve paint and most plastic materials.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear self-contained breathing apparatus, full protective clothing and rubber gloves. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

DIISOBUTYL CARBINOL

Synonyms—2,6-Dimethyl-4-heptanol; sec-Nonyl alcohol

United Nations Number..... 1

Formula— $[(CH_3)_2CHCH_2]_3CHOH$

Appearance—Colorless, oily liquid with a characteristic odor

Specific Gravity—0.81

Chemical Family—Alcohol

Pollution Category—USEPA IMO @ C

Applicable Bulk Reg. 46 CFR Subchapter D, Q

CHRIS Code DBC

Boiling Point 178°C 352°F

..... °C °F

Freezing Point -65°C -85°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) 0.3

Raid Vapor Pressure (psia) 0.06

Vapor Pressure 46°C (115°F) (psia) 0.1

Vapor Density (Air = 1.0) 4.98

Solubility in Water Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F) 165

Flammable Limits 0.8 to 6.1% at 212°F

Autoignition Temp. (°F) 484

Extinguishing Agents Carbon dioxide, dry chemical, alcohol foam

Special Fire Procedures Not pertinent

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Low toxicity.

Symptoms—Vapor causes eye, nose, and throat irritation. Liquid contact causes redness, flaking, cracking.

Short Exposure Tolerance—Eye irritation at less than 5 ppm. Nose and throat irritation at 10 ppm.

Exposure Procedures—Vapor—remove victim to fresh air. Skin or eye contact—remove contaminated clothing and flush affected areas with water for 15 minutes. Get medical advice.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned

DIISOBUTYLENE

Synonyms—Diisobutene; Diisobutylene, isomeric comp's; 2,4,4-Trimethyl pentene-1; 2,4,4-Trimethyl pentene-2; Trimethyl pentene

United Nations Number..... 2050

CHRIS Code..... DBL

Formula— C_5H_{10}

Appearance—Odor—Water white liquid; typical organic odor.

Specific Gravity—0.72

Chemical Family—Olefin

Pollution Category—USEPA _____ IMO B

Applicable Bulk Reg. 46 CFR Subchapter D, O

Boiling Point..... 102°C 215°F

..... °C °F

Freezing Point..... -93°C -136°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... 1.6

Vapor Pressure 46°C (115°F) (psia)..... 2.2

Vapor Density (Air = 1.0)..... 3.97

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous when exposed to heat or flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 20

Flammable Limits..... LEL=0.9% (est.) UEL—unavailable

Autoignition Temp. (°F)..... 788

Extinguishing Agents..... Foam, carbon dioxide, or dry chemical

Special Fire Procedures..... Cool exposed tanks with water. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 1, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Slight vapor hazard, and slight skin irritant.

Symptoms—Headache, nausea, weakness, mental depression, inability for sustained attention.

Short Exposure Tolerance—Irritant and narcotic in high concentration. Has caused liver damage in test animals.

Exposure Procedures—Vapor—remove victim to fresh air. Administer artificial respiration if necessary.

Skin—wash with copious amounts of water. Call a doctor.

REACTIVITY DATA

Stability—Will not spontaneously decompose.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 67 mmHg at 35°C.



DIISOBUTYL KETONE

Synonyms—DIBK; sym-Diisopropylacetone; sym-5-Diisopropylacetone; 2,6-Dimethyl-4-heptanone; Isovalerone; Valerone

United Nations Number..... 1157

Formula— $[(CH_3)_2CHCH_2]_2CO$

CHRIS Code..... DIK

Appearance—Odor—Colorless liquid; mild odor

Boiling Point..... 168°C 334°F

Specific Gravity—0.81

Freezing Point..... -41°C -42°F

Chemical Family—Ketone

Vapor Pressure 20°C (68°F) (mmHg)..... 1

Pollution Category—USEPA _____ IMO D

Reid Vapor Pressure (psia)..... 0.21

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Vapor Pressure 46°C (115°F) (psia)..... 0.48

Vapor Density (Air = 1.0)..... 4.9

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 140

Flammable Limits..... 0.8 to 6.2%

Autotemperature (°F)..... 745

Extinguishing Agents..... Carbon dioxide, dry chemical, alcohol foam

Special Fire Procedures..... Wear self-contained breathing apparatus. Cool fire-exposed tanks with water.

Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

2, 1, 1

Unavailable

25

25

General—Fairly toxic if inhaled; minor skin irritation.

Symptoms—Redness or irritation of skin; irritation of eye, nose and throat.

Short Exposure Tolerance—Animal tests show minor skin irritation, traces of eye injury. Inhalation resulted in 33% death rate in 8 hours, on test.

Exposure Procedures—Inhalation: Remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact: Flush affected areas for 15 minutes with water. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material: Mild steel can be used.

Cargo: Group 18 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear rubber gloves, face shield, and protective clothing. Secure ignition sources. Have all-purpose canister mask available. Keep unprotected personnel upwind of contaminated area. Flush with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



DIISOPROPANOLAMINE

Synonyms—2,2'-Dihydroxydipropylamine; DIPA;
1,1'-Iminodi-2-propanol

United Nations Number..... †

CHRIS Code..... DIP

Formula— $(CH_3CHOHCH_2)_2NH$

Appearance—Odor—White crystalline solid or colorless
molten liquid; ammonia-like odor
Specific Gravity—0.98 at 42°C

Boiling Point..... 249°C 480°F
..... °C °F
Freezing Point..... 42°C 108°F
..... °C °F

Chemical Family—Alkanolamines

Vapor Pressure 20°C (68°F) (mmHg)..... 0.0
Reid Vapor Pressure (psia)..... 0.0
Vapor Pressure 46°C (115°F) (psia)..... V. Low
Vapor Density (Air = 1.0)..... 4.59
Solubility in Water..... Complete

Pollution Category—USEPA IMO C
Applicable Bulk Reg. 46 CFR Subchapter O

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible
Electrical Group—D

General—Slight fire hazard when exposed to heat. Material kept at 120°-140°F for ease of handling. High temperature evolve ammonia and other toxic vapors.

Flash Point (°F)..... 260
Flammable Limits..... 1.1 to 5.4%
Autoignition Temp. (°F)..... 580
Extinguishing Agents..... Carbon dioxide, dry chemical, alcohol foam.
Special Fire Procedures..... Wear self-contained breathing apparatus and full protective clothing. Water may be ineffective on fire; water or foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
2, 2, 2	Unavailable	Unavailable	Unavailable

General—Slight skin irritation from contact. Slight vapor irritation. Principal hazard is to eyes. Wear eye protection. Possibility of thermal burns from hot liquid.

Symptoms—Liquid: skin irritation.

Short Exposure Tolerance—Breathing the mist generated from the chemical held at 338°F was not fatal to animals in an 8 hour exposure.

Exposure Procedures—If eyes are splashed with diisopropanolamine, wash with water immediately. Obtain medical aid.

REACTIVITY DATA

Stability—Chemically stable. Upon heating breaks down into original starting materials.

Compatibility—Material: No action on common materials at ambient conditions. Copper or copper alloys should not be used.

Cargo: Group 8 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear full face shields or goggles with side shield, or equivalent. Wear rubber gloves and protective clothing. Avoid contact with liquid which can cause thermal burns.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



DIISOPROPYLAMINE

Synonyms—DIPA; N-(1-Methylethyl)-2-propanamine

United Nations Number..... 1159

CHRIS Code..... DIA

Formula— $[(CH_3)_2CH]_2NH$

Appearance—Odor—Colorless liquid; amine odor

Specific Gravity—0.72

Chemical Family—Amine

Pollution Category—USEPA _____ IMO C

Applicable Bulk Reg. 46 CFR Subchapter _____ C

Boiling Point..... 84°C 183°F

..... °C °F

Freezing Point..... -98°C -92°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 70

Reid Vapor Pressure (psia)..... 2.5

Vapor Pressure 46°C (115°F) (psia)..... 3.7

Vapor Density (Air = 1.0)..... 3.5

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—Dangerous. Keep away from heat and open flame. Toxic oxides of nitrogen may form in fires. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 30

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 800

Extinguishing Agents..... Alcohol foam, CO₂, dry chemical

Special Fire Procedures..... Water may be ineffective. Wear eye protection and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 4

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

5/Skin

TLV/TWA (ppm)

5/Skin

General—Liquid irritating to skin and eyes on contact. Inhalation of fumes can cause pulmonary edema.

Symptoms—Eye, skin, and respiratory irritation.

Short Exposure Tolerance—Death results at 2200 ppm, or from repeated exposures of 260 ppm; nausea and impairment of vision occur between 25 and 50 ppm.

Exposure Procedures—Remove victim to fresh air. Apply artificial respiration, if breathing stops. Skin or eye contact—remove contaminated clothing and gently flush affected area with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Avoid copper and copper alloys.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear butyl rubber gloves, face shield or all-purpose canister respiratory protection, protective clothing. Secure ignition sources. Cover with sodium bisulfate and clean up. Flush spill with large quantities of water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

DIMETHYLAMINE

Synonyms—Dimethylamine, anhydrous; DMA;
Methanamine, N-methyl-; N-Methylmethanamine

United Nations Number..... 1032

CHRIS Code..... DMA

Formula— $(CH_3)_2NH$

Appearance—Odor—Colorless gas; fish-like or
ammonia-like odor

Specific Gravity—0.68 at 7°C (a liquid)

Chemical Family—Amine

Pollution Category—USEPA C IMO Q85

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 7°C 45°F

Freezing Point..... -96°C -141°F

Vapor Pressure 20°C (68°F) (mmHg)..... 1900

Reid Vapor Pressure (psia)..... 45

Vapor Pressure 46°C (115°F) (psia)..... 58

Vapor Density (Air = 1.0)..... 1.55

Solubility in Water..... Appreciable

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—C

General—Unless the flow of gas can be stopped, putting out a dimethylamine fire will permit an explosive vapor concentration to accumulate. Extremely flammable. Vapors are eye, skin and respiratory irritants.

Flash Point (°F)..... Flammable gas; solutions of 5% or more are considered flammable liquids

Flammable Limits..... 2.8 to 14.4%

Autoignition Temp. (°F)..... 756

Extinguishing Agents..... Stop flow of gas; CO₂, dry chemical, water fog

Special Fire Procedures..... Use of foam is not recommended. Tanks exposed to fire should be cooled with a water spray. Firefighting personnel should be provided with self-contained breathing apparatus and body protection.

HEALTH HAZARD DATA

Health Hazard Ratings
3, 2, 3

Odor Threshold (ppm)
0.047

PEL/TWA (ppm)
10

TLV/TWA (ppm)
10

General—Vapor extremely irritating. Liquid causes burns.

Symptoms—Eye irritation; irritation to nose and throat, coughing and sneezing; headache, nausea

Short Exposure Tolerance—20 ppm for 5 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, is often helpful. Skin or eye contact—immediately flood affected areas gently with water. Remove contaminated clothing and continue to flush affected area for 15 minutes. Get medical attention.

REACTIVITY DATA

Stability—Stable. DMA is highly reactive with other material.

Compatibility—Material: Steel is a suitable construction material. Copper, aluminum, and their alloys, magnesium, zinc and galvanized metal are attacked readily and should not be used.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, all-purpose canister respirator, protective clothing. Avoid contact with liquid. Secure ignition sources. Flush spill with large quantities of water. For a gas leak from a faulty tank, keep concentration of gas below the explosive mixture range by forced ventilation.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



DIMETHYLAMINE SOLUTION, 40%

Synonyms—Methanamine, N-methyl; N-Methyl
methanamine, 40%

United Nations Number..... 1180

CHRIS Code..... DMG

Formula— $(CH_3)_2NH$

Appearance—Clear, colorless liquid; ammoniacal,
fishy odor

Specific Gravity—0.892

Boiling Point..... 54°C 129°F

..... °C °F

Freezing Point..... -37°C -35°F

..... °C °F

Chemical Family—Aliphatic amines

Vapor Pressure 20°C (68°F) (mmHg)..... 170

Reid Vapor Pressure (psia)..... 8.8

Vapor Pressure 46°C (115°F) (psia)..... 9.2

Vapor Density (Air = 1.0)..... 1.55

Pollution Category—USEPA C IMO C

Applicable Bulk Reg. 46 CFR Subchapter Q

Solubility in Water..... Appreciable

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—B

General—Vapor is extremely flammable. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... -1 (cc)

Flammable Limits..... 2.8 to 14.4% (anhydrous)

Autoignition Temp. (°F)..... 752 (anhydrous)

Extinguishing Agents..... Water fog, CO₂, dry chemical, alcohol foam

Special Fire Procedures..... Use water fog to protect personnel and cool containers. Wear protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 3

Odor Threshold (ppm)

0.6

PEL/TWA (ppm)

10

TLV/TWA (ppm)

10

General—Vapor very irritating, liquid causes burns.

Symptoms—Vapor causes sneezing, coughing, pneumonitis, pulmonary edema. Liquid burns skin, eyes, mouth, throat.

Short Exposure Tolerance—Vapor very irritating above 10 ppm.

Exposure Procedures—Get medical attention. Inhalation: Remove to fresh air, rest, give mouth to mouth resuscitation or oxygen if needed. Ingestion: Do not induce vomiting. Skin contact: Flush skin and eyes for at least 15 minutes.

REACTIVITY DATA

Stability—Generally stable; reacts with acids, strong oxidizers. Can explode in contact with mercury if ammonia present, so keep mercury thermometers and similar instruments away.

Compatibility—Material: Suitable: Stainless steel, mild steel, iron. Unsuitable: (Corrosive) Aluminum, copper, zinc, brass, bronze.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact, do not breath vapor. Wear protective clothing (face shield, hard hat, goggles, rubber gauntlet gloves, apron, boots). Use self-contained breathing apparatus if needed. Do not flush into sewers; dike and remove, then flush spill area with water. Secure all ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

1990



DIMETHYLAMINE SOLUTION, 50%

Synonyms—Methanamine, N-methyl-; N-Methylmethanamine, 50%

United Nations Number..... 1160

CHRIS Code..... DMY

Formula— $(CH_3)_2NH$

Appearance—Clean, colorless liquid; ammoniacal, fishy odor

Specific Gravity—0.863

Chemical Family—Aliphatic amines

Pollution Category—USEPA C IMO C

Applicable Bulk Reg. 46 CFR Subchapter O

Boiling Point..... 45°C 113°F

..... °C °F

Freezing Point..... -43°C -45°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 316

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 1.55

Solubility in Water..... Appreciable

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid*

Electrical Group—B

General—Vapor is extremely flammable. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... -9

Flammable Limits..... 2.8 to 14.4% (anhydrous)

Autoignition Temp. (°F)..... 752 (anhydrous)

Extinguishing Agents..... Water fog, CO₂, dry chemical, alcohol foam

Special Fire Procedures..... Use water fog to protect personnel and cool containers. Wear protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)
3, 2, 3	0.6	10

General—Vapor very irritating, liquid causes burns.

Symptoms—Vapors cause sneezing, coughing, pneumonitis, pulmonary edema. Liquid burns skin, eyes, mouth, throat

Short Exposure Tolerance—Vapor very irritating above 10 ppm.

Exposure Procedures—Get medical attention. Inhalation: Remove to fresh air, rest, give mouth to mouth resuscitation if needed. Ingestion: Do not induce vomiting. Skin contact: Flush skin and eyes for at least 15 minutes.

REACTIVITY DATA

Stability—Generally stable; reacts with acids, strong oxidizers. Can explode in contact with mercury if ammonia present, so keep mercury thermometers and similar instruments away.

Compatibility—Material: Suitable: stainless steel, mild steel, iron. Unsuitable: (corrosive) Aluminum, copper, zinc, brass, bronze.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact, do not breath vapor. Wear protective clothing (face shield, hard hat, goggles, rubber gauntlet gloves, apron, boots). Use self-contained breathing apparatus if needed. Do not flush into sewers; dike and remove, then flush spill area with water. Secure all ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Grade based on calculated vapor pressure for 55% solution.

1990

† Unavailable



DIMETHYLETHANOLAMINE

Synonyms—Deanol; 2-(Dimethylamino)ethanol;
beta-Dimethylaminoethyl alcohol;
N,N-Dimethyl-N-(2-hydroxyethyl)amine

United Nations Number..... 2051

CHRIS Code..... DMB

Formula— $(CH_3)_2NC_2H_5OH$

Appearance—Odor—Colorless liquid; ammonia-like odor

Specific Gravity—0.89

Chemical Family—Alkanolamines

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Boiling Point..... 139°C 277°F

°C °F

Freezing Point..... -59°C -74°F

°C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 4.2

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 3.03

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—Moderate hazard, when exposed to heat or flame, can react vigorously with oxidizing materials.

Flash Point (°F)..... 105

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water may be ineffective

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Skin contact extremely dangerous.

Symptoms—Irritation of nose and throat.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—This is a relatively reactive substance which can react with many other chemicals.

Compatibility—Material: Copper and copper alloys, and zinc and galvanized iron are corroded readily and should be avoided.

Cargo: Group 8 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, full-protective clothing. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



DIMETHYLFORMAMIDE

Synonyms—N,N-Dimethylformamide; DMF; DMFA

United Nations Number..... 2265

Formula— $\text{HCON}(\text{CH}_3)_2$

CHRIS Code..... DMF

Appearance—Odor—Colorless liquid; unpleasant and fishy odor.

Bolling Point..... 153°C 307°F

Specific Gravity—0.95

Freezing Point..... -58°C -73°F

Chemical Family—Amide

Vapor Pressure 20°C (68°F) (mmHg)..... *

Pollution Category—USEPA _____ IMO D

Reid Vapor Pressure (psia)..... 0.16

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Vapor Pressure 46°C (115°F) (psia)..... 0.30

Vapor Density (Air = 1.0)..... 2.51

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate hazard, when exposed to heat or flame; can react with oxidizing materials. Vapors are irritating.

Flash Point (°F)..... 136

Flammable Limits..... 2.2 to 15.2%

Autoignition Temp. (°F)..... 833

Extinguishing Agents..... Alcohol foam, CO_2 , or dry chemical.

Special Fire Procedures..... Provide fire-fighters with self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

2, 2, 3

100

10/Skin

10/Skin

General—Moderate hazard. May be absorbed through skin. Experimental evidence of liver and kidney damage. May defat skin. Highly irritating.

Symptoms—Nausea, vomiting; skin irritation from liquid contact.

Short Exposure Tolerance—Prolonged inhalation of 100 ppm has produced liver damage in experimental animals.

Exposure Procedures—Wash contaminated skin with copious amounts of water. Irrigate eyes with water for at least 15 minutes.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Compatible with all common metals except copper and copper alloys.

Cargo: Group 10 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, safety glasses, protective clothing. Avoid contact with liquid. Secure ignition sources. Scoop up, add alcohol and burn in a safe place outside.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 3.7 mmHg at 25°C.

DIOCTYL PHTHALATE

Synonyms—Di-(2-ethylhexyl)phthalate; DOP;
bis(2-Ethylhexyl)phthalate; Octoil; Phthalic acid,
bis(2-ethylhexyl)ester

United Nations Number..... 1

Formula— $C_{26}H_{54}(COOC_8H_{17})_2$

CHRIS Code..... DOP

Appearance-Odor—Colorless oily liquid; mild odor.

Boiling Point..... 386°C 728°F

Specific Gravity—0.89

.....°C°F

Freezing Point..... -55°C -67°F

.....°C°F

Chemical Family—Ester

Vapor Pressure 20°C (68°F) (mmHg)..... 0.01

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... 13.45

Solubility in Water..... Insoluble

Pollution Category—USEPA III

Applicable Bulk Reg. 46 CFR Subchapter D

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight hazard, when exposed to heat or flame.

Flash Point (°F)..... 425

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 770

Extinguishing Agents..... Carbon dioxide, dry chemical, foam, water spray

Special Fire Procedures..... Water or foam may cause frothing. Do not direct water directly into fire. Use water to keep fire exposed containers cool.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

Unavailable

Unavailable

General—Suspected carcinogen. Produces no ill effects at normal temperatures but may give off irritating vapors at high temperatures.

Symptoms—After repeated exposures to skin, liquid causes reddening and scaling of the skin.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Skin contact—wash affected parts as soon as possible. Eye contact—flush eye gently with clean water. Continue washing for at least 15 minutes.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



1,4-DIOXANE

Synonyms—Diethylene dioxide; 1,4-Diethylenedioxi-
 Diethylene ether; Diethylene oxide; Dioxan;
 Dioxane; p-Dioxane; Glycol ethylene ether

United Nations Number..... 1185

CHRIS Code..... DOX

Formula— $O = (CH_2)_4 = O$

Appearance—Odor—Clear liquid; mild, alcoholic odor

Boiling Point..... 101°C 214°F

Freezing Point..... 12°C 54°F

Specific Gravity—1.04 at 20°/20°C

Vapor Pressure 20°C (68°F) (mmHg)..... 27

Reid Vapor Pressure (psia)..... 1.4

Vapor Pressure 46°C (115°F) (psia)..... 1.8

Vapor Density (Air = 1.0)..... 3.0

Solubility in Water..... Complete

Chemical Family—Cyclic ether

Pollution Category—USEPA B IMO D

Applicable Bulk Reg. 46 CFR Subchapter Q

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—When anhydrous, forms explosive peroxides with air. Dangerous, when exposed to heat or flame.

Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Toxic vapors are generated when heated.

Flash Point (°F)..... 54 (cc); 74 (TOC)

Flammable Limits..... 2 to 22%

Autoignition Temp. (°F)..... 356

Extinguishing Agents..... CO₂, dry chemical, alcohol foam

Special Fire Procedures..... Wear goggles, self-contained breathing apparatus and rubber overclothing.

Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 3

Odor Threshold (ppm)

620 mg/m³

PEL/TWA (ppm)

25/Skin

TLV/TWA (ppm)

25/Skin

General—Suspected carcinogen. Vapor has poor warning properties and can be inhaled in amounts which may cause serious intoxication or death with injury of liver and kidneys. Liquid can be absorbed through skin in sufficient quantities to produce injury.

Symptoms—Irritation to eyes, nose and throat (300 ppm)

Short Exposure Tolerance—300 ppm for 15 minutes cause mild irritation.

Exposure Procedures—For eye or skin contact—flush with water for 15 minutes and remove any contaminated clothing. Obtain medical care if exposed to high vapor concentration.

* NOTE: Detectable odor is greater than the TLV. Exposure to potentially dangerous vapor concentrations can occur before the vapor is detected by smell.

REACTIVITY DATA

Stability—Stable, no polymerization; forms peroxides with air, should be padded with nitrogen.

Compatibility—Material: Carbon steel recommended. Copper and copper alloys may cause slight discolorization.

Cargo: Group 41 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources. Small spills may be flushed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



DIPHENYL-DIPHENYL ETHER MIXTURE

Synonyms—Biphenyl-diphenyl ether mixture;
Diphenyl-diphenyl oxide mixture; Diphenyl
oxide-diphenyl mixture; Dowtherm A; Phenyl
ether-biphenyl mixture

United Nations Number..... +

Formula— $C_{12}H_{10}O$

CHRIS Code..... DDQ

Appearance—Odor—Straw color liquid; phenol-like odor

Boiling Point..... 257°C 495°F

Specific Gravity—1.07

Freezing Point..... 12°C 54°F

Chemical Family—Ether

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reld Vapor Pressure (psia)..... Low

Pollution Category—USEPA..... A IMO..... A

Vapor Pressure 46°C (115°F) (psia)..... Low

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

Vapor Density (Air = 1.0)..... 5.87

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate hazard, when exposed to heat or flame. Irritating vapors generated when heated.

Flash Point (°F)..... 255

Flammable Limits..... 0.8 to 3.3% at 300°F

Autoignition Temp. (°F)..... 1150

Extinguishing Agents..... CO_2 , dry chemical, water fog and foam

Special Fire Procedures..... Wear self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

1

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Skin irritation of more or less mild degree may be expected only from prolonged and repeated contacts.

Symptoms—Inhalation—eye or respiratory irritation. Skin contact—reddening, slight irritation.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush with water.

REACTIVITY DATA

Stability—Very stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, full protective clothing. Secure ignition sources. Small spills may be flushed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned

DIPHENYLMETHANE DIISOCYANATE

Synonyms—4,4-Diisocyanodiphenylmethane;
4,4'-Diphenylmethane diisocyanate;
Diphenylmethane-4,4'-diisocyanate; MDI; Methylene
bis(4-phenyl isocyanate); Methylene
bis-phenylisocyanate

Formula—(OCN₂C₆H₄)₂CH₂

Appearance-Odor—Light yellow solid (at room
temperature) or molten liquid; slightly musty odor
Specific Gravity—1.19 at 77°F (25°C)

Chemical Family—Isocyanate

Pollution Category—USEPA _____ IMO B

Applicable Bulk Reg. 46 CFR Subchapter _____ Q

United Nations Number..... 2489

CHRIS Code..... DPM

Boiling Point... Decomposes 392°C 738°F
..... °C °F

Freezing Point..... 37°C 99°F
..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reid Vapor Pressure (psia)..... V. Low

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... 8.5

Solubility in Water..... _____

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible

Electrical Group—NA

General—Light yellow solid. Flammable at high temperatures. Toxic vapors of carbon monoxide, oxides of nitrogen, hydrogen cyanide are generated when heated. Fire may cause polymerization and decomposition leading to violent rupture of containers or tanks.

Flash Point (°F)..... 374

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 465

Extinguishing Agents..... Water spray, CO₂, dry chemical, water spray.

Special Fire Procedures..... Wear self-contained breathing apparatus and protective clothing. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 4

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

0.01

TLV/TWA (ppm)

0.005

General—Vapor is strong irritant to eyes and throat; can cause eye and lung injury. Cannot be tolerated even at low concentrations.

Symptoms—Watering or reddening of eyes, diarrhea, and loss of weight. Breathlessness, chest discomfort, and reduced pulmonary function.

Short Exposure Tolerance—Animal tests have shown slight eye damage in 50% solution; oral lethal dose is in excess of 21.6 g/kg of body weight; no primary skin irritation; no deaths by inhalation in 5–6 hours.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and immediately flush affected areas with water for 15 minutes. Call a doctor.

REACTIVITY DATA

Stability—Material must be blanketed with dry nitrogen; unstable in traces of moisture, slowly forming carbon dioxide gas.

Compatibility—Material: Do not have in direct contact with wood.

Cargo: Group 12 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing and self-contained breathing apparatus. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-5802.

Remarks: * Negligible; reacts slowly.



DI-n-PROPYLAMINE

Synonyms—Dipropylamine; DPA; 1-Propanamine,
N-propyl-

United Nations Number..... 2383

CHRIS Code..... DNA

Formula— $(CH_3CH_2CH_2)_3N$

Appearance—Odor—Colorless liquid; pungent
ammoniacal odor

Specific Gravity—0.74

Chemical Family—Amines

Pollution Category—USEPA D IMO C

Applicable Bulk Reg. 46 CFR Subchapter D

Boiling Point..... 107°C 225°F

..... °C °F

Freezing Point..... -63°C -81°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 20

Reid Vapor Pressure (psia)..... 0.87

Vapor Pressure 46°C (115°F) (psia)..... 1.45

Vapor Density (Air = 1.0)..... 3.5

Solubility in Water..... 2.5% by weight

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—Dangerous when exposed to heat or flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 63

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Foam, CO₂, dry chemical

Special Fire Procedures..... Wear self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

0.01 to 0.1

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Toxic, noxious.

Symptoms—Skin burns, eye damage (permanent). Inhalation: pulmonary edema. Ingestion: alkaline burns, death.

Short Exposure Tolerance—Inhalation: 1000 ppm produces severe irritation of respiratory tract and lungs, with possible pulmonary edema.

Exposure Procedures—Get medical attention. Inhalation: Remove to fresh air, administer oxygen if needed. Skin, eye contact: Flush with water for at least 15 minutes.

REACTIVITY DATA

Stability—Stable. Reacts with acids.

Compatibility—Material: Dissolves paint and most plastics; swells rubber. Suitable: Carbon steel, stainless steel.
Unsuitable: Copper, zinc, brass, bronze, aluminum, magnesium.

Cargo: Group 7 on compatibility chart

SPILL OR LEAK PROCEDURE

Avoid contact. Wear self-contained breathing apparatus, face shield, protective clothing. Wash clothing thoroughly before reuse. For small spills, flush area with water spray. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

1990



DIPROPYLENE GLYCOL

Synonyms—2,2-Dihydroxydipropyl ether;
2,2'-Dihydroxyisopropyl ether; 1,1'-Oxydi-2-propanol

United Nations Number..... 1

Formula— $(CH_3CHOHCH_2)_2O$

CHRIS Code..... DPG

Appearance—Odor—Colorless, slightly viscous liquid;
odorless

Boiling Point..... 232°C 448°F

Specific Gravity—1.03

Freezing Point..... super cools °C °F

Chemical Family—Glycol ether

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reid Vapor Pressure (psia)..... V. Low

Vapor Pressure 46°C (115°F) (psia)..... 0.07

Vapor Density (Air = 1.0)..... 4.83

Pollution Category—USEPA _____ IMO III

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Slight hazard when exposed to heat or flame.

Flash Point (°F)..... 280

Flammable Limits..... LEL=2.2% UEL—unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Water, CO₂, dry chemical, alcohol foam

Special Fire Procedures..... Water or foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 0, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Not considered toxic under ordinary conditions of handling.

Symptoms—Minor eye irritant.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—Skin or eye contact—remove contaminated clothing and gently flush with water for 15 minutes. Get medical advice for eye contact.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



DOC ECENE

Synonyms—alpha-Dodecylene; Propylene tetramer;
Tetrapropylene

United Nations Number..... †

Formula—C₁₂H₂₄

CHRIS Code..... DOD

Appearance—Odor—Colorless liquid; pleasant odor

Boiling Point..... 213°C 415°F

Specific Gravity—0.78

Freezing Point..... -32°C -25°F

Chemical Family—Olefin

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... 0.01

Pollution Category—USEPA _____ IMO B

Vapor Pressure 46°C (115°F) (psia)..... 0.02

Applicable Bulk Reg. 46 CFR Subchapter D, Q

Vapor Density (Air = 1.0)..... 5.81

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid
Electrical Group—D

General—Moderate fire hazard when exposed to heat.

Flash Point (°F)..... 144

Flammable Limits..... LEL = 0.8% UEL—Unavailable

Autoignition Temp. (°F)..... 400

Extinguishing Agents..... Carbon dioxide, dry chemical, or foam

Special Fire Procedures..... Cool exposed tanks with water. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Vapor slightly irritating in high concentrations.

Symptoms—Slight smarting of the eyes or respiratory system if present in high concentrations.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 1 mmHg at 47.2°C.

† Unassigned



DODECYLBENZENE

Synonyms—Alkylbenzene; Detergent alkylate #2;
n-Dodecylbenzene; Laurylbenzene;
1-Phenyldodecane

United Nations Number..... ‡

Formula— $C_{12}H_{25}C_6H_5$

Appearance—Odor—Water-white liquid; kerosene-like
odor

Specific Gravity—0.86

Chemical Family—Aromatic hydrocarbons

Pollution Category—USEPA _____ IMO III

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code..... DDB

Boiling Point..... 246°C 475°F

Freezing Point..... 4°C 40°F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.01

Reid Vapor Pressure (psia)..... 4.1

Vapor Pressure 46°C (115°F) (psia)..... 4.7

Vapor Density (Air = 1.0)..... 8.4

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid.

Electrical Group—D

General—CO and CO₂ fumes produced on combustion.

Flash Point (°F)..... 235

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Confined area—CO₂, dry chemical. Open area—foam, water spray.

Special Fire Procedures..... Water or foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Very low toxicity.

Symptoms—Very low toxicity.

Short Exposure Tolerance—Very low toxicity.

Exposure Procedures—Skin contact—wash well with soap and water. Eye contact—flush with potable water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



DODECYL PHENOL

Synonyms—No common synonyms.

United Nations Number..... †

CHRIS Code..... DOL

Formula— $\text{CH}_3\text{C}_{11}\text{H}_{22}\text{C}_6\text{H}_4\text{OH}$

Appearance—Straw colored liquid; phenolic odor

Specific Gravity—0.90 to 0.99

Chemical Family—Phenols

Pollution Category—USEPA _____ IMO A

Applicable Bulk Reg. 46 CFR Subchapter _____ Q

Boiling Point..... 314-344°C 597-632°F

Reid Vapor Pressure (psia)..... †°C †°F

Freezing Point..... †°C †°F

Vapor Pressure 20°C (68°F) (mmHg)..... †

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 0.99

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame; decomposes when heated yielding toxic products.

Flash Point (°F)..... 325

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Wear self-contained breathing apparatus. Water can cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Moderately toxic, highly irritating.

Symptoms—Ingestion: Burning pain in mouth and throat, abdominal pain, vomiting, diarrhea, weakness, dizziness. Corrodes digestive tract. Inhalation: Irritation, bronchitis, pneumonia. Skin: Irritation, pain

Short Exposure Tolerance—

Exposure Procedures—Get medical attention. Ingestion: Drink water or milk, swallow activated charcoal or castor oil. Inhalation: Remove to fresh air. Skin contact: Wash twice with soap and water. Eye contact: Flush with water for at least 15 minutes.

REACTIVITY DATA

Stability—Generally stable but decomposes when heated forming toxic products. Reacts with oxidizing materials.

Compatibility—Material:

Cargo: Group 21 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact. Wear protective clothing and face shield. If spill is heated or burning, wear self-contained breathing apparatus. Material is a serious pollution hazard.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

1990



EPICHLOROHYDRIN

Synonyms—1-Chloro-2,3-epoxypropane;
3-Chloro-1,2-epoxypropane; Chloromethyloxirane;
2-Chloropropylene oxide; gamma-Chloropropylene
oxide; Oxirane, (chloromethyl)-; Propane,
1-chloro-2,3-epoxy

United Nations Number..... 2023

CHRIS Code..... EPC



Formula— $\text{CH}_2\text{CHCH}_2\text{Cl}$

Appearance—Odor—Colorless liquid; chloroform-like,
sweetish odor

Specific Gravity—1.18

Boiling Point..... 118°C 240°F

..... $^\circ\text{C}$ $^\circ\text{F}$

Freezing Point..... -58°C -73°F

..... $^\circ\text{C}$ $^\circ\text{F}$

Vapor Pressure 20°C (68°F) (mmHg)..... 12.5

Reid Vapor Pressure (psia)..... 0.87

Vapor Pressure 46°C (115°F) (psia)..... 1.0

Vapor Density (Air = 1.0)..... 3.18

Solubility in Water..... 6%

Chemical Family—Epichlorohydrin

Pollution Category—USEPA B IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—One of the products of combustion is hydrochloric acid gas, which is both toxic and corrosive. Ignited by heat and open flame. This product can decompose to form highly toxic phosgene gas.

Flash Point ($^\circ\text{F}$)..... 105

Flammable Limits..... 3.8 to 21%

Autoignition Temp. ($^\circ\text{F}$)..... 804

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog.

Special Fire Procedures..... Keep exposed tank cool with water spray. Provide respiratory and body protection to firefighting personnel.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
3, 3, 4	10 to 25	2/Skin	2/Skin

General—Suspected carcinogen. Vapor extremely irritating. Lung injury may be delayed. Liquid causes severe burns; absorbed by leather and causes delayed burns. Class B poison.

Symptoms—The liquid blisters skin on contact. The vapor causes eye and respiratory irritation. It may also cause vomiting, convulsions, rapid pulse, and respiratory paralysis.

Short Exposure Tolerance—Concentrations exceeding 40 ppm rapidly produce irritation to nose and eyes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical attention as soon as possible.

REACTIVITY DATA

Stability—Stable under usual handling conditions. However, it will polymerize at elevated temperatures or in the presence of certain catalysts; acids, alkalies and metallic halides are known to be effective catalysts for polymerization and should be avoided.

Compatibility—Material: Usually carried in steel tanks; however, the wet product will pit steel.

Cargo: Group 17 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Evacuate personnel not equipped with protective clothing and respiratory protection. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ETHANE

Synonyms—Bimethyl; Dimethyl; Ethyl hydride;
Methylmethane

United Nations Number ... refrigerated 1861
compressed 1035

CHRIS Code ETH

Formula— C_2H_6

Appearance—Odor—Colorless gas, colorless liquid;
odorless

Specific Gravity—0.45 (liquid)

Chemical Family—Saturated hydrocarbon

Pollution Category—USEPA _____ IMO 988

Applicable Bulk Reg. 46 CFR Subchapter D.Q

Boiling Point -89°C -128°F

Freezing Point -180°C -292°F

Vapor Pressure 20°C (68°F) (mmHg) V. High

Reid Vapor Pressure (psia) V. High

Vapor Pressure 46°C (115°F) (psia) V. High

Vapor Density (Air = 1.0) 1.04

Solubility in Water insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—D

General—Dangerous, when exposed to heat or flame. Unless the flow of gas can be stopped, extinguishing a fire will permit accumulation of an explosive concentration of vapor, and subsequent explosion or re-flash.

Flash Point (°F) -211

Flammable Limits 3 to 12.5%

Autoignition Temp. (°F) 859

Extinguishing Agents Stop flow of gas; CO₂, dry chemical

Special Fire Procedures Shut off gas supply, then use dry chemical or CO₂. Tanks exposed to fire should be kept cool with a continuous spray of water.

HEALTH HAZARD DATA

Health Hazard Ratings
Unavailable

Odor Threshold (ppm)
899

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Simple asphyxiant. Breathing vapor may cause unconsciousness without warning because of lack of oxygen. Contact with liquid will cause frostbite.

Symptoms—Inhalation—headache, dizziness, drowsiness. Skin contact—frostbite.

Short Exposure Tolerance—Exposure of guinea pigs to concentrations of from 4.7 to 5.5% for 2 hours caused only slight drowsiness and irregular respiration.

Exposure Procedures—Vapor—remove to fresh air; if breathing stops, apply artificial respiration. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Noncorrosive

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister respirator available. Liquid will evaporate rapidly. Secure all possible sources of ignition.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ETHANOLAMINE

Synonyms—Aminoethanol; 2-Aminoethanol;
beta-Aminoethyl alcohol; Colamine; Ethylolamine;
2-Hydroxyethylamine; beta-Hydroxyethylamine;
Monoethanolamine

United Nations Number..... 2491

Formula— $\text{HOCH}_2\text{CH}_2\text{NH}_2$

CHRIS Code..... MEA

Appearance-Odor—Colorless liquid; ammonia-like odor

Boiling Point..... 172°C 342°F

Specific Gravity—1.02

.....°C.....°F

Freezing Point..... 10°C 50°F

.....°C.....°F

Chemical Family—Amine

Vapor Pressure 20°C (68°F) (mmHg)..... 0.48

Reld Vapor Pressure (psia)..... 0.01

Vapor Pressure 46°C (115°F) (psia)..... 0.03

Vapor Density (Air = 1.0)..... 2.10

Pollution Category—USEPA..... IMO D

Solubility in Water..... Complete

Applicable Bulk Reg. 46 CFR Subchapter..... D

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid
Electrical Group—D

General—Moderate hazard, when exposed to heat or flame. Irritating vapors generated when heated.

Flash Point (°F)..... 200

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... greater than 500

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Respiratory and body protection should be worn by fire parties.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 2, 2

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

3

TLV/TWA (ppm)

3

General—Liquid contact causes severe eye irritation. Vapor inhalation causes respiratory irritation.

Symptoms—Respiratory irritation will range from itching to severe burning depending upon concentration.

Short Exposure Tolerance—50 ppm for 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, is often helpful. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—It will oxidize in the presence of air, so is often shipped under a pad of inert gas. Ethanolamine is a reactive material combining chemically with many other substances.

Compatibility—Material: Corrosive to copper and its alloys; also attacks rubber.

Cargo: Group 8 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, face shield or all-purpose canister respirator, protective clothing. Avoid contact with liquid. Cover spill with sodium bisulfate. Wash with excess of water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ETHOXY TRIGLYCOL

Synonyms—2-[2-(2-Ethoxyethoxy)ethoxy]ethanol;
Ethoxytriethylene glycol; Triethylene glycol ethyl
ether; Triglycol ethyl ether; Triglycol monoethyl
ether

United Nations Number..... 1

Formula— $C_2H_5O(CH_2)_2O(CH_2)_2OCH_2CH_2OH$

Appearance-Odor—Colorless and practically odorless

Specific Gravity—1.02

Chemical Family—Glycol ether

Pollution Category—USEPA IMO D

Applicable Bulk Reg. 46 CFR Subchapter D

CHRIS Code..... ETG

Boiling Point..... 255°C 491°F

Freezing Point..... -19°C -2°F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.01

Reid Vapor Pressure (psia)..... V. Low

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... 6.14

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Slight fire hazard, when exposed to heat or flame.

Flash Point (°F)..... 275

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Carbon dioxide, dry chemical, alcohol foam

Special Fire Procedures..... Water and foam may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Under ordinary conditions of handling, not considered toxic.

Symptoms—No appreciable hazard in ordinary handling or use.

Short Exposure Tolerance—Not pertinent.

Exposure Procedures—Eye contact—flush gently with water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



ETHYL ACETATE

Synonyms—Acetic acid, ethyl ester; Acetic ester; Acetic ether; Ethyl ethanoate; Vinegar naphtha

United Nations Number..... 1173

Formula— $\text{CH}_3\text{COOC}_2\text{H}_5$

CHRIS Code..... ETA

Appearance—Odor—Colorless liquid; pleasant, fruity odor

Boiling Point..... 77°C 171°F

Specific Gravity—0.90

Freezing Point..... -83°C -117°F

Chemical Family—Ester

Vapor Pressure 20°C (68°F) (mmHg)..... *

Pollution Category—USEPA D IMO D

Reid Vapor Pressure (psia)..... 3.27

Applicable Bulk Reg. 46 CFR Subchapter D

Vapor Pressure 46°C (115°F) (psia)..... 4.5

Vapor Density (Air = 1.0)..... 3.04

Solubility in Water..... 8.7%

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Ethyl acetate is highly flammable and its vapors form explosive mixtures with air. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 24 (cc)

Flammable Limits..... 2.2 to 11.5%

Autoignition Temp. (°F)..... 800

Extinguishing Agents..... CO_2 , alcohol foam, water fog, dry chemical

Special Fire Procedures..... Use of dry chemical where it can get into a tank of ethyl acetate is not recommended. Fire involving spills outside of tanks can be extinguished with dry chemical.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

100

400

400

General—Vapor causes some irritation. Absorption is chiefly by inhalation. Continued skin contact will dry and crack skin with chance of dermatitis and infection.

Symptoms—Headache, irritation of respiratory passages and eyes.

Short Exposure Tolerance—1000 ppm for 5 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable. Will hydrolyze (react with water) on standing to form acetic acid and ethyl alcohol. This reaction is greatly accelerated by bases (alkalies). Can react vigorously with oxidizing materials.

Compatibility—Material: Softens and dissolves rubber and many plastics.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 100 mmHg at 27°C.



ETHYL ACRYLATE

Synonyms—Acrylic acid, ethyl ester; Ethyl propenoate; Ethyl 2-propenoate; 2-Propenoic acid, ethyl ester

United Nations Number..... 1917

CHRIS Code..... EAC

Formula— $\text{CH}_2 = \text{CHCOOC}_2\text{H}_5$

Appearance-Odor—Colorless liquid; pungent odor

Specific Gravity—0.93

Chemical Family—Acrylates

Pollution Category—USEPA D IMO A

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 99°C 211°F

..... °C °F

Freezing Point..... -39°C -103°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 29.3

Reid Vapor Pressure (psia)..... 1.4

Vapor Pressure 46°C (115°F) (psia)..... 2.0

Vapor Density (Air = 1.0)..... 3.5

Solubility in Water..... 1.5%

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Ignited by heat, sparks or open flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Fire may cause violent rupture of tank. Toxic and irritating vapors generated when heated.

Flash Point (°F)..... 60(oc); 48°F (TCC)

Flammable Limits..... 1.8 to 9.5% (calculated)

Autoignition Temp. (°F)..... 700

Extinguishing Agents..... CO_2 , dry chemical, water fog, alcohol foam

Special Fire Procedures..... Keep tank cool with a water spray to prevent polymerization. Wear chemical protective clothing, eye protection and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 3

Odor Threshold (ppm)

0.00047

PEL/TWA (ppm)

5/Skin

TLV/TWA (ppm)

5

General—Suspected carcinogen. Vapor irritating.

Symptoms—Eye and throat irritation, shortness of breath, and convulsions.

Short Exposure Tolerance—50 ppm for 15 minutes. 2000 ppm vapor killed rats in 4 hours with death attributable to severe pulmonary irritation.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Will polymerize spontaneously if not inhibited.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 14 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ETHYL ALCOHOL

Synonyms—Alcohol; Alcohol Anhydrous; Alcohol C-2;
Cologne spirit; Denatured alcohol; Ethanol; Ethyl
hydroxide; Fermentation alcohol; Grain alcohol;
Methyl carbinol

United Nations Number..... 1170

Formula— C_2H_5OH

CHRIS Code..... EAL

Appearance—Odor—Colorless liquid; smells like wine or

Boiling Point..... 78°C 173°F

shellac thinner

..... °C °F

Specific Gravity—0.79

Freezing Point..... -114°C -173°F

..... °C °F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... 44

Reid Vapor Pressure (psia)..... 2.3

Vapor Pressure 46°C (115°F) (psia)..... 3.5

Vapor Density (Air = 1.0)..... 1.6

Solubility in Water..... Complete

Pollution Category—USEPA..... IMO..... III

Applicable Bulk Reg. 46 CFR Subchapter..... D

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous when exposed to heat or flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 65

Flammable Limits..... 3.3 to 19%

Autoignition Temp. (°F)..... 793

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water may not be effective unless large quantities are used.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 0, 1

Odor Threshold (ppm)

10

PEL/TWA (ppm)

1000

TLV/TWA (ppm)

1000

General—One of the least hazardous industrial organic solvents.

Symptoms—Dizziness, double vision, and other classic alcohol intoxication symptoms. These may be accompanied by symptoms such as vomiting, attributable to the denaturant.

Short Exposure Tolerance—5000–10,000 ppm irritates eyes and upper respiratory tract; stupor and drowsiness may result after an hour at this concentration. More than 1000 ppm may cause headache and eye irritation.

Exposure Procedures—Vapor—remove victim for fresh air; if breathing stops, apply artificial respiration. Eye contact—gently flush with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Secure ignition sources. Spills may be flushed away with water, but should not be flushed into a confined space because of the explosion hazard.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ETHYLAMINE

Synonyms—Aminoethane; Ethylamine, anhydrous;
Monoethylamine

United Nations Number..... 1036

CHRIS Code..... EAM

Formula— $\text{CH}_3\text{CH}_2\text{NH}_2$

Appearance—Odor—Colorless liquid or gas; strong
ammonia-like odor.

Specific Gravity—0.80

Chemical Family—Amine

Pollution Category—USEPA B IMO C

Applicable Bulk Reg. 46 CFR Subchapter O

Boiling Point..... 17°C 62°F

..... °C °F

Freezing Point..... -81°C -114°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 880

Reid Vapor Pressure (psia)..... 29.8

Vapor Pressure 46°C (115°F) (psia)..... 40.8

Vapor Density (Air = 1.0)..... 1.55

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—C

General—Toxic oxides of nitrogen may form in fire. Dangerous. Keep away from heat and open flame.
Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... less than 0

Flammable Limits..... 3.5 to 14.0%

Autoignition Temp. (°F)..... 725

Extinguishing Agents..... Alcohol foam, carbon dioxide, or dry chemical

Special Fire Procedures..... Keep burning tank and tanks adjacent to it cool with a water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 3

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

10

TLV/TWA (ppm)

10

General—Direct contact can cause burns.

Symptoms—Liquid causes eye injury and skin irritation.

Short Exposure Tolerance—Unavailable

Exposure Procedures—In case of contact with eyes or skin, immediately flush with plenty of water for at least 15 minutes; for eyes get medical attention. Remove contaminated clothing and shoes at once.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Steel, stainless steel and nickel are compatible. Aluminum and copper should not be used.

Cargo: Group 7 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

If possible, wear butyl rubber gloves, face shield or all-purpose canister respirator, and protective clothing. Secure ignition sources. Cover with sodium bisulfate. Clean up. Do not flush spill into confined spaces where flammable vapors can accumulate.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

ETHYLAMINE SOLUTION, 70%

Synonyms—Ethylamine, aqueous solutions; MEA, 70%;
Monoethylamine solution, 70%

United Nations Number..... 2270

CHRIS Code..... EAN

Formula— $C_2H_5NH_2$

Boiling Point..... 38°C 100°F

Appearance—Odor—Colorless liquid; sharp, ammoniacal
odor

Freezing Point..... < -90°C < -130°F

Specific Gravity—0.8

Vapor Pressure 20°C (68°F) (mmHg)..... 450

Chemical Family—Amine

Reid Vapor Pressure (psia)..... 14.8

Pollution Category—USEPA _____ IMO C

Vapor Pressure 46°C (115°F) (psia)..... 15.5

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Vapor Density (Air = 1.0)..... 1.56

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—D

General—Highly flammable vapor. Keep away from ignition sources. Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... below 0

Flammable Limits..... 3.5 to 14.0%

Autoignition Temp. (°F)..... 723

Extinguishing Agents..... Water fog, dry chemical, CO_2 , alcohol foam

Special Fire Procedures..... Wear protective clothing, self-contained breathing apparatus, and eye
protection.

HEALTH HAZARD DATA

Health Hazard Ratings
3, 2, 3

Odor Threshold (ppm)
0.83

PEL/TWA (ppm)
10

TLV/TWA (ppm)
10

General—This very volatile solution produces a toxic irritating vapor.

Symptoms—Inhalation: Irritation, coughing, chest pain, pulmonary edema. Ingestion: severe burns of mouth and
stomach. Skin and eyes: Severe irritation and burns.

Short Exposure Tolerance—High volatility means vapor concentration can easily exceed TLV even at room
temperature.

Exposure Procedures—Get medical attention. Skin or eye contact: Flush skin and eyes with water for 15
minutes. Inhalation: Remove to fresh air and provide mouth to mouth resuscitation or oxygen as needed.

REACTIVITY DATA

Stability—Stable. Reacts with acids and oxidizers. Reacts explosively with mercury.

Compatibility—Material: Suitable: Stainless steel, mild steel, nickel, tinned iron. Unsuitable: Copper, aluminum,
zinc, brass, bronze, galvanized iron, polyethylene, rubber.

Charge: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact and stay upwind. Eliminate ignition sources. Wear self-contained breathing apparatus or
amine-type mask, plastic gloves, face shield, goggles. Wash clothing before reuse. Flush spill area with water.
Do not flush spill into confined spaces where flammable vapors can accumulate.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

1990



ETHYLBENZENE

Synonyms—EB; Ethylbenzol; Phenylethane

United Nations Number..... 1175

CHRIS Code..... ETB

Formula— C_8H_{10}

Appearance—Odor—Colorless liquid; aromatic odor

Specific Gravity—0.87

Chemical Family—Aromatic hydrocarbon

Pollution Category—USEPA C IMO C*

Applicable Bulk Reg. 46 CFR Subchapter D.Q

Boiling Point..... 136°C 277°F
*C *F
Freezing Point..... -85°C -138°F
*C *F

Vapor Pressure 20°C (68°F) (mmHg)..... 15.3
Reid Vapor Pressure (psia)..... 0.4
Vapor Pressure 46°C (115°F) (psia)..... 0.8
Vapor Density (Air = 1.0)..... 3.66
Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Irritating vapors are generated when heated. Vapors may travel considerable distances from a source in a flammable concentration. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 59

Flammable Limits..... 1.0 to 6.7%

Autoignition Temp. (°F)..... 810

Extinguishing Agents..... CO_2 , dry chemical, foam, water fog

Special Fire Procedures..... Fight in the same manner as any Grade C petroleum fire. Firefighters should wear self-contained breathing apparatus, protective clothing and eye protection.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

2, 2, 2

140

100

100

General—Vapors cause eye irritation, dizziness, narcosis (paralysis), burns of the skin, sensation of chest constriction. Irritation of respiratory tract, conjunctivitis, dermatitis. Exfoliation of large patches of skin and chapped appearance result.

Symptoms—irritation to eyes and throat, dizziness and a feeling of chest constriction.

Short Exposure Tolerance—200 ppm for 30 minutes; 1000 ppm irritates skin and mucous membranes. 2000 ppm extremely irritating.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Rubber in prolonged exposure to ethylbenzene first swells, then softens.

Charge: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Pollution Category C oil-like, 33 CFR 151.49.

ETHYL BUTANOL

Synonyms—2-Ethylbutanol; 2-Ethyl-1-butanol; 2-Ethyl butyl alcohol; sec-Hexyl alcohol; sec-Pentylcarbinol; Pseudohexyl alcohol

United Nations Number..... 2275

CHRIS Code..... EBT

Formula— $\text{CH}_3\text{CH}_2\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{OH}$

Appearance—Odor—Colorless liquid; mild odor

Specific Gravity—0.83

Chemical Family—Alcohols

Pollution Category—USEPA _____ IMO @D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Boiling Point..... 148°C 293°F

Freezing Point..... -114°C -173°F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.9

Reid Vapor Pressure (psia)..... 0.07

Vapor Pressure 46°C (115°F) (psia)..... 0.14

Vapor Density (Air = 1.0)..... 3.4

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 137

Flammable Limits..... 1.9 to 8.8%

Autoignition Temp. (°F)..... 580 (calculated)

Extinguishing Agents..... Water spray, dry chemical, foam or CO_2 .

Special Fire Procedures..... Cool exposed tanks with water. If a leak or spill has not ignited, use water spray to disperse vapors.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 2, 0

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Low toxicity.

Symptoms—Animals tests show minor skin irritation after 24 hours. Severe surface damage of eye when alcohol in sufficient concentration. No deaths upon ingestion.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Eye and skin contact—gently flush affected areas with water for 15 minutes. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Secure ignition sources. Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ETHYL CHLORIDE

Synonyms—Chloroethane; Ether, hydrochloric;
Hydrochloric ether; Monochloroethane; Muriatic
ether

United Nations Number..... 1037

Formula— $\text{CH}_3\text{CH}_2\text{Cl}$

CHRIS Code..... ECL

Appearance-Odor—Colorless gas or liquid; ether-like
odor

Boiling Point..... 12°C 54°F

Specific Gravity—0.92

°C °F

Freezing Point..... -139°C -218°F

°C °F

Chemical Family—Halogenated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 1000

Reid Vapor Pressure (psia)..... 34.5

Vapor Pressure 46°C (115°F) (psia)..... 40

Vapor Density (Air = 1.0)..... 2.22

Pollution Category—USEPA _____ IMO # _____

Solubility in Water..... Slight

Applicable Bulk Reg. 46 CFR Subchapter..... Q

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—D

General—A highly flammable, volatile liquid; produces highly poisonous phosgene gas when ignited. Unless flow of gas can be stopped, putting out an ethyl chloride fire will permit accumulation of an explosive vapor concentration.

Flash Point (°F)..... -45

Flammable Limits..... 3.6 to 14.8%

Autoignition Temp. (°F)..... 966

Extinguishing Agents..... Stop flow of gas; CO_2 , dry chemical, water fog

Special Fire Procedures..... Fire parties must wear respiratory protection. Keep tanks cool with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

1000

TLV/TWA (ppm)

1000

General—Vapor harmful. Liquid may cause skin or eye injury similar to frostbite.

Symptoms—Irritating to eyes. Drowsiness and dizziness. Frostbitten areas will be white.

Short Exposure Tolerance—Inhalation of 19,000 ppm in air caused partial intoxication in one minute which increased to distinct intoxication with slight analgesia in 12 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and immediately flush affected areas with water for 15 minutes. Handle frostbitten parts gently. Get medical advice or attention.

REACTIVITY DATA

Stability—Dangerous reaction is possible with oxidizing agents. Slow hydrolysis (reaction with water) in presence of salt or fresh water to form toxic and corrosive fumes of hydrogen chloride gas.

Compatibility—Material: Compatible with most materials of construction.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Secure ignition sources. If water temperature is above 54°F, the ethyl chloride will soon boil off. Do not flush spill into confined spaces where flammable vapors can accumulate. Personnel not wearing respiratory protection should be kept upwind of the spill.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: # No Determination



ETHYLENE

Synonyms—Bicarbutetted hydrogen; Elayl; Ethene;
Olefiant gas

United Nations Number ... compressed 1962
refrigerated 1038

CHRIS Code ETL

Formula— CH_2CH_2

Appearance—Odor—Colorless liquid or gas; very faint,
sweet odor.

Specific Gravity—0.34

Chemical Family—Olefin

Pollution Category—USEPA IMO GAS

Applicable Bulk Reg. 46 CFR Subchapter D, O

Boiling Point -104°C -155°F

Freezing Point -169°C -272°F

Vapor Pressure 20°C (68°F) (mmHg) *

Reid Vapor Pressure (psia) *

Vapor Pressure 46°C (115°F) (psia) *

Vapor Density (Air = 1.0) 0.99

Solubility in Water Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—C

General—Unless flow of gas can be stopped, putting out an ethylene fire will permit the accumulation of an explosive vapor concentration. Vapors are anesthetic.

Flash Point ($^\circ\text{F}$) -213

Flammable Limits 2.7 to 34%

Autoignition Temp. ($^\circ\text{F}$) 842

Extinguishing Agents Stop flow of gas; CO_2 , dry chemical, water fog

Special Fire Procedures Tanks exposed in fire should be kept cool with a water spray. Attempt to shut off leak. Wear self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—A simple asphyxiant. High concentrations cause anesthesia.

Symptoms—Dizziness and drowsiness. Contact with liquid will cause frostbite.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Ethylene is a reactive compound but must be catalyzed before most reactions take place.

Compatibility—Material: Ethylene is not corrosive.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister available. For a gas leak from a faulty tank, keep concentration of gas below the explosive mixture range by forced ventilation. Avoid contact with liquid. Secure ignition sources. The liquid will rapidly boil away, leaving no residue.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Ethylene is a gas at temperatures above 48.7°F .



ETHYLENE CHLOROHYDRIN

Synonyms—2-Chlorethanol; 2-Chloroethanol;
2-Chloroethyl alcohol; Ethylene chlorhydrin; Glycol
chlorohydrin

United Nations Number..... 1135

Formula— $\text{CICH}_2\text{CH}_2\text{OH}$

CHRIS Code..... ECH

Appearance-Odor—Colorless liquid; faint
alcohol-ether-like odor.
Specific Gravity—1.21

Boiling Point..... 128°C 262°F
°C °F
Freezing Point..... -68°C -92°F
°C °F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg).....
Roid Vapor Pressure (psia)..... †
Vapor Pressure 46°C (115°F) (psia)..... 0.44
Vapor Density (Air = 1.0)..... 2.78
Solubility in Water..... Complete

Pollution Category—USEPA _____ IMO G
Applicable Bulk Reg. 46 CFR Subchapter O

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid
Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame. Dangerous; when heated to decomposition, emits highly toxic fumes of phosgene.

Flash Point (°F)..... 140
Flammable Limits..... 4.9 to 15.9%
Autoignition Temp. (°F)..... 797
Extinguishing Agents..... Water, CO_2 , alcohol foam and dry chemical
Special Fire Procedures..... Wear self-contained breathing apparatus and full protective clothing. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings..... 3, 2, 0
Odor Threshold (ppm)..... High
PEL/TWA (ppm)..... 1/Skin
TLV/TWA (ppm)..... 1/Skin

General—Little margin of safety between early reversible symptoms and fatal intoxication. Fatal amounts may be absorbed by the skin.

Symptoms—Vapor—causes nausea, vomiting, vertigo, incoordination, numbness.

Short Exposure Tolerances—Absorption by inhalation or skin may cause death. Inhalation—240 ppm lethal to rats in four hours. Human fatality at 350 ppm for two and one-half hours.

Exposure Procedures—Vapor—remove victim from vapor and administer oxygen if available. Administer artificial respiration if necessary. If swallowed, induce vomiting. Call a doctor.

REACTIVITY DATA

Stability—Dangerously decomposes at high temperatures.

Compatibility—Material: Steel is satisfactory.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear neoprene gloves, plastic protective clothing and self-contained breathing apparatus. Provide good ventilation. Secure all ignition sources. Wash skin immediately with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 6.8 mmHg at 25°C.
† Unavailable



ETHYLENE CYANOHYDRIN

Synonyms—2-Cyanoethanol; Glycol cyanohydrin;
Hydracrylonitrile; 1-Hydroxy-2-cyanoethane;
3-Hydroxypropanenitrile; 3-Hydroxypropionitrile;
beta-Hydroxypropionitrile

United Nations Number..... +

Formula— $\text{HOCH}_2\text{CH}_2\text{CN}$

CHRIS Code..... ETC

Appearance—Odor—Straw-colored liquid; not unpleasant odor.

Boiling Point...Decomposes 227°C 440°F

Specific Gravity—1.04

Freezing Point..... -48°C -50°F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Pollution Category—USEPA _____ IMO D

Reid Vapor Pressure (psia)..... V. Low

Applicable Bulk Reg. 46 CFR Subchapter..... O

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... 2.45

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—When heated, ethylene cyanohydrin gives off poisonous fumes of cyanides. Reacts with water to produce cyanide gas, which is highly poisonous and flammable vapors.

Flash Point (°F)..... 265

Flammable Limits..... 2.3 to 12.1%

Autoignition Temp. (°F)..... 922

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam

Special Fire Procedures..... Firefighters should wear self-contained breathing apparatus and full protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 0, 2

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Toxic by ingestion. Avoid high vapor concentrations.

Symptoms—Headache, dizziness, blueness of lips and fingernails.

Short Exposure Tolerance—Unavailable

Exposure Procedures—If ingested, induce vomiting at once; vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

See Medical Kit Information, Appendix B

REACTIVITY DATA

Stability—Avoid basic contamination to prevent polymerization. Stable on prolonged storage. Reacts with water. Reacts vigorously with oxidizing materials, chlorosulfonic acid, oleum, sodium hydroxide, sulfuric acid.

Compatibility—Material: Corrosive to mild steel.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid all contact with liquid or vapor. Wear rubber gloves, face shield, full protective clothing. Secure ignition sources. Flood with copious amounts of water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ± Unassigned

ETHYLENEDIAMINE

Synonyms— 1,2-Diaminoethane; 1,2-Ethanediamine;
Ethylenediamine, anhydrous

United Nations Number..... 1604

CHRIS Code..... EDA

Formula— $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$

Boiling Point..... 117°C 243°F

Appearance—Odor—Colorless liquid; mildly ammonia-like
odor

Freezing Point..... 11°C 52°F

Specific Gravity—0.91

Vapor Pressure 20°C (68°F) (mmHg)..... 10.7

Chemical Family—Amine

Reid Vapor Pressure (psia)..... 0.6

Pollution Category—USEPA D IMO C

Vapor Pressure 46°C (115°F) (psia)..... 0.9

Applicable Bulk Reg. 46 CFR Subchapter O

Vapor Density (Air = 1.0)..... 2.1

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Ignited by heat and open flame. Irritating vapors are generated when heated.

Flash Point ($^\circ\text{F}$)..... 99

Flammable Limits..... 5.8 to 11.1%

Autoignition Temp. ($^\circ\text{F}$)..... 725

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Because this material can cause severe eye and skin burns and respiratory distress, fire parties must wear full body and respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 3, 3

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

10

TLV/TWA (ppm)

10

General—Causes severe burns. Vapor harmful.

Symptoms—Coughing, redness of eyes, wheezing breath. Liquid contact can cause immediate skin damage and blistering.

Short Exposure Tolerance—400 ppm has been reported to produce immediate and severe irritation to nose and throat.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, can prove helpful. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—This is a reactive substance, combining chemically with many others.

Compatibility—Material: Copper and its alloys are corroded readily and should be avoided.

Cargo: Group 7 compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, all-purpose canister respirator, protective clothing. Secure ignition sources. Keep unprotected personnel away from spill. If possible cover with sodium bisulfate. Spray with water. An alternative is to reduce vapor hazard by covering with alcohol foam.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: On-scene supervisors should avoid vapor exposure to persons who have asthma or other respiratory ailments.



ETHYLENE DIBROMIDE

Synonyms—Bromofume; 1,2-Dibromoethane;
sym-Dibromoethane; EDB; Ethane, 1,2-dibromo-;
Ethylene bromide; Glycol dibromide

United Nations Number..... 1805

CHRIS Code..... EDB

Formula— $\text{BrCH}_2\text{CH}_2\text{Br}$

Appearance—Odor—Colorless liquid; sweet odor

Specific Gravity—2.17 at 60°F

Chemical Family—Halogenated hydrocarbon

Pollution Category—USEPA X IMO B

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 131°C 268°F

Freezing Point..... 8°C 48°F

Vapor Pressure 20°C (68°F) (mmHg)..... 8.0

Reid Vapor Pressure (psia)..... 0.4

Vapor Pressure 46°C (115°F) (psia)..... 0.7

Vapor Density (Air = 1.0)..... 8.5

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—NA

Electrical Group—D

General—Ethylene dibromide is difficultly flammable. Dangerous, when heated to decomposition, it emits highly toxic fumes of bromides.

Flash Point (°F)..... None

Flammable Limits..... None

Autoignition Temp. (°F)..... 960

Extinguishing Agents..... Water spray, dry chemical, foam or CO_2

Special Fire Procedures..... Fire fighters should wear full-protective clothing and respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 3

Odor Threshold (ppm)
22

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Skin

General—Suspected carcinogen. Prolonged contact with skin should be avoided. Toxic by inhalation, skin contact and ingestion.

Symptoms—Blistering of skin; destruction of tissue.

Short Exposure Tolerance—200 ppm for one hour; 5000 ppm for several minutes might be fatal.

Exposure Procedures—Contaminated shoes and clothing should be removed at once and the skin should be thoroughly cleaned with soap and water. If eyes are accidentally contaminated they should be flushed thoroughly with flowing water for 15 minutes. A physician should be consulted.

REACTIVITY DATA

Stability—Stable, has no oxidizing or polymerizing characteristics. Will not react with air, water vapor, fresh or salt water at temperatures below 115°F.

Compatibility—Material: Reacts vigorously with aluminum and magnesium. No appreciable attack on steel, wood, or cloth. Softens and deteriorates rubber and paint.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Wash away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ETHYLENE DICHLORIDE

Synonyms—1,2-Dichloroethane; sym-Dichloroethane;
Dutch liquid; Dutch oil; EDC; Ethane, 1,2-dichloro-;
Ethylene chloride; Glycol dichloride

United Nations Number..... 1184

CHRIS Code..... EDC

Formula— $\text{ClCH}_2\text{CH}_2\text{Cl}$

Appearance—Colorless, oily liquid; chloroform-like
odor

Specific Gravity—1.28

Chemical Family—Halogenated hydrocarbon

Pollution Category—USEPA B IMO B

Applicable Bulk Reg. 46 CFR Subchapter O

Boiling Point..... 84°C 183°F

Freezing Point..... -36°C -33°F

Vapor Pressure 20°C (68°F) (mmHg).....

Rel. Vapor Pressure (psia)..... 2.7

Vapor Pressure 46°C (115°F) (psia)..... 4.0

Vapor Density (Air = 1.0)..... 3.42

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—The vapors are irritating. In contact with a hot surface, ethylene dichloride decomposes into phosgene, which is highly poisonous. Ignited by heat, sparks or open flame.

Flash Point ($^\circ\text{F}$)..... 65

Flammable Limits..... 6.2 to 16%

Autoignition Temp. ($^\circ\text{F}$)..... 775

Extinguishing Agents..... CO_2 , dry chemical, foam, water fog

Special Fire Procedures..... Keep exposed tanks cool with water spray. Water may be ineffective on fire. Supply respiratory protection and full protective clothing for fire parties.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 2, 3

Odor Threshold (ppm)

200*

PEL/TWA (ppm)

1

TLV/TWA (ppm)

10

General—Suspected carcinogen. Vapor harmful; causes systemic poisoning through inhalation. Liquid contact on skin may cause dermatitis or a burn. Toxic by inhalation, skin contact and ingestion.

Symptoms—Irritation, dizziness, nausea, rapid pulse, blueness of lips and fingernails.

Short Exposure Tolerance—200 ppm for one hour.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

* NOTE: Detectable odor is greater than the TLV. Exposure to potentially dangerous vapor concentrations can occur before the vapor is detected by smell.

REACTIVITY DATA

Stability—Relatively stable.

Compatibility—Material: Non-corrosive at normal atmospheric temperatures when dry. When contaminated with water at elevated temperatures it corrodes iron.

Causes: Group 38 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 100 mmHg at 29.4°C .

ETHYLENE GLYCOL*

Synonyms—1,2-Dihydroxyethane; 1,2-Ethanediol;
Ethylene alcohol; Ethylene dihydrate; Glycol; Glycol
alcohol; Monoethylene glycol

United Nations Number..... †

Formula— $\text{HOCH}_2\text{CH}_2\text{OH}$

CHRIS Code..... EGL

Appearance—Colorless, syrupy liquid; slight odor,
sweetish taste

Boiling Point..... 187°C 367°F

Specific Gravity—1.13

Freezing Point..... -12°C 10°F

Chemical Family—Glycol

Vapor Pressure 20°C (68°F) (mmHg)..... 0.05

Reid Vapor Pressure (psia)..... 0.008

Pollution Category—USEPA _____ IMO D

Vapor Pressure 46°C (115°F) (psia)..... 0.01

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Vapor Density (Air = 1.0)..... 2.21

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight hazard when exposed to heat or flame.

Flash Point (°F)..... 240

Flammable Limits..... LEL=3.2% UEL-unavailable

Autoignition Temp. (°F)..... 775 (antifreeze grade); 752 (pure)

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water may be ineffective on fire. Cool fire exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 0, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
50

TLV/TWA (ppm)
50

General—Relatively non-toxic unless ingested. If ingested, serious injury or death may result from as little as 60 ml (approx. 2 oz.).

Symptoms—Headache, nausea, and dizziness.

Short Exposure Tolerance—Inhalation is no hazard at normal room temperatures.

Exposure Procedures—Ingestion: induce vomiting and call a physician. Never give fluids or induce vomiting if victim is unconscious or having convulsions. Skin and eyes: flush with water for 10 minutes.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Most materials of construction are suitable.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Data are for the "pure" grade, not the "anti-freeze" grade.

† Unassigned



ETHYLENE GLYCOL BUTYL ETHER

Synonyms—2-Butyl ethanol; Butyl Cellosolve; Butyl
oxitol; Dowanol EB; Ektasolve EB Solvent;
Ethanol, 2-butoxy-

United Nations Number..... 2388

Formula— $\text{HOCH}_2\text{CH}_2\text{OC}_4\text{H}_9$

Appearance—Odor—Colorless oily liquid; mild rancid odor

Specific Gravity—0.90

Chemical Family—Glycol ether

Pollution Category—USEPA _____ IMO III

Applicable Bulk Reg. 46 CFR Subchapter D

CHRIS Code..... EGM

Boiling Point..... 171°C 340°F

Freezing Point..... -87°C -125°F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.78

Reid Vapor Pressure (psia)..... 2.2

Vapor Pressure 46°C (115°F) (psia)..... 3.2

Vapor Density (Air = 1.0)..... 4.07

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F)..... 141 (cc)

Flammable Limits..... 1.1 to 10.6%

Autoignition Temp. (°F)..... 472

Extinguishing Agents..... Water, alcohol foam, carbon dioxide or dry chemical.

Special Fire Procedures..... The same techniques used for fighting fire involving combustible petroleum products are applicable. Cool fire exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 2

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Eye and respiratory tract irritation, narcosis, blood, kidney, and to a lesser degree, liver damage can be produced in animals from a single or repeated exposures at concentrations less than saturation.

Symptoms—Eye, nose, and throat irritation.

Short Exposure Tolerance—200 ppm for approximately one hour.

Exposure Procedures—Prevent repeated skin contact by wearing protective clothing.

REACTIVITY DATA

Stability—in general, an inert solvent.

Compatibility—Material: Compatible with usual materials of construction. Plastic materials and rubber are not recommended.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid personnel contact with liquid and vapor. Secure all sources of ignition.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ETHYLENE GLYCOL DIACETATE

Synonyms—1,2-Ethanediol diacetate; Ethylene acetate;
Ethylene diacetate; Glycol diacetate

United Nations Number..... †

CHRIS Code EGY

Formula— $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{OOCCH}_3$

Appearance—Odor—Colorless liquid; faint fruity odor

Specific Gravity—1.13

Chemical Family—Ester

Pollution Category—USEPA IMO C

Applicable Bulk Reg. 46 CFR Subchapter D.O.

Boiling Point 190°C 375°F

..... °C °F

Freezing Point -41°C -42°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) 0.3

Reid Vapor Pressure (psia) †

Vapor Pressure 46°C (115°F) (psia) Low

Vapor Density (Air = 1.0) †

Solubility in Water 10%

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard.

Flash Point (°F) 205

Flammable Limits 1.6 to 8.4%

Autoignition Temp. (°F) 900

Extinguishing Agents Confined area— CO_2 , dry chemical. Open area—polar solvent foam, water fog.

Special Fire Procedures Unavailable

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Low toxicity

Symptoms—Unavailable

Short Exposure Tolerance—Animal tests show: No primary skin irritation, a trace of eye injury. Inhalation caused no deaths in 24 hour period.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water. Call a doctor.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

‡ Unassigned



ETHYLENE GLYCOL ETHYL ETHER

Synonyms—Cellosolve Solvent; Dowanol EE; EE
Solvent; Ethanol, 2-ethoxy; 2-Ethoxyethanol;
Ethylene glycol monoethyl ether; Glycol monoethyl
ether

United Nations Number..... 1171

CHRIS Code..... EGE

Formula— $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH}$

Boiling Point..... 135°C 275°F

Appearance-Odor—Colorless liquid; ether-like odor.

..... °C °F

Practically odorless.

Freezing Point..... -78°C -94°F

Specific Gravity—0.93

..... °C °F

Chemical Family—Glycol ethers

Vapor Pressure 20°C (68°F) (mmHg)..... 4.0

Reid Vapor Pressure (psia)..... 0.1

Pollution Category—USEPA C IMO D

Vapor Pressure 46°C (115°F) (psia)..... 0.17

Applicable Bulk Reg. 46 CFR Subchapter..... D

Vapor Density (Air = 1.0)..... 3.1

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F)..... 120

Flammable Limits..... 1.7 to 15.6%

Autoignition Temp. (°F)..... 460

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog.

Special Fire Procedures..... The same techniques used for fighting fire involving combustible petroleum products are applicable. Cool fire exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 2

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

5/Skin

General—Low hazard for acute inhalation; moderate for chronic inhalation.

Symptoms—Headache, nausea, eye irritation.

Short Exposure Tolerance—Exposure to air saturated with cellosolve vapor (0.6%) for a few seconds resulted in irritation of the eyes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—This is a relatively stable compound.

Compatibility—Material: Softens rubber and many plastics. Avoid aluminum and its alloys.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ETHYLENE GLYCOL ETHYL ETHER ACETATE

Synonyms—Cellosolve Acetate; Ethanol, 2-ethoxy-, acetate; 2-Ethoxyethylacetate; Glycol monoethyl ether acetate

United Nations Number..... 1172

Formula— $\text{CH}_3\text{COOC}_2\text{H}_4\text{OC}_2\text{H}_5$

CHRIS Code..... EGA

Appearance-Odor—Colorless liquid; pleasant fruity odor

Boiling Point..... 156°C 313°F

Specific Gravity—0.97

°C °F

Freezing Point..... -62°C -79°F

°C °F

Chemical Family—Ester

Vapor Pressure 20°C (68°F) (mmHg)..... 1.2

Reid Vapor Pressure (psia)..... 0.1

Vapor Pressure 46°C (115°F) (psia)..... 0.2

Vapor Density (Air = 1.0)..... 4.72

Solubility in Water..... 23% Appreciable

Pollution Category—USEPA _____ IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F)..... 135

Flammable Limits..... LEL = 1.7% UEL—Unavailable

Autoignition Temp. (°F)..... 715

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... The same techniques used for fighting fire involving combustible petroleum products are applicable. Cool fire exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

0.056

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

5/Skin

General—Slight skin irritation. More of a chronic systemic hazard from inhalation.

Symptoms—Irritation from skin contact. Vapor: Irritation of nose and throat.

Short Exposure Tolerance—High vapor concentrations can cause nose and throat irritation.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—This is a relatively stable compound.

Compatibility—Material: Softens many plastics.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ETHYLENE GLYCOL METHYL ETHER

Synonyms—Dowanol EM; Ethanol, 2-methoxy-; Glycol monomethyl ether; 2-Methoxyethanol; Methyl Cellosolve; Methyl oxitol

United Nations Number..... 1188

Formula— $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OH}$

Appearance—Odor—Colorless liquid; mild, agreeable odor

Specific Gravity—0.97

Chemical Family—Glycol ether

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code..... EME

Boiling Point..... 124°C 255°F

..... °C °F

Freezing Point..... -85°C -121°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 8.2

Reid Vapor Pressure (psia)..... 0.39

Vapor Pressure 46°C (115°F) (psia)..... 0.6

Vapor Density (Air = 1.0)..... 2.82

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F)..... 115 (cc)

Flammable Limits..... 2.5 to 18.8%

Autoignition Temp. (°F)..... 551

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... The same techniques used for fighting fires involving combustible petroleum products are applicable. Cool fire exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 2

Odor Threshold (ppm)

0.9

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

5/Skin

General—Harmful vapor; liquid absorption through the skin may be harmful.

Symptoms—Drowsiness, confusion, loss of mental ability, headache.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—Vapor—remove the victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—This is a relatively stable compound.

Compatibility—Material: Softens many plastics.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-9802.

Remarks:

ETHYLENE OXIDE

Synonyms—Anprolene; Dimethylene oxide; EO;
Epoxyethane; 1,2-Epoxyethane; Oxirane

United Nations Number..... 1040

Formula— C_2H_4O

Appearance—Odor—Clear, colorless liquid; ether-like odor

Specific Gravity—0.88

Chemical Family—Alkylene oxides

Pollution Category—USEPA A IMO #

Applicable Bulk Reg. 46 CFR Subchapter O

CHRIS Code..... EOX

Boiling Point..... 11°C 51°F

Freezing Point..... -111°C -168°F

Vapor Pressure 20°C (68°F) (mmHg)..... 1080

Reid Vapor Pressure (psia)..... 38.5

Vapor Pressure 46°C (115°F) (psia)..... 48.0

Vapor Density (Air = 1.0)..... 1.52

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—B

General—Irritating vapors generated when heated. Flammable—does not need oxygen for combustion. If local "hot spots" develop in the tank, the liquid in the tank may explode.

Flash Point (°F)..... below 0

Flammable Limits..... 2 to 100%

Autoignition Temp. (°F)..... 804

Extinguishing Agents..... Stop flow of gas; CO_2 , dry chemical, water fog

Special Fire Procedures..... It is important to keep the temperature of storage tank low; use large amounts of water. Approach only after considering explosion danger. Keep firefighting personnel behind cover if practicable. If the water supply is inadequate or the tank shows signs of overheating, evacuate the area.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 3, 2

Odor Threshold (ppm)

50

PEL/TWA (ppm)

29 CFR 1910.1047

TLV/TWA (ppm)

1

General—Suspected carcinogen. Moderate hazard, for both acute and chronic exposures. Volatility is high and pulmonary absorption is rapid.

Symptoms—Burning sensation in eyes, nose and throat; dizziness and headache.

Short Exposure Tolerance—200 ppm for 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical attention immediately.

REACTIVITY DATA

Stability—Ethylene oxide's tendency to polymerize increases rapidly when the temperature goes above 30°C. It will decompose with explosive violence when the temperature reaches 571°C.

Compatibility—Material: EO may polymerize violently when in contact with highly active catalytic surfaces such as anhydrous iron, tin and aluminum chlorides, pure iron and aluminum oxides and alkali metal hydroxides. Do not use copper, silver or their alloys.

Cargo: Unassigned in the compatibility chart. For compatibility assistance, call G-MTH-1 (202-287-1577).

SPILL OR LEAK PROCEDURE

Wear rubber gloves, large heavy face shield (if in doubt use body shield also) and self-contained breathing apparatus. Secure ignition sources. Avoid contact with liquid. Flush with large quantities of water. Do not flush spill into confined spaces where flammable vapors can accumulate. Notify local fire department.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ETHYL ETHER

Synonyms—Anesthesia ether; Anesthetic ether; Diethyl ether; Diethyl oxide; Ethane, 1,1'-oxybis-; Ether; Ethoxyethane; Ethyl oxide; 1,1'-Oxybisethane; Solvent ether; Sulfuric ether

United Nations Number..... 1155

CHRIS Code..... EET

Formula—(C₂H₅)₂O

Appearance-Odor—Colorless liquid; sweet, pungent odor

Boiling Point..... 34°C 94°F
°C °F

Freezing Point..... -118°C -180°F
°C °F

Specific Gravity—0.70

Chemical Family—Ether

Vapor Pressure 20°C (68°F) (mmHg)..... 442

Reid Vapor Pressure (psia)..... 16.0

Vapor Pressure 46°C (115°F) (psia)..... 23.0

Vapor Density (Air = 1.0)..... 2.55

Solubility in Water..... 7.0%

Pollution Category—USEPA B IMO III

Applicable Bulk Reg. 46 CFR Subchapter..... Q

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—C

General—A highly flammable, volatile liquid with a wide explosive range and low autoignition temperature.

Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... -49

Flammable Limits..... 1.85 to 48.0%

Autoignition Temp. (°F)..... 356

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Cool tank with water spray. Keep surroundings cool to reduce the amount of vapors produced. The danger of reignition is high.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 0, 2

Odor Threshold (ppm)

1

PEL/TWA (ppm)

400

TLV/TWA (ppm)

400

General—Ethyl ether is a volatile liquid possessing irritative and narcotic properties. Absorption of excessive quantities by any route may lead progressively to a state of intoxication, loss of consciousness and death due to respiratory failure.

Symptoms—Exhilaration may be experienced first followed by drowsiness and unconsciousness. Contact with the skin may cause dermatitis.

Short Exposure Tolerance—1000 ppm for 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, when administered by trained personnel, is helpful. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—In the presence of air, ether forms ethyl peroxide, which may explode if heated.

Compatibility—Material: Compatible with most of the usual materials of construction. Ether swells natural rubber, so protective clothing should be made of plastic which resists ether.

Cargo: Group 41 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, large heavy face shield (if in doubt use body shield also). Have self-contained breathing apparatus available. Avoid contact with liquid. Secure all ignition sources. Do not flush spill into confined spaces where flammable vapors can accumulate. If a spill occurs into navigable water, the ether will float downstream and create a severe fire hazard until it has all vaporized.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



2-ETHYL HEXANOL

Synonyms—Alcohol C-8; 2-Ethyl-1-hexanol;
2-Ethylhexyl alcohol; Octanol; Octyl
alcohol

United Nations Number..... 1

CHRIS Code..... EHX

Formula— $\text{CH}_3(\text{CH}_2)_5\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{OH}$

Appearance—Odor—Colorless, slightly viscous liquid;
alcoholic odor

Specific Gravity—0.83

Boiling Point..... 183°C 352°F

Freezing Point..... <-78°C <-108°F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... 0.38

Reid Vapor Pressure (psia)..... 0.01

Vapor Pressure 46°C (115°F) (psia)..... 0.015

Vapor Density (Air = 1.0)..... 4.5

Solubility in Water..... Slight

Pollution Category—USEPA..... IMO @ C

Applicable Bulk Reg. 46 CFR Subchapter..... D. Q

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F)..... 179

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 581

Extinguishing Agents..... Alcohol foam, CO_2 , dry chemical, water spray

Special Fire Procedures..... Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Practically non-hazardous. Slight effect from absorption of liquid through skin.

Symptoms—Mild skin irritation.

Short Exposure Tolerance—Not pertinent

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing. Flush affected areas gently with water for 15 minutes; 20–30 minutes for eye contact. Get medical attention.

REACTIVITY DATA

Stability—Will undergo self-reaction if contaminated. Does not require stabilizer.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



2-ETHYLHEXYL ACRYLATE

Synonyms—Acrylic acid, 2-ethylhexyl ester;
2-Ethylhexyl, 2-propenoate; Octyl acrylate

United Nations Number..... +

CHRIS Code..... EAI

Formula— $\text{CH}_2 = \text{CHCO}_2\text{CH}_2\text{CH}(\text{C}_4\text{H}_9)\text{C}_4\text{H}_9$

Boiling Point..... 215-218°C 418-425°F

Appearance—Colorless liquid; pleasant odor

Freezing Point..... -85°C -130°F

Specific Gravity—0.89

Vapor Pressure 20°C (68°F) (mmHg)..... 0.1

Chemical Family—Acrylate

Reid Vapor Pressure (psia)..... 0.01

Pollution Category—USEPA _____ IMO B

Vapor Pressure 46°C (115°F) (psia)..... 0.015

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Vapor Density (Air = 1.0)..... 6.35

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate hazard, when exposed to heat or flame; will polymerize on heating.

Flash Point (°F)..... 188 (cc)

Flammable Limits..... LEL=0.8% UEL=6.4%

Autoignition Temp. (°F)..... 485

Extinguishing Agents..... Dry chemical, CO_2 , foam, water

Special Fire Procedures..... Water or foam may cause frothing. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 1, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Liquid irritating to skin on contact.

Symptoms—Skin irritation.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush with water.

REACTIVITY DATA

Stability—Unstable; polymerizes easily unless inhibited.

Compatibility—Material: Non-corrosive to carbon steel.

Cargo: Group 14 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear rubber gloves, face shield, and protective clothing. Have all-purpose canister mask available. Secure ignition sources. Flush spill away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Polymerizes.
‡ Unassigned



2-ETHYL HEXYL NITRATE

Synonyms—Alkyl (C7-C9) nitrates; Mixed octyl nitrates;
Octyl nitrates

United Nations Number..... †

Formula— $\text{CH}_3\text{CH}_2\text{C}_6\text{H}_{13}\text{NO}_2$

CHRIS Code..... ONE

Appearance—Odor—Light yellow liquid; ester, fruity odor

Boiling Point..... 83°C †362°F
Decomposes before boiling°C

Specific Gravity—0.96

Freezing Point..... 17°C 58°F
.....°C°F

Chemical Family—Nitrates

Vapor Pressure 20°C (68°F) (mmHg)..... 0.04

Pollution Category—USEPA IMO B

Reid Vapor Pressure (psia)..... †

Applicable Bulk Reg. 46 CFR Subchapter O

Vapor Pressure 46°C (115°F) (psia)..... 0.31

Vapor Density (Air = 1.0)..... 6

Solubility in Water..... 0.02%

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid.

Electrical Group—NA

General—Combustible—gives off toxic nitrogen oxides, carbon monoxide, and carbon dioxide gases when heated or burned.

Flash Point (°F)..... 175 (cc)

Flammable Limits..... LEL = 0.25% UEL—Unavailable

Autotemperature (°F)..... 266

Extinguishing Agents..... Water fog, foam, dry chemical, CO_2

Special Fire Procedures..... Avoid breathing vapor. Can explode if heated while confined—cool storage container with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

1 to 10

Unavailable

Unavailable

General—When heated, decomposes to form nitrogen oxides. Low toxicity by ingestion and inhalation; slightly toxic by skin contact.

Symptoms—Mild skin and eye irritation on contact. Inhalation produces headaches, dizziness, nausea, and low blood pressure.

Short Exposure Tolerance—Low health risk from inhalation unless the liquid is heated to decomposition or mist is formed.

Exposure Procedures—Ingestion: If conscious, drink water, induce vomiting. Inhalation: Remove to fresh air. Skin: Flush with soap and water. Eyes: Flush with water for at least 15 minutes.

REACTIVITY DATA

Stability—Stable at ambient temperature, decomposes when heated. Can explode if heated to high temperatures while confined. Reacts with strong oxides, strong bases, strong reducing agents.

Compatibility—Material: Suitable: Mild steel, stainless steel, aluminum, copper, zinc, tin, brass, bronze, neoprene, nitrile rubber. Unsuitable: Butyl rubber, ethylene-propylene rubber.

Cargo: Group 34 of the compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Avoid contact, especially vapor. Secure all ignition sources. Wear goggles and neoprene or nitrile gloves—use self-contained breathing apparatus if needed. Dike spill, soak up with sand or earth; dispose by controlled burning.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Decomposition point

† Unavailable

1990



ETHYLIDENE NORBORNENE

Synonyms—5-Ethylidene bicyclo(2,2,1)hept-2-ene;
Ethylidene norbornylene; Ethylidene norcamphene

United Nations Number..... 1

Formula— C_9H_{12}

CHRIS Code..... ENB

Appearance—Odor—Colorless liquid with a turpentine-like odor

Boiling Point..... 148°C 298°F

Specific Gravity—0.90

.....°C.....°F

Freezing Point..... -80°C -112°F

.....°C.....°F

Chemical Family—Olefins

Vapor Pressure 20°C (68°F) (mmHg)..... 4.53

Reid Vapor Pressure (psia)..... 0.23

Vapor Pressure 46°C (115°F) (psia)..... 0.33

Vapor Density (Air = 1.0)..... 4.1

Pollution Category—USEPA..... IMO B

Applicable Bulk Reg. 46 CFR Subchapter..... O

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid
Electrical Group—C

General—Dangerous fire hazard.

Flash Point (°F)..... 96

Flammable Limits..... 0.9 to 6.4%

Autoignition Temp. (°F)..... 522

Extinguishing Agents..... Carbon dioxide, dry chemical, foam

Special Fire Procedures..... Wear protective clothing. Water may be ineffective on fire. Cool exposed containers with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

3, 1, 4

0.007 to 0.14

5

5

General—Moderate skin irritant. Excessive contact with skin should be avoided.

Symptoms—Inhalation—vapors cause headache, dizziness, nausea, vomiting and respiratory distress.

Ingestion—irritation of entire digestive system. Irritates eyes and skin.

Short Exposure Tolerance—Prolonged exposure to vapor proved toxic to rats.

Exposure Procedures—Remove contaminated clothing and flush affected areas with plenty of water for at least 15 minutes. Remove victim to fresh air. Administer artificial respiration if necessary. If ingested, induce vomiting. Get medical attention.

REACTIVITY DATA

Stability—Stable at temperatures below 200°C, but unstable above 350°C, decomposing rapidly in presence of air.

Compatibility—Material: Non-corrosive to steel, stainless steel and aluminum. Glass, "Teflon" and ceramics are acceptable.

Cargo: Group 30 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, face shield and protective clothing. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



ETHYL METHACRYLATE

Synonyms—Ethyl 2-methacrylate; Ethyl alpha-methacrylate; Ethyl 2-methyl-2-propenoate; Methacrylic acid, ethyl ester; 2-Propenoic acid, 2-methyl-, ethyl ester

United Nations Number..... 2277

CHRIS Code..... ETM

Formula— $C_5H_8COOC_2H_5$

Boiling Point..... 117°C 243°F

Appearance—Odor—Colorless liquid; sharp unpleasant odor

Freezing Point..... -50°C -58°F

Specific Gravity—0.82

Vapor Pressure 20°C (68°F) (mmHg)..... 15

Chemical Family—Acrylates

Reid Vapor Pressure (psia)..... 0.77

Pollution Category—USEPA C IMO D

Vapor Pressure 46°C (115°F) (psia)..... 1.0

Applicable Bulk Reg. 46 CFR Subchapter Q

Vapor Density (Air = 1.0)..... 3.84

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Fire may cause violent rupture of tank due to polymerization. Forms explosive mixtures with air in the presence of heat or flame. Flashback along vapor trail may occur. Vapor may explode if heated in an enclosed area.

Flash Point (°F)..... 70

Flammable Limits..... 1.8% to saturation

Autoignition Temp. (°F)..... 740

Extinguishing Agents..... CO₂, dry chemical, chemical foam

Special Fire Procedures..... Easily forms explosives mixtures with air. Remove all sources of flames, sparks or other ignition sources. Electrical devices should be grounded and bonded. Cool tanks with water fog.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 2

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Moderately toxic, liquid causes skin irritation. Vapors mildly irritating.

Symptoms—Skin allergy develops, vapor causes corneal ulceration, visual disturbance, irritation to respiratory tract, lack of appetite, nausea, convulsion, coma.

Short Exposure Tolerance—100 ppm over 8 hours. Animal tests show effects are not cumulative.

Exposure Procedures—Remove victim to fresh air. Immediately flush affected area with water, use mild soap and water for skin exposure. Experiments have shown Ethyl Methacrylate to be a teratogen; this means that physical defects can be produced in the developing embryo.

REACTIVITY DATA

Stability—Polymerizes; inhibitor required. Can react with oxidizing agents. Ground storage drums or tanks to prevent accumulation of static electricity.

Compatibility—Material: Glass, types 316 and 304 stainless steel, or aluminum are suitable; corrosive to mild steel.

Cargo: Group 14 of compatibility chart.

SPILL OR LEAK PROCEDURE

Protective clothing, goggles, neoprene gloves, self-contained breathing apparatus should be worn. Flush spills with water fog. Dike flaming pools and extinguish using chemical foams. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



2-ETHYL-3-PROPYLACROLEIN

Synonyms—2-Ethyl hexanal; 2-Ethyl-2-hexenal;
2-Ethyl-3-propyl acrylaldehyde

United Nations Number..... 1

CHRIS Code..... EPA

Formula— $C_9H_{16}O$ = $C(C_2H_5)CHO$

Appearance—Odor—Yellow liquid; sharp, powerful,
irritating odor

Specific Gravity—0.85

Chemical Family—Aldehyde

Pollution Category—USEPA _____ IMO B

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Boiling Point..... 175°C 347°F

Freezing Point..... 3°C 38°F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.5

Reid Vapor Pressure (psia)..... 0.07

Vapor Pressure 46°C (115°F) (psia)..... 0.12

Vapor Density (Air = 1.0)..... 4.35

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F)..... 155

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 382

Extinguishing Agents..... CO_2 , dry chemical, water fog, alcohol foam

Special Fire Procedures..... The vapors of this chemical are highly irritating. For this reason, respiratory protection is necessary. In other respects, firefighting techniques will be the same as for a Grade E petroleum product.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 2

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Vapor is irritating to respiratory passages. Liquid irritating to skin.

Symptoms—Burning sensation in respiratory passages or on skin in contact with the liquid.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Unavailable

Cargo: Group 19 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Small spills may be washed away with water. For large spill, cover with sodium bisulfite ($NaHSO_3$). Add small amounts of water and mix. Scoop up. Wash site with soap solution.

If a spill occurs, call the National Response Center, 800-424-9802.

Remarks: ‡ Unassigned

FORMALDEHYDE SOLUTIONS (37 to 50%)

Synonyms—Formalin; Formalith; Formic aldehyde solution; Formol; Fyde; Methanal solution; Methylene oxide; Morbiciid

United Nations Number ... solutions 2209
flammable soln. 1188

CHRIS Code FMS

Formula—HCHO

Appearance—Odor—Colorless liquid; pungent, irritating odor

Specific Gravity—1.11 to 1.13

Chemical Family—Aldehyde

Pollution Category—USEPA _____ IMO C

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point 97°C 208°F

..... °C °F

Freezing Point 1°C °F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) 1.3

Reid Vapor Pressure (psia) 0.09

Vapor Pressure 46°C (115°F) (psia) 0.15

Vapor Density (Air = 1.0) 1.03

Solubility in Water Complete

FIRE & EXPLOSION HAZARD DATA

Grade—D or E: Combustible liquid (grade depends on concentration)

Electrical Group—B

General—When the solution is heated, highly flammable vapors are given off.

Flash Point (°F) 122 to 185

Flammable Limits 7.0 to 73% (formaldehyde vapor in air)

Autoignition Temp. (°F) 806

Extinguishing Agents CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures The vapors are highly irritating, so fire parties should wear respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
3, 2, 3	below 1	3	1*

General—Suspected carcinogen. Major effect is local irritation of eyes, nose, and throat. Strong formaldehyde solutions cause a hardening effect and primary skin irritation upon direct contact.

Symptoms—Coughing, copious watering of eyes, severe respiratory irritation.

Short Exposure Tolerance—At a vapor concentration of 10 to 20 ppm breathing becomes difficult. Exposure to 650 ppm for a few minutes may cause death.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Solutions are often shipped at elevated temperatures to prevent polymer formation.

Compatibility—Material: Corrosive to steel and to copper and its alloys.

Cargo: Group 19 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Secure ignition source. If possible, cover large spills with sodium bisulfite (NaHSO₃). Add small amount of water and mix. Scoop up. Wash site with soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: The commercial material is shipped as water solution of from about 37% to 50% concentration.

Methanol is often used to inhibit polymerization.

* Proposed change in TLV to 0.3 ppm.

† Unavailable



FORMIC ACID

Synonyms—Formic acid; Hydrogencarboxylic acid;
Methanoic acid

United Nations Number..... 1779

CHRIS Code..... FMA

Formula—HCOOH

Appearance—Odor—Colorless liquid; sharp, penetrating odor

Specific Gravity—1.22

Chemical Family—Organic acid

Pollution Category—USEPA D IMO D

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 101°C 213°F

Freezing Point..... 8°C 47°F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.8

Reid Vapor Pressure (psia)..... 1.5

Vapor Pressure 46°C (115°F) (psia)..... 2.1

Vapor Density (Air = 1.0)..... 1.6

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid.

Electrical Group—D

General—Formic acid is a corrosive, combustible liquid. Toxic vapors are generated in fires.

Flash Point (°F)..... 156 (cc)

Flammable Limits..... 18 to 57%

Autoignition Temp. (°F)..... 1114

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Firefighting parties should wear rubber boots and gauntlets and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 3, 3

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

5

TLV/TWA (ppm)

5

General—Natural, slow decomposition yields carbon monoxide (CO), a chemical asphyxiant, and water.

Enclosed spaces must be tested for oxygen content (19.5% min.) before entering. Vapor irritating. Liquid causes burns.

Symptoms—Choking, respiratory irritation, watering of the eyes; skin contact will cause severe itching or burning.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and immediately flush affected areas gently with water for 15 minutes. Get medical attention. Use protective clothing to prevent personal contact.

REACTIVITY DATA

Stability—Reacts with bases (alkalis) to produce heat. It is also a reducing agent.

Compatibility—Material: Type 316, stainless steel or lead-lined tanks are satisfactory.

Cargo: Group 4 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Use respiratory protection and protective clothing. Eliminate all sources of ignition. Cover contaminated surfaces and spill with large quantities of soda ash or sodium bicarbonate. Mix and add water if necessary for good mixing. Scoop up slurry. Wash site with soda ash solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



FREON

Synonyms—Genetron; Isotron; Halon; Refrigerant gas;
Ucon

United Nations Number.....

CHRIS Code.....

Formula—*See "Remarks" below.

Appearance—Odor—Colorless liquid or gas; sweetish
odor

Specific Gravity—above 1.0

Chemical Family—Halogenated compounds

Pollution Category—USEPA _____ IMO 0999

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Boiling Point..... °C _____ °F _____

Freezing Point..... °C _____ °F _____

Vapor Pressure 20°C (68°F) (mmHg)..... Varies

Reld Vapor Pressure (psia)..... Varies

Vapor Pressure 46°C (115°F) (psia)..... Varies

Vapor Density (Air = 1.0)..... 30 or more

Solubility in Water..... Neckleable

FIRE & EXPLOSION HAZARD DATA

Grade—NA

Electrical Group—NA

General—Freon 11, 12, and 114 do not burn. Freon 22 and 113 when heated can form weakly combustible mixtures.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... In contact with hot surfaces or a naked flame these compounds form phosgene, an extremely poisonous gas. Keep tanks, adjacent to fire, cool with water spray. Fire fighters wear full protective clothing including self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

Unavailable

1000

General—Vapors are non-irritating to eyes, nose, throat, lungs, and skin, very low toxicity.

Symptoms—Drowsiness with or without nausea.

Short Exposure Tolerance—10,000 ppm for 5 minutes.

Exposure Procedures—Remove victim to fresh air. If breathing stops, apply artificial respiration. Get medical attention. If the liquid has spilled onto the skin, points of contact may be frostbitten, handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Chemically stable, but see Special Fire Procedures above.

Compatibility—Material: Compatible with most materials of construction.

Cargo: Group 36 of Compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. The liquid may boil away (see below) at ambient temperature. Extinguish open flames in vicinity of the spill in order to avoid generation of phosgene.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:	<u>Formula</u>	<u>Freon</u>	<u>Halon</u>	<u>**Boiling Point</u>	<u>***CHRIS Code</u>
	CCl ₃ F	11	113	+74.8°F	TCF
	CCl ₂ F ₂	12	122	-21.6	DCF
	CHClF ₂	22	121	-41.4	MCF
	CCl ₂ FOCClF ₂	113	233	+117.6	TTF
	CClF ₂ CClF ₂	114	242	+38.4	DTE



FURFURAL

Synonyms—Ant oil, artificial; Artificial oil of ants; Fural;
2-Furaldehyde; 2-Furancarbal; 2-Furancarboxaldehyde; Furfuraldehyde; Furfuran
carboxylic aldehyde; Furfurole; Furole; Pyromucic
aldehyde

United Nations Number..... 1189

CHRIS Code..... FFA

Formula— C_5H_4OCHO

Boiling Point..... 161°C 322°F

Appearance—Odor—Colorless to reddish-brown liquid,
penetrating almond-like odor

Freezing Point..... -37°C -34°F

Specific Gravity—1.20

Vapor Pressure 20°C (68°F) (mmHg)..... 1.53

Chemical Family—Aldehyde

Reid Vapor Pressure (psia)..... 0.1

Pollution Category—USEPA D IMO C

Vapor Pressure 46°C (115°F) (psia)..... 0.15

Applicable Bulk Reg. 46 CFR Subchapter D

Vapor Density (Air = 1.0)..... 3.31

Solubility in Water..... 8.3%

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Moderate hazard, when exposed to heat or flame. Furfural can explode on contact with strong mineral acids and alkalis (caustics). Irritating vapors are generated when heated.

Flash Point (°F)..... 155

Flammable Limits..... 2.1 to 19.3%

Autoignition Temp. (°F)..... 743

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Wear eye protection, self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

2, 2, 3

0.4

2/Skin

2/Skin

General—Liquid is irritating to skin and eyes on contact. Vapor is respiratory irritant.

Symptoms—Irritation of respiratory passages.

Short Exposure Tolerance—15 ppm for 15 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Furfural can explode on contact with strong mineral acids and alkalis. Reacts with numerous organic materials.

Compatibility—Material: Dissolves or softens many plastics and rubber formulations.

Cargo: Group 19 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves and protective clothing. Have self-contained breathing apparatus available. Avoid contact with liquid. Small spills may be washed away with water. Cover large spills with sodium bisulfite (NaHSO₃). Add small amount of water and mix. Scoop up. Wash site with soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



FURFURYL ALCOHOL

Synonyms—2-Furancarbinol; 2-Furanmethanol;
Furfuralcohol; Furylcarbinol; 2-Furylcarbinol;
alpha-Furylcarbinol; 2-Furylmethanol;
2-Hydroxymethylfuran

United Nations Number..... 2874

Formula— $C_6H_6OCH_2OH$

CHRIS Code..... FAL

Appearance—Odor—Colorless-amber liquid turning to
dark red-brown when exposed to light and air.
Slight brine-like odor.
Specific Gravity—1.29

Boiling Point..... 171°C 349°F
.....°C.....°F
Freezing Point..... -31°C -24°F
.....°C.....°F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... 1
Reid Vapor Pressure (psia)..... 0.07
Vapor Pressure 46°C (115°F) (psia)..... 0.1
Vapor Density (Air = 1.0)..... 3.37
Solubility in Water..... Complete

Pollution Category—USEPA..... IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid
Electrical Group—C

General—Slight explosion hazard when exposed to heat or flame. However it will react with explosive violence
in contact with mineral acids or their vapors, or with strong organic acids or their vapors.

Flash Point (°F)..... 167
Flammable Limits..... 1.8 to 16.3%
Autoignition Temp. (°F)..... 916
Extinguishing Agents..... Confined area—CO₂, dry chemical. Open area—polar solvent foam, water
spray.
Special Fire Procedures..... Wear eye protection, clothing resistant to furfuryl alcohol, respiratory
protection.

HEALTH HAZARD DATA

Health Hazard Ratings..... 2, 1, 2
Odor Threshold (ppm)..... 8
PEL/TWA (ppm)..... 10/Skin
TLV/TWA (ppm)..... 10/Skin

General—Skin absorption may cause toxic effects. Harmful if swallowed. Toxic concentrations of vapors may be
present at temperatures above room temperature.

Symptoms—Headaches, watering eyes, irritated skin.

Short Exposure Tolerance—Vapor exposures—Rats show 8 percent mortality after one six hour exposure to 47
ppm and 100 percent mortality at 243 and above. Absorption through skin is very rapid.

Exposure Procedures—Eyes—wash with water for 10 minutes. Remove contaminated clothing and wash.
Skin—wash with soap and water. Ingestion—induce vomiting. Inhalation—move to fresh air. Get medical
advice or attention.

REACTIVITY DATA

Stability—Stable. Reactive with organic or mineral acids.

Compatibility—Material: Do not use near lacquers, varnish, or resins. Can ship in ordinary steel.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact
with liquid. Secure ignition sources. Spill area may be washed with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Ground storage drums or tanks to prevent accumulation of static electricity.



GASOLINE, MOTOR

Synonyms—Benzin; Motor spirit; Petrol

United Nations Number.....1203

Formula— C_8H_{12} to C_9H_{18}

Appearance—Odor—Colorless to straw-white liquid;
sweet, pleasant odor—gasoline

Specific Gravity—0.72 to 0.78

Chemical Family—Misc. hydrocarbon mixture

Pollution Category—USEPA _____ IMO 1

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code.....GAT

Boiling Point.....60–199°C 140–380°F

°C °F

Freezing Point.....°C °F

°C °F

Vapor Pressure 20°C (68°F) (mmHg).....180

Reid Vapor Pressure (psia).....7.4

Vapor Pressure 46°C (115°F) (psia).....12.5

Vapor Density (Air = 1.0).....3.4

Solubility in Water.....Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous fire and explosion hazard in presence of heat or flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F).....–40

Flammable Limits.....1.4 to 7.6%

Autoignition Temp. (°F).....495

Extinguishing Agents.....CO₂, dry chemical, foam water fog

Special Fire Procedures.....Tanks exposed to fire should be kept cool with a water spray. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 2

Odor Threshold (ppm)
0.25

PEL/TWA (ppm)
300

TLV/TWA (ppm)
300

General—Liquid irritating to skin and eyes on contact. Vapor inhalation leads to intoxication.

Symptoms—Inhalation: Marked vertigo, inability to walk a straight line, hilarity, incoordination, intense burning in throat and lungs, possibly bronchopneumonia, nausea, vomiting.

Short Exposure Tolerance—0.5 to 1.6% vapor concentration was fatal to a man after 5 minutes exposure; 500 to 30,000 ppm was fatal to a youth.

Exposure Procedures—Inhalation: Immediately remove victim from contaminated atmosphere. If breathing is interrupted, artificial respiration should be applied immediately. A physician should be called.

REACTIVITY DATA

Stability—Chemically stable.

Compatibility—Material: Almost any usual material of construction is suitable. Natural rubber is softened and will deteriorate rapidly.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear polyethylene gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources. Small spills may be flushed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



GLUTARALDEHYDE SOLUTION, 50%

Synonyms—Cidex; 1,3-Diformylpropane; Gluteral;
Glutaric dialdehyde; Glutarol; Pentanedial;
1,5-Pentanedial

United Nations Number..... †

CHRIS Code..... GTA

Formula— $\text{HO}(\text{CH}_2)_3\text{COH}$

Appearance—Odor—Light yellow liquid; rotten apple odor

Specific Gravity—1.124

Chemical Family—Aldehydes

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Boiling Point..... 188°C 370°F

Freezing Point..... -14°C 7°F

Vapor Pressure 20°C (68°F) (mmHg)..... 17

Reid Vapor Pressure (psia)..... <1

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 3.4

Solubility in Water..... Soluble

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable

Electrical Group—NA

General—Will decompose if heated (greater than approximately 400°C) to yield carbon monoxide, carbon dioxide, hydrocarbons.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... None

HEALTH HAZARD DATA

Health Hazard Ratings

1, 3, 3

Odor Threshold (ppm)

0.04

PEL/TWA (ppm)

0.2

TLV/TWA (ppm)

0.2

General—Moderate irritation to the skin.

Symptoms—Extended exposures result in irritation of respiratory tract. Ingestion yields irritation of mouth and stomach.

Short Exposure Tolerance—The lowest lethal concentration for rats in 4 hours is 5000 ppm.

Exposure Procedures—Immediately flush with plenty of water for 15 minutes. For ingestion, give large amounts of water and induce vomiting if conscious.

REACTIVITY DATA

Stability—Stable, but decomposes thermally about 400°C forming carbon oxides and hydrocarbons.

Compatibility—Material: Mildly corrosive to mild steel, aluminum, copper, zinc, tin, brass and bronze.

Cargo: Group 19 of compatibility chart.

SPILL OR LEAK PROCEDURE

Flush with water. Wear goggles or face shield and rubber gloves. Prevent water contamination. Toxic to fish.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable
‡ Unassigned



GLYCERINE

Synonyms—Glycerol; Glycyl alcohol; 1,2,3-Propanetriol;
Trihydroxypropane; 1,2,3-Trihydroxypropane

United Nations Number..... 1

Formula— $\text{CH}_2\text{COCH}_2\text{COH}(\text{CH}_2)_2$

CHRIS Code..... GCR

Appearance-Odor—Colorless liquid; faint pleasant odor

Boiling Point..... 280°C 554°F

..... °C °F

Specific Gravity—1.26

Freezing Point..... 18°C 64°F

..... °C °F

Chemical Family—Ketone/Alcohol (exhibits properties of both)

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reid Vapor Pressure (psia)..... V. Low

Pollution Category—USEPA _____ IMO III

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... 3.17

Applicable Bulk Reg. 46 CFR Subchapter..... D

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight hazard, when exposed to heat, flame, or powerful oxidizers.

Flash Point (°F)..... 320

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 698

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

0, 0, 0

Odorless

10 mg/m³ as a mist

10 mg/m³ as a mist

General—Skin contact with liquid causes slight skin irritation.

Symptoms—Contact with the liquid can cause skin irritation.

Short Exposure Tolerance—No appreciable hazard.

Exposure Procedures—Wash glycerine from skin with water. Launder clothing contaminated by the liquid.

REACTIVITY DATA

Stability—Reacts with strong oxidizing agents. Polymerizes about 300°F.

Compatibility—Material: No apparent effect on steel or aluminum.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Secure ignition sources. Spills may be washed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Even a small amount of water or other impurity will greatly lower the freezing point.

‡ Unassigned



HEPTANE

Synonyms—Dipropylmethane; n-Heptane; Heptyl hydride; Normal heptane

United Nations Number..... 1208

CHRIS Code..... HPT

Formula— $\text{CH}_3(\text{CH}_2)_5\text{CH}_3$

Appearance—Odor—Volatile, colorless liquid, sweet gasoline-like odor
Specific Gravity—0.68

Boiling Point..... 98°C 208°F
Freezing Point..... -91°C -132°F

Chemical Family—Saturated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 11.4
Reid Vapor Pressure (psia)..... 1.8
Vapor Pressure 46°C (115°F) (psia)..... 2.5
Vapor Density (Air = 1.0)..... 3.45
Solubility in Water..... Negligible

Pollution Category—USEPA _____ IMO C
Applicable Bulk Reg. 46 CFR Subchapter _____ D.O.

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid
Electrical Group—D

General—Highly flammable, dangerous fire risk. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 25 (cc)
Flammable Limits..... 1.2 to 6.7%
Autoignition Temp. (°F)..... 433
Extinguishing Agents..... Confined area— CO_2 , dry chemical. Open area—foam.
Special Fire Procedures..... Fire fighters should have respiratory devices. Keep fire exposed containers cool with water.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
0, 0, 1	220	400	400

General—Moderately toxic by inhalation.

Symptoms—Irritation of mucous membranes, dizziness, slight nausea, intoxication.

Short Exposure Tolerance—1000 ppm for 6 minutes developed slight dizziness. 500 ppm for 15 minutes results in a condition resembling intoxication by ethyl alcohol.

Exposure Procedures—If inhaled in conc. amounts, remove victim to fresh air and use oxygen. If splashed in eyes, wash with water for 15 minutes. Call a doctor.

REACTIVITY DATA

Stability—Non-reactive but dangerous fire risk. Keep away from heat, sparks, or open flame.

Compatibility—Material: Mild steel and stainless steel are suitable. Natural rubber will soften and deteriorate rapidly.

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Have all-purpose canister masks available. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



HEXAMETHYLENEIMINE

Synonyms—Azacyclohexane; Hexahydroazepine;
Homopiperidine

United Nations Number..... 2493

Formula— $C_6H_{12}N$

CHRIS Code..... HMI

Appearance—Odor—Colorless to light yellow liquid;
ammonia-like odor
Specific Gravity—0.88

Boiling Point..... 132°C 270°F
Freezing Point..... -35°C -36°F

Chemical Family—Imine

Vapor Pressure 20°C (68°F) (mmHg)..... 5
Reid Vapor Pressure (psia)..... 4.2
Vapor Pressure 46°C (115°F) (psia)..... 5.6
Vapor Density (Air = 1.0)..... 1
Solubility in Water..... Complete

Pollution Category—USEPA _____ IMO C
Applicable Bulk Reg. 46 CFR Subchapter _____ Q

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid
Electrical Group—C

General—Toxic oxides of nitrogen may form in fire. Dangerous fire hazard. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 62
Flammable Limits..... 1.8 to 2.3%
Autoignition Temp. (°F)..... Unavailable
Extinguishing Agents..... Water, CO_2 , dry chemical
Special Fire Procedures..... Wear eye protection and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
3, 3, 3	Unavailable	Unavailable	Unavailable

General—Liquid is irritating to the skin and respiratory tract and the vapor causes eye injury. High vapor concentration may cause serious eye injury.

Symptoms—Eye, skin and respiratory irritation.

Short Exposure Tolerance—The approximate lethal vapor concentration for a four hour exposure is reported to be 4800 ppm in rats.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, is often helpful. Skin or eye contact—immediately flood affected areas gently with water. Remove contaminated clothing and continue to flush affected areas for 15 minutes. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Corrodes copper and its alloys in air; corrodes aluminum especially when wet. Removes paint; swells rubber. No effect on carbon steel, wood, cloth.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Self-contained breathing apparatus of all-purpose canister mask should be worn when contact is anticipated. Wear impervious gloves and safety goggles. Keep away from heat, sparks and open flames; avoid breathing of vapors. Flush spill with large quantities of water. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



iso-HEXANE

Synonyms—2-Methyl pentane

United Nations Number..... 1208

Formula— $\text{CH}_3(\text{CH}_2)_4\text{CH}_3$

Appearance—Colorless liquid; gasoline-like odor

Specific Gravity—0.66

Chemical Family—Saturated hydrocarbons

Pollution Category—USEPA _____ IMO C

Applicable Bulk Reg. 46 CFR Subchapter _____ D, O

CHRIS Code..... IHA

Boiling Point..... 80°C 140°F

°C °F

Freezing Point..... -152°C -242°F

°C °F

Vapor Pressure 20°C (68°F) (mmHg)..... >100

Reid Vapor Pressure (psia)..... 6.0

Vapor Pressure 46°C (115°F) (psia)..... 9.0

Vapor Density (Air = 1.0)..... 3.0

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—B or C: Flammable liquid depending on flash point and Reid Vapor Pressure.

Electrical Group—D

General—Dangerous. Keep away from sparks, heat, or open flame. Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... -10

Flammable Limits..... 1.7 to 7.0%

Autoignition Temp. (°F)..... 583

Extinguishing Agents..... Carbon dioxide, dry chemical, water spray

Special Fire Procedures..... Cool containers with water if exposed to fire. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

500

TLV/TWA (ppm)

Unavailable

General—Vapor slightly irritating. Liquid causes slight skin irritation on contact.

Symptoms—Inhalation causes irritation of respiratory tract, cough, mild depression, cardiac arrhythmia. Aspiration causes severe irritation of lungs, coughing, pulmonary edema; excitement followed by depression. Ingestion causes nausea, vomiting, swelling of abdomen, headache, depression.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Inhalation: maintain respiration, give oxygen, if needed. Aspiration: enforce bed rest; administer oxygen. Ingestion: DO NOT induce vomiting. Get medical attention or advice. Eyes: wash with copious amounts of water. Skin: wipe off, wash with soap and water.

REACTIVITY DATA

Stability—Dangerous; keep away from sparks, heat, or open flame. Can react vigorously with oxidizing materials.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 31 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources. Do not flush spill into confined spaces where flammable vapors can accumulate.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



n-HEXANE

Synonyms—Hexane; Hexyl hydride; Normal hexane

United Nations Number..... 1208

Formula— C_6H_{14}

CHRIS Code..... HXA

Appearance—Odor—Colorless watery liquid; gasoline-like odor.

Boiling Point..... 69°C 158°F

Specific Gravity—0.86

Freezing Point..... -94°C -137°F

Chemical Family—Saturated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 97.0

Reid Vapor Pressure (psia)..... 5.0

Pollution Category—USEPA..... IMO C

Vapor Pressure 46°C (115°F) (psia)..... 7.0

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

Vapor Density (Air = 1.0)..... 2.98

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... -7.0

Flammable Limits..... 1.1 to 7.7%

Autoignition Temp. (°F)..... 500

Extinguishing Agents..... Dry chemical, foam or carbon dioxide.

Special Fire Procedures..... Water may be ineffective on fire. Cool fire exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

0, 0, 1

Unavailable

50

50

General—Minor skin irritant. Irritation caused by vapor inhalation. n-Hexane is toxic by ingestion.

Symptoms—Inhalation causes irritation of respiratory tract cough and mild depression. Aspiration causes severe lung irritation, coughing and pulmonary edema. Ingestion causes nausea, vomiting, swelling of abdomen, headache and depression.

Short Exposure Tolerance—30,000 ppm vapor concentration causes narcosis of rats in one hour. 0.5% vapor concentration caused distinct dizziness and giddiness of humans in just ten minutes.

Exposure Procedures—Vapor—remove from area and administer artificial respiration, if necessary, and then oxygen. Eye-wash immediately with copious amounts of water. Ingestion—DO NOT induce vomiting. Get medical attention or advice.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Certain plastics are unsuitable.

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield and protective clothing. Have all purpose canister mask available. Gas leak—keep concentration of gas below explosive limits by forced ventilation. Liquid—absorb on paper and discharge paper. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

HEXANOL

Synonyms—Alcohol C-6; Amyl carbinol; 1-Hexanol;
n-Hexanol; Hexanols; Hexyl alcohol; n-Hexyl
alcohol; 1-Hydroxyhexane; Pentylcarbinol

United Nations Number..... 2282

CHRIS Code..... HXN

Formula— $\text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{OH}$

Appearance—Odor—Colorless liquid; mild-sweet odor

Boiling Point..... 157°C 315°F

..... °C °F

Freezing Point..... -52°C -62°F

..... °C °F

Specific Gravity—0.82

Vapor Pressure 20°C (68°F) (mmHg)..... <1.0

Reid Vapor Pressure (psia)..... 0.75

Vapor Pressure 46°C (115°F) (psia)..... 1.00

Vapor Density (Air = 1.0)..... 3.52

Solubility in Water..... Slight

Chemical Family—Alcohol

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F)..... 140

Flammable Limits..... 1.2 to 7.7% (calculated)

Autoignition Temp. (°F)..... 559

Extinguishing Agents..... Carbon dioxide, dry chemical, alcohol foam, water spray

Special Fire Procedures..... Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings
unavailable

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Practically non-toxic. Handle as a detergent.

Symptoms—Similar to alcohol intoxication.

Short Exposure Tolerance—Saturated vapor not fatal.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable. May soften some paints and plastics.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear chemical gloves and goggles. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



HEXYLENE GLYCOL

Synonyms—2-Methyl-2,4-pentanediol;
Trimethyltrimethylene glycol; alpha, alpha,
alpha'-Trimethyltrimethylene glycol

United Nations Number..... 1

CHRIS Code..... HXG

Formula— $(CH_3)_2COHCH_2CHOHCH_3$

Appearance-Odor—Colorless liquid; slight odor

Boiling Point..... 196°C 385°F

..... °C °F

Specific Gravity—0.92

Freezing Point..... -50°C -58°F

..... °C °F

Chemical Family—Glycol

Vapor Pressure 20°C (68°F) (mmHg)..... 0.05

Reid Vapor Pressure (psia)..... Low

Pollution Category—USEPA IMO III

Vapor Pressure 46°C (115°F) (psia)..... 0.01

Applicable Bulk Reg. 46 CFR Subchapter D

Vapor Density (Air = 1.0)..... 4.0

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F)..... 205

Flammable Limits..... 4.7 to 100%

Autoignition Temp. (°F)..... greater than 500°F.

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water or foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 0, 0

Odor Threshold (ppm)

less than 50

PEL/TWA (ppm)

25

TLV/TWA (ppm)

25

General—Vapor irritating to skin and eyes at high concentrations. Liquid very irritating to eyes, slightly irritating to skin.

Symptoms—Headache, dizziness, nausea; strong local irritation of the eyes, nose, and throat; and respiratory discomfort.

Short Exposure Tolerance—1 ppm for 30 minutes.

Exposure Procedures—Remove victim to fresh air. Give artificial respiration if necessary. Wash spilled liquid from skin with water. Get medical attention if rash develops or if victim has any breathing difficulty.

REACTIVITY DATA

Stability—Reacts with strong oxidizing agents.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



HYDROCHLORIC ACID

Synonyms—Chlorohydric acid; Hydrogen chloride;
Muriatic acid

United Nations Number..... 1789

CHRIS Code..... HCL

Formula—HCl (dissolved in water)

Appearance—Odor—Colorless to light yellow liquid;
irritating, pungent odor

Specific Gravity—1.01 to 1.21

Chemical Family—Inorganic acid

Pollution Category—USEPA D IMO D

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 110°C 230°F

..... °C °F

Freezing Point..... -78°C -105°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 212

Reid Vapor Pressure (psia)..... 8.0

Vapor Pressure 46°C (115°F) (psia)..... 10.5

Vapor Density (Air = 1.0)..... 1.26

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as a corrosive liquid.

Electrical Group—B (based upon possible hydrogen gas (H₂) generation should a leak or spill occur)

General—Hydrochloric acid will not burn. It will react with many metals, giving off hydrogen gas which is highly flammable. If hydrogen is trapped in confined spaces, it can form an explosive mixture with air. See data sheet for hydrogen. Toxic and irritating vapors are generated when heated.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... Acid tanks exposed to a fire should be cooled by a water spray. Fire parties must wear respiratory protection in order to avoid breathing acid vapor. Full protective clothing must also be worn.

HEALTH HAZARD DATA

Health Hazard Ratings
3, 3, 2

Odor Threshold (ppm)
1 to 5

PEL/TWA (ppm)
5*

TLV/TWA (ppm)
5*

General—Inhalation of gas results primarily in irritation of upper respiratory passages. Liquid severely irritating to skin and eyes.

Symptoms—Where touched by liquid, the skin may tingle or burn. Breathing the vapors will cause severe coughing and watering of the eyes.

Short Exposure Tolerance—Inhalation of 1500 ppm in air are fatal in a few minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, is often helpful. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Reacts with bases (caustics) to generate heat.

Compatibility—Material: Corrodes many metals, causing the evolution of hydrogen gas. Iron and aluminum are corroded readily.

Cargo: Group 1 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Have body shield available. Secure ignition sources. If possible, cover the contaminated surface and spill with sodium bicarbonate or a soda ash, slaked lime mixture (50-50). Mix and add water if necessary to form a slurry. Scoop up slurry. Wash site with soda ash solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * PEL and TLV based upon hydrogen chloride gas.



(NOTE: This cargo is currently not permitted to be shipped in bulk in U.S. waters)

HYDROGEN (Liquefied)

Synonyms—LH₂; Liquid hydrogen; Protium

United Nations Number ... compressed 1049
refrigerated 1996

Formula—H₂

Appearance—Odor—Colorless gas or liquid; odorless

Specific Gravity—0.07 at b.p.

Chemical Family—

Pollution Category—USEPA _____ IMO # _____

Applicable Bulk Reg. 46 CFR Subchapter _____

CHRIS Code HXX

Boiling Point -253°C -423°F

Freezing Point °C °F

Freezing Point -259°C -435°F

Freezing Point °C °F

Vapor Pressure 20°C (68°F) (mmHg) V. High

Reid Vapor Pressure (psia) V. High

Vapor Pressure 46°C (115°F) (psia) V. High

Vapor Density (Air = 1.0) 0.07

Solubility in Water Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—B

General—Will react violently with strong oxidizers. Will ignite easily with oxygen. Vapors form explosive or combustible mixture with air over a wide range of concentrations. Flame is almost invisible. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F) Gas

Flammable Limits 4.0 to 75%

Autoignition Temp. (°F) 1075

Extinguishing Agents First stop flow of gas. CO₂, dry chemical, water

Special Fire Procedures Source of hydrogen MUST be eliminated before fire is put out to prevent accumulation of explosive vapors. If the insulation fails on a liquid hydrogen tank exposed to fire, the tank will explode; evacuate firefighters and have them take cover.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Odorless

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Simple asphyxiant. Not considered toxic. Avoid skin contact with liquid.

Symptoms—Inhalation: Drowsiness and high-pitched, squeaky voice. Skin contact: Numbness and whitening of skin at the area of contact.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Remove victim to fresh air; if breathing stops, apply artificial respiration. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention immediately. Avoid sparks and open flames.

REACTIVITY DATA

Stability—Will ignite readily when exposed to spark source. Liquid hydrogen will flash into vapor at temperature above -400°F resulting in a sudden and large increase in pressure if confined.

Compatibility—Material: Mild steel and most iron alloys become brittle at liquid hydrogen temperatures. Aluminum and stainless steel (300 series) may be used.

Cargo: Not shipped in bulk.

SPILL OR LEAK PROCEDURE

Secure all nearby ignition sources immediately. Isolate spill area and call local fire department and the Captain of the Port, U.S. Coast Guard. If the liquid does not catch fire, it will soon boil off and leave no residue.

If a spill occurs, call the National Response Center, 800-424-8902.

Remarks: * Bulk shipments not permitted.

HYDROGEN PEROXIDE (72% or less)

Synonyms—Albone; High-strength hydrogen peroxide;
Hioxyl; Hydrogen dioxide; Hydroperoxide; Peroxide;
Superoxol

United Nations Number..... 2015

Formula— H_2O_2

CHRIS Code..... HPO

Appearance—Odor—Colorless watery liquid; slightly sharp
odor.

Boiling Point..... 125°C 257°F

Freezing Point..... -40°C -40°F

Specific Gravity—1.29 or less

Vapor Pressure 20°C (68°F) (mmHg)..... *

Chemical Family—

Reid Vapor Pressure (psia)..... Varies

Vapor Pressure 46°C (115°F) (psia)..... Varies

Pollution Category—USEPA..... IMO C

Vapor Density (Air = 1.0)..... Varies

Applicable Bulk Reg. 46 CFR Subchapter..... C

Solubility in Water..... Soluble

FIRE & EXPLOSION HAZARD DATA

Grade—Not applicable

Electrical Group—Not applicable

General—Not flammable but may cause fire and react violently with combustibles and metals. Powerful oxidizer.
May cause fire and explode on contact with combustibles and metals.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... Powerful oxidizer. Wear protective clothing including self-contained breathing
apparatus. Flood discharge area with water.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 3, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

1

TLV/TWA (ppm)

1

General—Vapor is irritating.

Symptoms—Vapors cause eye and nose discomfort in moderate concentrations; less than 52% causes
temporary irritation. Above 52% can cause blisters and eye damage.

Short Exposure Tolerance—77 ppm for 30 minutes.

Exposure Procedures—Avoid contact, immediately flush with water. If ingested give water, induce vomiting if
conscious. Remove contaminated clothing and shoes.

REACTIVITY DATA

Stability—Pure grades are stable, but contamination with metals or dirt can cause violent or rapid
decomposition.

Compatibility—Material: Incompatible with iron, copper, brass, bronze, chromium, zinc, lead, manganese, silver,
and catalytic metals.

Cargo: Unassigned in compatibility chart. For compatibility assistance, call

G-MTH-1 (202-267-1577).

SPILL OR LEAK PROCEDURE

Wear protective inner and outer clothing, impermeable apron, neoprene gloves. Flush area with water. Isolate
material from contacting flammable liquids or combustible materials. Evacuate area for at least 1/2 mile if fire
exists.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 5 mmHg at 86°F.



2-HYDROXYETHYL ACRYLATE

Synonyms—Ethylene glycol monoacrylate; HEA;
beta-Hydroxyethyl acrylate; 2-Hydroxyethyl
2-propenoate

United Nations Number..... 1

Formula— $H_2C = CHCOOCH_2OH$

CHRIS Code..... HAI

Appearance—Odor—Colorless liquid with sweet odor

Boiling Point..... <210°C <410°F

..... °C °F

Specific Gravity—1.10

Freezing Point..... -30°C -22°F

..... °C °F

Chemical Family—Monomers and polymerizable esters

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... NP

Solubility in Water..... Complete

Pollution Category—USEPA..... IMO B

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard; however, dangerous when exposed to high temperatures due to liberation of toxic fumes.

Flash Point (°F)..... 220

Flammable Limits..... LEL = 1.8% UEL—unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... CO₂, dry chemical, water, alcohol foam.

Special Fire Procedures..... Wear eye protection, self-contained breathing apparatus, and impermeable protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

4, 4, 4

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Severe eye damage, irritated skin, serious illness after ingestion. Class B poison.

Symptoms—Watering of eyes, red or irritated skin.

Short Exposure Tolerance—Avoid inhalation of hot vapors. Irritation of skin upon short contact; burn after prolonged contact. Animal tests show no deaths after ingestion.

Exposure Procedures—If swallowed, induce vomiting; remove victim to fresh air if any ill effects from breathing vapors are felt. Flush eyes and skin immediately after contact for approximately 15 minutes. Call a doctor.

REACTIVITY DATA

Stability—No spontaneous decomposition, but can polymerize.

Compatibility—Material: Corrodes mild steel, tin plate, and polymerizes. No effect on stainless steel, aluminum, or mild steel with phenolic resin surfaces. Swells rubber, removes paints.

Cargo: Unassigned in compatibility guide. See Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear eye protection. Neoprene rubber or other impermeable protective clothing should be worn. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



ISO* (as a prefix)
Look under parent compound.

Synonyms—

United Nations Number.....

CHRIS Code

Formula—

Boiling Point °C °F

Appearance-Odor—

..... °C °F

Specific Gravity—

Freezing Point °C °F

Chemical Family—

Vapor Pressure 20°C (68°F) (mmHg)

Pollution Category—USEPA IMO

Reid Vapor Pressure (psia)

Applicable Bulk Reg. 46 CFR Subchapter

Vapor Pressure 46°C (115°F) (psia)

Vapor Density (Air = 1.0)

Solubility in Water

FIRE & EXPLOSION HAZARD DATA

Grade—

Electrical Group—

General—

Flash Point (°F)

Flammable Limits

Autoignition Temp. (°F)

Extinguishing Agents

Special Fire Procedures

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

FEL/TWA (ppm)

TLV/TWA (ppm)

General—

Symptoms—

Short Exposure Tolerance—

Exposure Procedures—

REACTIVITY DATA

Stability—

Compatibility—Material:

Cargo:

SPILL OR LEAK PROCEDURE

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * For example, if you wanted to look up iso-propyl alcohol it would be shown as iso-PROPYL ALCOHOL under "P" not "I".



ISOPHORONE

Synonyms—Isosacetophenone;
3,5,5-Trimethyl-2-cyclohexene-1-one

United Nations Number..... +

Formula— $C(O)CHC(CH_3)CH_2C(CH_3)_2CH_2$

CHRIS Code..... IPH

Appearance—Odor—Water white liquid; peppermint-like odor

Boiling Point..... 215°C 419°F

Specific Gravity—0.93

Freezing Point..... -8°C 17°F

Chemical Family—Ketone

Vapor Pressure 20°C (68°F) (mmHg)..... 0.3

Pollution Category—USEPA D IMO D

Reid Vapor Pressure (psia)..... Low

Applicable Bulk Reg. 46 CFR Subchapter..... D

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 4.75

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 184

Flammable Limits..... 0.84 to 3.8%

Autoignition Temp. (°F)..... 860

Extinguishing Agents..... Water spray, carbon dioxide, dry chemical or foam.

Special Fire Procedures..... Use water spray to disperse vapors. Water may be used to flush spills.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 2, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

4

TLV/TWA (ppm)

5

General—Highly toxic, strong irritant to skin and eyes.

Symptoms—Eye, nose, and throat irritation; narcosis.

Short Exposure Tolerance—25 ppm is an irritant to most humans. Animal tests resulted in eye injury and slight skin irritation after 24 hours; inhalation killed 1 of 6 animals in 8 hours.

Exposure Procedures—Remove victim to fresh air and use oxygen. Flush eyes for 15 minutes with water. Wash off skin. Get medical help.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Steel is satisfactory.

Cargo: Group 18 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, and protective clothing. Secure ignition sources. Have all-purpose canister mask available. Keep unprotected personnel upwind. Flush spill with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



ISOPRENE

Synonyms—beta-MethylbivinyI; 2-Methyl-1,3-butadiene;
3-Methyl-1,3-butadiene

United Nations Number..... 1218

CHRIS Code..... IPR

Formula— $\text{CH}_2 = \text{C}(\text{CH}_3)\text{CH} = \text{CH}_2$

Appearance—Odor—Colorless liquid; mild aromatic odor

Boiling Point..... 34°C 93°F

°C °F

Freezing Point..... -148°C -231°F

°C °F

Specific Gravity—0.69

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... 15.0

Vapor Pressure 46°C (115°F) (psia)..... 23.0

Vapor Density (Air = 1.0)..... 2.35

Solubility in Water..... Insoluble

Chemical Family—Olefins

Pollution Category—USEPA B IMO C

Applicable Bulk Reg. 46 CFR Subchapter Q

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—D

General—In a fire, polymerization may occur and violently rupture the container. It is recommended that isoprene be stored under an inert atmosphere (preferably nitrogen) with at least 50 ppm tert-butylcatechol present as an inhibitor. Keep away from sparks, heat or open flame.

Flash Point (°F)..... -65

Flammable Limits..... 2.0 to 9.0%

Autoignition Temp. (°F)..... 428

Extinguishing Agents..... Carbon dioxide, dry chemical, foam

Special Fire Procedures..... Cool exposed tanks with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

0.005

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Isoprene is an irritant to mucuous membranes of the eyes, nose, and upper respiratory passages.

Symptoms—Vapor—Eye and upper respiratory tract irritant. Liquid may irritate eyes.

Short Exposure Tolerance—No data on human exposure are available but concentrations of 5% in air are fatal to mice.

Exposure Procedures—Remove to fresh air. In case of contact with liquid immediately flush skin or eyes with water for at least 15 minutes; remove contaminated clothing and shoes at once. Call a physician.

REACTIVITY DATA

Stability—Readily oxidized, polymerized. Should be inhibited to prevent polymerization.

Compatibility—Material: May soften some types of rubber or paint.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources. Do not flush spill into confined spaces where flammable vapors can accumulate.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 400 mmHg at 15°C.



KEROSENE

Synonyms—Coal oil; Fuel oil no. 1; Illuminating oil;
Kerosine; Range oil

United Nations Number..... 1223

CHRIS Code..... KRS

Formula—Mixture of hydrocarbons

Boiling Point..... 170-300°C 338-572°F

Appearance-Odor—Pale yellow to water white oily liquid;
strong odor

Freezing Point..... -45°C -50°F

Specific Gravity—0.81

Vapor Pressure 20°C (68°F) (mmHg)..... 2.04

Chemical Family—Petroleum oil

Reid Vapor Pressure (psia)..... 0.1

Pollution Category—USEPA _____ IMO 1

Vapor Pressure 46°C (115°F) (psia)..... 0.15

Applicable Bulk Reg. 46 CFR Subchapter..... D

Vapor Density (Air = 1.0)..... 4.5

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Flammable, moderate risk.

Flash Point (°F)..... 100 to 150

Flammable Limits..... 0.7 to 5.0%

Autoignition Temp. (°F)..... 444

Extinguishing Agents..... Confined area—CO₂, dry chemical. Open area—foam, water fog.

Special Fire Procedures..... Tanks exposed to fire should be kept cool with a water spray. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 1

1

Unavailable

Unavailable

General—Moderately toxic by ingestion and inhalation.

Symptoms—Inhalation: Marked vertigo, inability to walk a straight line, hilarity, incoordination, intense burning in throat and lungs, possibly bronchopneumonia, nausea, vomiting.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Inhalation: Remove victim from contaminated atmosphere. If breathing is interrupted, artificial respiration should be applied immediately. Call a doctor.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Most metals are suitable, but kerosene causes rusting of steel.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources. Small spills may be flushed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



LIQUEFIED NATURAL GAS

Synonyms—LNG; Methane, refrigerated liquid, or
Natural gas; refrigerated liquid

United Nations Number ... compressed 1971
refrigerated 1972

CHRIS Code LNG

Formula—Mixture of CH₄ and C₂H₆

Appearance-Odor—Colorless liquefied gas; usually
odorized to give a weak skunk like odor

Specific Gravity—0.41 to 0.45 at -182°C

Chemical Family—Paraffins

Pollution Category—USEPA _____ IMO 098

Applicable Bulk Reg. 46 CFR Subchapter _____ D O

Boiling Point -161°C -258°F

..... °C °F

Freezing Point -182°C -296°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) High

Reid Vapor Pressure (psia) High

Vapor Pressure 46°C (115°F) (psia) High

Vapor Density (Air = 1.0) 0.55-1.0

Solubility in Water Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—D

General—Containers may explode in fire. Vapor may travel to ignition source and flash back along vapor trail.

Unless the flow of gas can be stopped, putting out an LNG fire will permit the accumulation of an explosive concentration of vapor and subsequent explosion or reflash.

Flash Point (°F) Flammable gas

Flammable Limits 5.3 to 14.0%

Autoignition Temp. (°F) 999

Extinguishing Agents Stop flow of gas; Dry chemical for small fires.

Special Fire Procedures Use water to cool exposed tanks. Do not extinguish large spill fires. Allow to burn while cooling adjacent equipment with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 0, 0

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Vapors are non-irritating to eyes and throat. Liquid will cause frostbite.

Symptoms—If concentration of gas is high enough, may cause asphyxiation. No systemic effect even at 5% concentration in air.

Short Exposure Tolerance—Data not available.

Exposure Procedures—Vapor—remove victim to open air. Administer artificial respiration if necessary. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Stainless steel, nickel steel and aluminum are suitable.

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources. Call fire department. For leak from faulty tank keep concentration below flammable limits by forced ventilation. If the LNG does not catch fire, it will soon boil off.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



LIQUEFIED PETROLEUM GAS

Synonyms—Bottled gas; LPG; Petroleum gases.
liquefied; Propane-Butane mixtures; Pyrofax

United Nations Number 1075

CHRIS Code LPG

Formula—Mixture of C_3H_8 's and C_4H_{10}

Appearance—Odor—Colorless compressed gas, with faint
skunk odor

Specific Gravity—0.51 to 0.58 at -50°C (liquid)

Chemical Family—Paraffins

Pollution Category—USEPA IMO gas

Applicable Bulk Reg. 46 CFR Subchapter D, Q

Boiling Point -40°C -40°F

..... $^{\circ}\text{C}$ $^{\circ}\text{F}$

Freezing Point $\text{NP}^{\circ}\text{C}$ $^{\circ}\text{F}$

..... $^{\circ}\text{C}$ $^{\circ}\text{F}$

Vapor Pressure 20°C (68°F) (mmHg) High

Reid Vapor Pressure (psia) High

Vapor Pressure 46°C (115°F) (psia) High

Vapor Density (Air = 1.0) 1.5

Solubility in Water Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—D

General—Containers may explode in fire. Vapor is heavier than air and may travel a long distance to a source of ignition and flash back. Unless the flow of gas can be stopped, putting out an LPG fire will permit the accumulation of an explosive concentration of vapor and subsequent explosion or reflash.

Flash Point ($^{\circ}\text{F}$) 156

Flammable Limits 2.2 to 9.5%

Autoignition Temp. ($^{\circ}\text{F}$) 871

Extinguishing Agents Stop flow of gas; Water (Let fire burn)

Special Fire Procedures Allow to burn while cooling adjacent equipment with water. Shut off leak if possible.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 0, 0

Odor Threshold (ppm)
5000 to 20000

PEL/TWA (ppm)
1000

TLV/TWA (ppm)
1000

General—Not irritating to eyes, nose or throat. If inhaled, will cause dizziness. Liquid will cause frostbite.

Symptoms—Concentration in air greater than 10% causes dizziness in a few minutes. High concentration cause asphyxiation.

Short Exposure Tolerance—None

Exposure Procedures—Vapor—remove victim to open air. Administer artificial respiration if necessary. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Stainless steel, nickel steel and aluminum are suitable.

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources. Call fire department. For leak from faulty tanks, keep concentration below flammable limits by forced ventilation. If the LPG does not catch fire, it will soon boil off.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



MALEIC ANHYDRIDE

Synonyms—cis-Butenedioic anhydride; 2,5-Furandione

United Nations Number..... 2215

Formula— $C_4H_2O_3$

CHRIS Code..... MLA

Appearance—Colorless liquid, white solid (as needles, crystals or fused tablets); acrid, choking odor

Boiling Point..... 200°C 392°F

Specific Gravity—Molten: 1.3 at 70°C; Solid: 1.48 at 15°C

Freezing Point..... 60°C 140°F

Chemical Family—

Vapor Pressure 20°C (68°F) (mmHg)..... 0.15

Pollution Category—USEPA D IMO D

Reid Vapor Pressure (psia)..... †

Applicable Bulk Reg. 46 CFR Subchapter Q

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 3.38

Solubility in Water.....

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Mild fire hazard. Inertion with nitrogen recommended to avoid reaction with water vapor. When heated, can decompose and overpressurize storage tanks.

Flash Point (°F)..... 215 (cc); 230 (oc)

Flammable Limits..... 1.4 to 7.1%

Autoignition Temp. (°F)..... 878

Extinguishing Agents..... Alcohol foam, carbon dioxide

Special Fire Procedures..... Water and foam can cause frothing. Can react with dry chemical. Keep tanks cool in fire by spraying water on them from safe distance. Wear self-contained breathing apparatus, and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 2, 1

Odor Threshold (ppm)

0.3 to 0.5

PEL/TWA (ppm)

0.25

TLV/TWA (ppm)

0.25

General—Will burn skin and eyes; dangerous to aquatic life.

Symptoms—Inhalation: Moderately irritating, coughing, sneezing, bronchitis from chronic exposure. Skin: Irritation, redness; dermatitis from chronic exposure. Eyes: Irritation, can be severe, tearing. Ingestion: Little or no risk; nausea.

Short Exposure Tolerance—Limited inhalation risk if space well ventilated.

Exposure Procedures—Ingestion: Induce vomiting. Inhalation: Remove to fresh air, give oxygen if necessary. Skin contact: Flush with water for at least 15 minutes. Eye contact: Flush with water for at least 15 minutes; call physician. For skin contact with molten maleic anhydride, remove solid from skin and treat as normal chemical and thermal burn, and wash with soap and water.

REACTIVITY DATA

Stability—Generally stable. When heated in presence of alkali metals or amines (even in low concentrations of 200 ppm), decomposes rapidly and can overpressurize tanks. Reacts with strong oxidizers. No reactivity except in presence of water (corrosive).

Compatibility—Material: Not corrosive to metals except in the presence of water.

Cargo: Group 11 of compatibility chart.

SPILL OR LEAK PROCEDURE

Use protective equipment including goggles, face shield, rubber gloves, rubber boots, coveralls, rubber apron. Use organic vapor-acid gas canister. Dike and let spill solidify, then dispose. Alternative, add water to dissolve spill (forming maleic acid) and neutralize with soda ash, then dispose.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Hydrolyzes slowly with cold water; frothing with hot water

† Unavailable

1990



MESITYL OXIDE

Synonyms—Isobutenyl methyl ketone;
Isopropylideneacetone; Methyl iso-butenyl ketone;
Methyl isobutenyl ketone; 4-Methyl-3-penten-2-one;
iso-Propylideneacetone

United Nations Number..... 1229

CHRIS Code..... MSO

Formula— $(CH_3)_2C = CHCOCH_3$

Boiling Point..... 130°C 266°F

Appearance—Odor—Oily, colorless liquid; honey-like odor

°C °F

Freezing Point..... -59°C -74°F

Specific Gravity—0.86

°C °F

Chemical Family—Ketones

Vapor Pressure 20°C (68°F) (mmHg)..... 8.7

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... 0.67

Vapor Density (Air = 1.0)..... 3.5

Pollution Category—USEPA _____ IMO D

Solubility in Water..... Slight

Applicable Bulk Reg. 46 CFR Subchapter _____ O

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Flammable, dangerous fire risk, vapor forms explosive mixture with air. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 84

Flammable Limits..... 1.3 to 8.8%

Autoignition Temp. (°F)..... 652

Extinguishing Agents..... Alcohol foam, carbon dioxide or dry chemical

Special Fire Procedures..... Wear complete protective clothing and self-contained breathing apparatus.

Cool exposed tanks with water. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

3, 3, 3

12

15

15

General—Moderately toxic by ingestion, inhalation, and skin absorption.

Symptoms—Irritation of eyes, headaches, coughing, difficult breathing, nose and throat irritation, mild intoxication.

Short Exposure Tolerance—5 minutes—100 ppm predicted eye and mucous membrane irritation with difficult breathing, headache. Similar exposure at 800 ppm. Predicted severe eye and respiratory irritation. Vapor conc. 500 ppm for 30–80 min. considered dangerous to life.

Exposure Procedures—Immediately remove victim from exposure and treat on symptomatic bases. Flush skin promptly with soap and water. If swallowed, do not induce vomiting. Get medical attention.

REACTIVITY DATA

Stability—Stable. Reacts with oxidizing agents; strong alkalis (caustics), and mineral acids.

Compatibility—Material: Non-corrosive to steel.

Cargo: Group 18 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

METHACRYLIC ACID

Synonyms—alpha-Methacrylic acid; 2-Methylacrylic acid; 2-Methylpropenoic acid; 2-Methylpropanoic acid; Propenoic acid, 2-methylene

United Nations Number..... 2531

Formula— $\text{CH}_2 = \text{C}(\text{CH}_3)\text{COOH}$

CHRIS Code..... MAD

Appearance-Odor—Water-white liquid with a vinegar-like odor

Boiling Point..... 161°C 325°F

Specific Gravity—1.015

°C °F

Freezing Point..... 14°C 57°F

°C °F

Chemical Family—Organic acid

Vapor Pressure 20°C (68°F) (mmHg)..... 1

Reid Vapor Pressure (psia)..... 0.048

Vapor Pressure 46°C (115°F) (psia)..... 0.097

Vapor Density (Air = 1.0)..... 2.5

Solubility in Water..... Soluble

Pollution Category—USEPA _____ IMO 0

Applicable Bulk Reg. 46 CFR Subchapter..... 0

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate to dangerous when heated to decomposition, emitting toxic fumes.

Flash Point (°F)..... 171

Flammable Limits..... 2.1 to 12.6%

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Alcohol foam, CO₂, dry chemicals or water spray.

Special Fire Procedures..... High temperatures give off toxic acidic fumes. Wear self-contained breathing apparatus, and full protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

5

20

20

General—Vapors are mildly irritating to the eyes; the liquid is strongly corrosive to the skin and eyes.

Symptoms—Irritation of eyes, nose and throat; skin may experience a slight burning sensation.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Move victim to fresh air, keep warm and quiet. Eyes—flush with water for at least 15 minutes. Skin—flush with water then wash with soap. Ingestion—do not induce vomiting. Call a physician immediately.

REACTIVITY DATA

Stability—Normally stable; however, if stored above 120°F for long periods of time, it can polymerize violently, giving off heat. Reacts with oxidizers.

Compatibility—Material: Corrodes steel, wood, cloth and paint. Glass, 302, 304 and 316 stainless steel are suitable.

Cargo: Group 4 of the compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, aprons, boots and acid goggles. Avoid skin contact and prolonged exposure to vapors. Neutralize spills with soda ash and flush with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Methacrylic acid is normally inhibited with hydroquinone or the methyl ether of hydroquinone.



METHACRYLONITRILE

Synonyms—2-Cyanopropene; Isopropene cyanide;
MAN; 2-Propenenitrile, 2-methyl-

United Nations Number..... 3079

CHRIS Code..... MET

Formula— $\text{CH}_2 = \text{C}(\text{CH}_3)\text{CN}$

Appearance—Odor—Clear, colorless liquid; no

appreciable odor

Specific Gravity—0.80

Chemical Family—Cyanides

Pollution Category—USEPA C IMO B

Applicable Bulk Reg. 46 CFR Subchapter O

Boiling Point..... 90°C 195°F

..... °C °F

Freezing Point..... -36°C -32°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 48.3

Reid Vapor Pressure (psia)..... 7.64

Vapor Pressure 46°C (115°F) (psia)..... 10.8

Vapor Density (Air = 1.0)..... 1.17

Solubility in Water..... 2.6%

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—NA

General—Very flammable; tends to polymerize violently rather than burn. Decomposes to toxic products.

Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 55

Flammable Limits..... Unavailable—tends to polymerize violently

Autoignition Temp. (°F)..... Unavailable—tends to polymerize violently

Extinguishing Agents..... Water fog, alcohol foam, CO_2 , dry chemical

Special Fire Procedures..... Wear self-contained breathing apparatus and protective clothing. Use water to cool exposed containers.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

1*

1/Skin

1/Skin

General—Very toxic, avoid all contact.

Symptoms—Only moderately irritating to eyes and skin. Inhalation: Weakness, headache, confusion, nausea, vomiting, respiratory paralysis, convulsions.

Short Exposure Tolerance—

Exposure Procedures—Get medical attention. Inhalation: Remove to fresh air, create artificial airway if needed.

Eyes: Flush with water for at least 15 minutes. Skin: Wash with soap and water twice. Medical personnel should wear protective clothing.*

See Medical Kit Information, Appendix B

REACTIVITY DATA

Stability—Generally stable except when heated. Polymerizes on prolonged exposure to light. Reacts with oxidizers and reducers.

Compatibility—Material: Suitable: Iron

Cargo: Group 15 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid all contact, including vapor. Remove all ignition sources. Absorb with clay, earth, sawdust. Dispose by authorized incineration or landfill. Wear gloves, goggles, rubber aprons and boots, self-contained breathing apparatus. Wash clothing before reuse.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * NOTE: Detectable odor and TLV are the same, therefore odor is not a reliable method of detecting hazardous concentrations.

1990



METHANE

Synonyms—Marsh gas; Methyl hydride; Natural gas

United Nations Number ... compressed 1971
refrigerated 1972

Formula—CH₄

CHRIS Code MTH

Appearance—Odor—Colorless gas; mild, sweet odor

Boiling Point -162°C -259°F
°C °F

Specific Gravity—0.42 at -160°C (a liquid)

Freezing Point -182°C -289°F
°C °F

Chemical Family—Paraffin

Vapor Pressure 20°C (68°F) (mmHg) V. High

Pollution Category—USEPA IMO Gas

Reid Vapor Pressure (psia) V. High

Applicable Bulk Reg. 46 CFR Subchapter D, Q

Vapor Pressure 46°C (115°F) (psia) V. High

Vapor Density (Air = 1.0) 0.55

Solubility in Water Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—D

General—Unless the flow of gas can be stopped, putting out a methane fire will permit the accumulation of an explosive concentration of vapor and subsequent explosion or reflash.

Flash Point (°F) -306

Flammable Limits 5.0 to 15%

Autoignition Temp. (°F) 1000

Extinguishing Agents Stop flow of gas; Water, CO₂, or dry chemical

Special Fire Procedures Keep burning tank and methane tanks adjacent to it cool with a water spray.
Stop flow of gas.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 0

Odor Threshold (ppm)

200

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Simple asphyxiant. Breathing gas may cause unconsciousness without warning because of lack of oxygen.

Symptoms—Liquid can cause frostbite on skin contact. High gaseous concentrations may cause asphyxiation. No systemic effects, even at 5% concentration in air.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Remove to fresh air; if breathing has stopped, apply artificial respiration. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Non-corrosive to steel

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources. If methane does not catch fire, it will soon boil off.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



METHOXY TRIGLYCOL

Synonyms—2-[2-(2-Methoxyethoxy)ethoxy]ethanol;
Triethylene glycol methyl ether

United Nations Number..... †

CHRIS Code..... MTG

Formula— $\text{CH}_3\text{O}(\text{C}_2\text{H}_4\text{O})_3\text{H}$

Appearance—Odor—Colorless liquid; mild odor

Specific Gravity—1.05

Chemical Family—Glycol ether

Pollution Category—USEPA IMO D

Applicable Bulk Reg. 46 CFR Subchapter D

Boiling Point..... 249°C 480°F

..... °C °F

Freezing Point..... -44°C -47°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 5.66

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Moderate fire hazard if exposed to heat.

Flash Point (°F)..... 245

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Alcohol foam

Special Fire Procedures..... Unavailable

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—No health hazard under normal conditions of handling.

Symptoms—Unavailable

Short Exposure Tolerance—Unavailable

Exposure Procedures—Eye contact—flush gently with water. Get medical advice if any discomfort.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unassigned



METHYL ACETATE

Synonyms—Acetic acid, methyl ester

United Nations Number..... 1231

Formula— $\text{CH}_3\text{COOCH}_3$

Appearance—Odor—Colorless liquid; fragrant odor

Specific Gravity—0.92

Chemical Family—Ester

Pollution Category—USEPA IMO III

Applicable Bulk Reg. 46 CFR Subchapter D

CHRIS Code..... MTT

Boiling Point..... 54°C 129°F
..... $^\circ\text{C}$ $^\circ\text{F}$

Freezing Point..... -98°C -144°F
..... $^\circ\text{C}$ $^\circ\text{F}$

Vapor Pressure 20°C (68°F) (mmHg)..... 170

Reid Vapor Pressure (psia)..... 4.8

Vapor Pressure 46°C (115°F) (psia)..... 6.1

Vapor Density (Air = 1.0)..... 2.6

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous, when exposed to heat or flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point ($^\circ\text{F}$)..... 14

Flammable Limits..... 4 to 14%

Autoignition Temp. ($^\circ\text{F}$)..... 850

Extinguishing Agents..... Alcohol foam, dry chemical, or CO_2

Special Fire Procedures..... Water may be ineffective due to low flash point, but water should be used to keep fire-exposed containers cool. If a leak or spill has not ignited, use water spray to disperse the vapors and to protect men attempting to stop a leak. Water may dilute spills to non-flammable mixtures.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 0, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

200

TLV/TWA (ppm)

200

General—Skin contact with liquid causes defatting and cracking of skin. Vapor irritating.

Symptoms—Irritation of respiratory passages, eyes, dizziness, depression, burning of eyes.

Short Exposure Tolerance—400 ppm for unknown duration.

Exposure Procedures—If the eyes are affected, irrigate continuously with water for at least 15 minutes. Obtain medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Compatible with common materials of construction.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



METHYL ACETYLENE-PROPADIENE MIXTURE

Synonyms—Allene-methyl acetylene mixture; MAPP Gas; Methyl acetylene-allene mixture; Propadiene-methyl acetylene mixture; Propyne-allene mixture

United Nations Number..... 1080

CHRIS Code..... MAP

Formula— $\text{CH}_2\text{C}\equiv\text{CH}$, $\text{H}_2\text{C}=\text{C}\equiv\text{CH}_2$ plus other C-3s and C-4s, saturated and unsaturated.

Appearance-Odor—Colorless gas with musty odor

Specific Gravity—0.58

Chemical Family—Hydrocarbon (Olefin)

Pollution Category—USEPA _____ IMO gas

Applicable Bulk Reg. 46 CFR Subchapter O

Boiling Point..... °C ____ °F ____

..... °C ____ °F ____

Freezing Point..... °C ____ °F ____

..... °C ____ °F ____

Vapor Pressure 20°C (68°F) (mmHg)..... 5820

Reid Vapor Pressure (psia)..... 1.85

Vapor Pressure 46°C (115°F) (psia)..... High

Vapor Density (Air = 1.0)..... 1.5

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—Liquified Flammable Gas (LFG)

Electrical Group—C

General—MAPP gas is highly flammable but not shock sensitive. Unless the flow of gas can be stopped, putting out a MAPP gas fire will permit the accumulation of an explosive concentration of vapor, and subsequent explosion or reflash.

Flash Point (°F)..... Flammable gas

Flammable Limits..... 3.4 to 10.8%

Autoignition Temp. (°F)..... 850

Extinguishing Agents..... Stop flow of gas; Water, CO_2 , dry chemical

Special Fire Procedures..... Use water spray to cool burning tank and adjacent MAPP tanks.

HEALTH HAZARD DATA

Health Hazard Ratings
Unavailable

Odor Threshold (ppm)
100

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—The toxicity of MAPP is similar to that of propane and acetylene.

Symptoms—Contact with MAPP liquid may cause frost-type burns.

Short Exposure Tolerance—Toxicity is slight, but high concentrations (5000 ppm) can have an anesthetic effect.

Exposure Procedures—Remove to fresh air. Give artificial respiration if breathing stops. If liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—This cargo is stabilized.

Compatibility—Material: Alloys containing over 67% copper should not be used.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Boiling Range: -38 to -20°C; -36 to -4°F.

** Freezing Range: -101 to -137°C; -151 to -214°F.



METHYL ACRYLATE

Synonyms—Acrylic acid, methyl ester; Methyl propenoate; Methyl 2-propenoate; 2-Propenoic acid methyl ester

United Nations Number..... 1919

CHRIS Code..... MAM

Formula— $\text{CH}_2=\text{CHCOOCH}_3$

Appearance—Odor—Colorless liquid; sharp pungent odor

Specific Gravity—0.95

Chemical Family—Acrylates

Pollution Category—USEPA _____ IMO B

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Boiling Point..... 80°C 176°F

Freezing Point..... -75°C -103°F

Vapor Pressure 20°C (68°F) (mmHg)..... 68.2

Reid Vapor Pressure (psia)..... 3.1

Vapor Pressure 46°C (115°F) (psia)..... 4.1

Vapor Density (Air = 1.0)..... 3.0

Solubility in Water..... 5.2%

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Irritating vapors are generated in fires. Ignited by heat, sparks or open flame. Fire may cause violent rupture of tank due to polymerization. Flashback along vapor trail may occur.

Flash Point (°F)..... 18 to 27

Flammable Limits..... 2.8 to 25%

Autoignition Temp. (°F)..... 875

Extinguishing Agents..... CO_2 , dry chemical, foam, water fog

Special Fire Procedures..... Cool tank with a water spray. Supply fire parties with body and respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 3

Odor Threshold (ppm)

20

PEL/TWA (ppm)

10/Skin

TLV/TWA (ppm)

10/Skin

General—Vapor severely irritating. Liquid may cause severe damage from prolonged skin contact.

Symptoms—Watery eyes, severe burning sensation of throat and nasal passages, coughing and sneezing.

Short Exposure Tolerance—25 ppm for 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; If breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Methyl acrylate will polymerize readily, unless inhibited, evolving considerable amounts of heat. At high temperatures it may polymerize even though inhibited.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 14 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



METHYL ALCOHOL

Synonyms—Alcohol C-1; Carbinol; Colonial spirits;
Columbian spirits; Methanol; Methyl hydroxide;
Pyroxylic spirit; Wood alcohol; Wood spirit

United Nations Number..... 1230

CHRIS Code..... MAL

Formula— CH_3OH

Appearance—Colorless liquid; smells like wine or
shellac thinner

Specific Gravity—0.79

Chemical Family—Alcohol

Pollution Category—USEPA D IMO III

Applicable Bulk Reg. 46 CFR Subchapter D

Boiling Point..... 64°C 148°F

..... °C °F

Freezing Point..... -98°C -144°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 100

Reid Vapor Pressure (psia)..... 4.5

Vapor Pressure 46°C (115°F) (psia)..... 7.0

Vapor Density (Air = 1.0)..... 1.11

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Methyl alcohol is a flammable liquid. At "room" temperature, gives off a vapor which is both toxic and, when mixed with air, explosive within certain limits. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 61

Flammable Limits..... 5.5 to 36.5%

Autoignition Temp. (°F)..... 878

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Avoid breathing vapors. Provide body and respiratory protection for fire parties. Keep tanks cool with water spray. Water may not be effective unless large quantities are used.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 2

Odor Threshold (ppm)
50 to 2000*

PEL/TWA (ppm)
200/Skin

TLV/TWA (ppm)
200/Skin

General—Vapor inhalation dangerous. May be absorbed through skin. Poisonous if swallowed.

Symptoms—Dizziness, unconsciousness, and sighing respiration.

Short Exposure Tolerance—1000 ppm for 1 hour has caused headache, eye irritation and fatigue.

Exposure Procedures—Remove victim to fresh air. Give artificial respiration if breathing stops. Skin or eye contact—remove contaminated clothing. Flush affected areas gently with water for 15 minutes. Get medical advice or attention.

*NOTE: Odor threshold is not considered adequate warning of potential dangerous vapor concentrations.

REACTIVITY DATA

Stability—Stable. Can react vigorously with oxidizing materials.

Compatibility—Material: Compatible with most materials of construction.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



METHYLAMINE SOLUTION, 40%

Synonyms—Aminomethane; Monomethyl amine

United Nations Number..... 1235

CHRIS Code..... MTA

Formula— CH_3NH_2

Appearance—Odor—Water white to pale straw color;
fishy or ammoniacal odor
Specific Gravity—0.897

Boiling Point..... 48°C 118°F
Freezing Point..... -38°C -36°F

Chemical Family—Aliphatic amines

Vapor Pressure 20°C (68°F) (mmHg)..... 245
Reid Vapor Pressure (psia)..... 10
Vapor Pressure 46°C (115°F) (psia)..... 13
Vapor Density (Air = 1.0)..... 1.07
Solubility in Water..... Complete

Pollution Category—USEPA..... IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—B: Flammable liquid

Electrical Group—D

General—Vapor very flammable. When heated, can decompose to toxic nitrogen oxides. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 10 (cc)

Flammable Limits..... 4.4 to 20.7%

Autoignition Temp. (°F)..... 806

Extinguishing Agents..... Alcohol foam, water spray, CO_2 , dry chemical

Special Fire Procedures..... Wear protective clothing, self-contained breathing apparatus and eye protection.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
Unavailable	0.021	10	10

General—Vapors are highly irritating and toxic.

Symptoms—Ingestion: Digestive tract burns. Skin: Irritation, dermatitis, burns. Eyes: Irritation, burns, pulmonary edema. Inhalation: Sneezing, coughing, burning chest pain.

Short Exposure Tolerance—As little as 20–100 ppm causes eye, nose, throat irritation. Vapor is so irritating that people do not voluntarily continue hazardous exposure.

Exposure Procedures—Get medical attention. Eyes and skin: Flush with water at least 15 minutes. If skin burned, do not cover or apply ointment for first 24 hours. Inhalation: Remove to fresh air with mouth to mouth resuscitation or oxygen if needed. Ingestion: Do not induce vomiting. If conscious, drink water.

REACTIVITY DATA

Stability—Stable. Can react with acids and oxidizers.

Compatibility—Material: Suitable: Stainless steel, mild steel, iron. Unsuitable: Aluminum, copper, zinc, magnesium.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact including vapor. Secure ignition sources and dilute with water or use absorbent material. Wear hard hat, safety goggles, face shield, rubber gauntlet gloves, rubber apron, rubber safety shoes or rubber boots, self-contained breathing apparatus, as needed. Do not flush spills into confined spaces where flammable vapors can accumulate. Keep from entering waterway.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

1990



METHYL AMYL ACETATE

Synonyms—1,3-Dimethylbutyl acetate; sec-Hexyl acetate; MAAC; Methyl iso-butyl carbinol acetate; Methyl iso-butyl carbinyl acetate; Methylisoamyl acetate; 4-Methyl-2-pentanol acetate; 4-Methyl-2-pentyl acetate

United Nations Number..... 1233

CHRIS Code..... MAC

Formula— $\text{CH}_3\text{COOCH}(\text{CH}_3)\text{CH}_2\text{CH}(\text{CH}_3)_2$

Appearance-Odor—Water white liquid; mild fruity odor

Boiling Point..... 145°C 295°F

Freezing Point..... -64°C -83°F

Specific Gravity—0.86

Vapor Pressure 20°C (68°F) (mmHg)..... 3.6

Reid Vapor Pressure (psia)..... 0.21

Vapor Pressure 46°C (115°F) (psia)..... 0.34

Vapor Density (Air = 1.0)..... 5.0

Solubility in Water..... Negligible

Chemical Family—Ester

Pollution Category—USEPA IMO C

Applicable Bulk Reg. 46 CFR Subchapter D.O

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Flammable, moderate fire risk.

Flash Point (°F)..... 110

Flammable Limits..... 0.9 to 5.7% (calculated)

Autoignition Temp. (°F)..... 510 (calculated)

Extinguishing Agents..... Confined area—CO₂, dry chemical. Open area—foam, water spray.

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings
2, 1, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Moderately toxic by ingestion and inhalation, can cause skin irritation on prolonged exposure.

Symptoms—Irritation of respiratory passages, vomiting, dizziness, depression, burning of eyes.

Short Exposure Tolerance—Animal tests: No primary skin irritation, traces of eye inflammation; 4 hour exposure inhalation killed 1 out of 8; 8 hours exposure killed 5 of 8.

Exposure Procedures—Ingestion—induce vomiting. Inhalation—remove victim to fresh air and administer oxygen if necessary. Eye or skin contact—flush gently with water for 15 minutes. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: No effects on steel; will swell rubber and can dissolve certain coatings.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, protective clothing, face shield. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



METHYLAMYL ALCOHOL

Synonyms—Isobutyl methyl carbinol; Isobutyl methyl methanol; MAOH; Methyl iso-butyl carbinol; 4-Methyl-2-pentanol; MIBC; MIC

United Nations Number..... 2053

CHRIS Code..... MIC

Formula— $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}(\text{CH}_3)_2$

Appearance—Odor—Colorless liquid; mild alcoholic odor

Specific Gravity—0.81

Chemical Family—Alcohol

Pollution Category—USEPA _____ IMO C

Applicable Bulk Reg. 46 CFR Subchapter D.O

Boiling Point..... 132°C 269°F

Freezing Point..... -90°C -130°F

Vapor Pressure 20°C (68°F) (mmHg)..... 3.8

Reid Vapor Pressure (psia)..... 0.2

Vapor Pressure 46°C (115°F) (psia)..... 0.4

Vapor Density (Air = 1.0)..... 3.5

Solubility in Water..... 1.8%

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate hazard, when exposed to heat or flame.

Flash Point (°F)..... 131

Flammable Limits..... 1.0 to 5.5%

Autoignition Temp. (°F)..... 583 (calculated)

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Provide fire parties with respiratory protection if they must enter spaces to fight the fire.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

50

PEL/TWA (ppm)

25/Skin

TLV/TWA (ppm)

25/Skin

General—Essentially an anesthetic with little or no cumulative toxicological properties. Prolonged contact with liquid may produce drying and cracking of the skin.

Symptoms—Burning of nasal passages and watering of eyes, burning or itching at site of skin contact, dizziness or drowsiness.

Short Exposure Tolerance—2900 ppm cause immediate irritation of the eyes, nose and throat; 2–4 hours, narcosis; 8–10 hours, profound depression and possible death.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Relatively stable.

Compatibility—Material: Most materials of construction are satisfactory.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



METHYL BROMIDE

Synonyms—Bromomethane; Embafume; Methane,
bromo-; Monobromomethane

United Nations Number..... 1062

CHRIS Code..... MTB

Formula—CH₃Br

Appearance—Odor—Colorless liquid; sweet,
chloroform-like odor

Specific Gravity—1.73 at 20°C (a liquid)

Chemical Family—Halogenated hydrocarbons

Pollution Category—USEPA C IMO gas

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 5°C 40°F

..... °C °F

Freezing Point..... -93°C -135°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 1420

Reid Vapor Pressure (psia)..... 45

Vapor Pressure 46°C (115°F) (psia)..... 60

Vapor Density (Air = 1.0)..... 3.27

Solubility in Water..... 1.7%

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Compressed Gas (LCG)

Electrical Group—D

General—Toxic and irritating gases are generated when exposed to heat or fire. Practically non-flammable. Fire and explosion hazard is slight.

Flash Point (°F)..... Virtually non-flammable in air; burns in oxygen (O₂).

Flammable Limits..... 10 to 15%

Autoignition Temp. (°F)..... 998

Extinguishing Agents..... Water spray, dry chemical

Special Fire Procedures..... Cool tanks in vicinity of fire with a water spray. Leaking tanks must not be approached unless wearing full body and respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 3, 4

Odor Threshold (ppm)

Unavailable*

PEL/TWA (ppm)

5/Skin

TLV/TWA (ppm)

5/Skin

General—Suspected carcinogen. Poisonous by inhalation. Effects may be delayed. Liquid causes burns; may be absorbed by clothing, particularly shoes, to cause delayed burns. Class B poison.

Symptoms—Double vision, nausea, dizziness, headache. Severe exposure results in convulsions, muscular tremors, and possibly death.

Short Exposure Tolerance—20 ppm for 5 minutes.

Exposure Procedures—Remove victim to fresh air. Administer artificial respiration if unconscious. Oxygen administered by trained personnel is often helpful. Get medical attention immediately.

REACTIVITY DATA

Stability—Forms aluminum alkyls in presence of aluminum. Aluminum alkyls are spontaneously ignitable materials.

Compatibility—Material: Not corrosive to most metals.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Personnel without respiratory protection must be kept upwind of spill.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * NOTE: The effects of inhaling this material may be delayed. Exposure to potentially dangerous vapor concentrations can occur before the product can be detected by smell.



METHYL CHLORIDE

Synonyms—Chloromethane; Methane, chloro-

United Nations Number..... 1063

Formula—CH₃Cl

CHRIS Code..... MTC

Appearance—Odor—Colorless gas or liquid; faintly sweet odor

Boiling Point..... -24°C -11°F

Specific Gravity—0.92

Freezing Point..... -87°C -124°F

Chemical Family—Halogenated hydrocarbons

Vapor Pressure 20°C (68°F) (mmHg)..... 3800

Pollution Category—USEPA B IMO 989

Reid Vapor Pressure (psia)..... 118.7

Applicable Bulk Reg. 46 CFR Subchapter Q

Vapor Pressure 46°C (115°F) (psia)..... 142

Vapor Density (Air = 1.0)..... 1.78

Solubility in Water..... 0.5%

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—D

General—As with a Liquefied Flammable Gas, extinguishing the fire without stopping the gas leakage may increase the danger by permitting the accumulation of an explosive mixture. Ignited by heat, sparks or open flame. Toxic and irritating gases are generated in fires.

Flash Point (°F)..... <32

Flammable Limits..... 8.1 to 17.2%

Autoignition Temp. (°F)..... 1170

Extinguishing Agents..... Stop flow of gas; CO₂, dry chemical, water fog

Special Fire Procedures..... Keep tank cool with water spray. Both the vapor of the product and its combustion products are poisonous. Provide firefighters with respiratory protection and full protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

0, 0, 2

50

50/Skin

General—Suspected carcinogen. Vapor very harmful. Liquid or cold gas may cause skin or eye injury similar to frostbite.

Symptoms—Dizziness, staggering gait, drowsiness; recovery is slow. Frostbitten areas will be white. Death may result from a single high exposure or repeated moderate exposures.

Short Exposure Tolerance—300 ppm for 5 minutes.

Exposure Procedures—Remove victim to fresh air. Apply artificial respiration if breathing stops. If the liquid has spilled onto the person, points of contact may be frostbitten. Protect any frozen areas from mechanical damage. Get medical attention.

* NOTE: Detectable odor is greater than the TLV. Exposure to potentially dangerous vapor concentrations can occur before the product can be smelled.

REACTIVITY DATA

Stability—Decomposes upon contact with moisture. At high temperatures it may decompose to phosgene, chlorine and carbon monoxide.

Compatibility—Material: When in contact with aluminum, the product which forms may ignite spontaneously in air. Do not use aluminum, aluminum alloys, zinc, die castings, magnesium or magnesium alloys.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Secure ignition sources. Small spills will vaporize and disperse.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Liquefied Flammable Gases are regulated by 46 CFR Part 38.

2-METHYL-6-ETHYLANILINE

Synonyms—6-Ethyl-2-methyl benenamine;
Ethyl-o-toluidine; Methyl ethyl aniline

United Nations Number..... +

CHRIS Code..... MEA

Formula— $C_9H_{13}N$

Appearance-Odor—Clear to amber liquid; mildly pungent
odor

Specific Gravity—0.97

Chemical Family—Aromatic amines

Pollution Category—USEPA..... IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Boiling Point..... 231°C 448°F

..... °C..... °F

Freezing Point..... -25°C -13°F

..... °C..... °F

Vapor Pressure 20°C (68°F) (mmHg)..... 0.06

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... 0.009

Vapor Density (Air = 1.0)..... 4.67

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Mild hazard, toxic fumes of nitrous oxides and CO_2 , are given off by high temperatures or combustion.

Flash Point (°F)..... 232

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... CO_2 , dry chemical, foam, water spray

Special Fire Procedures..... Water protective clothing, gloves, and goggles and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings
Unavailable

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Severe eye irritant, nonirritating to the skin.

Symptoms—Skin develops blue tinge from lack of oxygen in the blood.

Short Exposure Tolerance—Rats subject to 260 ppm for 4 hours produced no symptoms.

Exposure Procedures—Flush eyes immediately with water for 15 minutes. Wash skin with water. Remove to fresh air.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 9 of compatibility chart.

SPILL OR LEAK PROCEDURE

Soak up spill with sawdust, sand, or incinerate. Wear protective clothing, goggles, have self-contained breathing apparatus at hand.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable
‡ Unassigned



METHYL ETHYL KETONE

Synonyms—2-Butanone; Ethyl methyl ketone; MEK

United Nations Number..... 1193

Formula— $\text{CH}_3\text{COC}_2\text{H}_5$

Appearance—Colorless liquid with a lacquer thinner odor

Specific Gravity—0.80

Chemical Family—Ketone

Pollution Category—USEPA D IMO III

Applicable Bulk Reg. 46 CFR Subchapter D

CHRIS Code..... MEK

Boiling Point..... 80°C 176°F

°C °F

Freezing Point..... -86°C -123°F

°C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 100

Reid Vapor Pressure (psia)..... 3.5

Vapor Pressure 46°C (115°F) (psia)..... 4.5

Vapor Density (Air = 1.0)..... 2.5

Solubility in Water..... 27%

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous fire hazard, when exposed to heat or flame.

Flash Point (°F)..... 30

Flammable Limits..... 1.8 to 11.5%

Autoignition Temp. (°F)..... 960

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam

Special Fire Procedures..... Water spray may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 2

Odor Threshold (ppm)

10

PEL/TWA (ppm)

200

TLV/TWA (ppm)

200

General—Vapor is irritating with moderate narcotic effect when inhaled. Vapor very irritating to eyes. Slight skin irritation on contact.

Symptoms—Irritation in eyes, nose, and throat. Dizziness, headache, nausea and lack of communication.

Short Exposure Tolerance—Limited by irritant properties of vapor. 30,000 ppm is intolerable to man because of irritation of eyes and nasal passages; 3000 ppm is intolerable to man for more than just a short period of time.

Exposure Procedures—Remove any contaminated clothing promptly and flush skin with copious amounts of water. In case of eye burns, flush with water for ten minutes.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Softens and dissolves many plastics.

Cargo: Group 18 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-9302.

Remarks:



2-METHYL-5-ETHYLPYRIDINE

Synonyms—Aldehyde-collidine; Aldehydeine;
3-Ethyl-6-methyl pyridine; 5-Ethyl-2-methyl pyridine;
5-Ethyl-2-picoline; MEP

United Nations Number 2300

CHRIS Code MEP

Formula— $\text{CH}_3\text{C}_6\text{H}_4\text{NC}_2\text{H}_5$, or $\text{C}_8\text{H}_{11}\text{N}$

Appearance—Odor—Colorless liquid; sharp penetrating
odor

Specific Gravity—0.82

Chemical Family—Amine

Pollution Category—USEPA IMO B

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point 178°C 353°F

Freezing Point -79°C -84°F

Vapor Pressure 20°C (68°F) (mmHg) 0.9

Reid Vapor Pressure (psia) 0.1

Vapor Pressure 46°C (115°F) (psia) 0.16

Vapor Density (Air = 1.0) 4.18

Solubility in Water Slight

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame. Irritating vapors are generated when heated.

Flash Point (°F) 165

Flammable Limits 1.1 to 6.6%

Autoignition Temp. (°F) 939

Extinguishing Agents Alcohol foam, carbon dioxide, dry chemical, water spray

Special Fire Procedures Wear protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

2, 2, 2

Unavailable

Unavailable

Unavailable

General—Moderately toxic, skin irritant.

Symptoms—Redness and swelling from skin contact with liquid.

Short Exposure Tolerance—1700 ppm lethal to a rat in 3.7 hours.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected area with water for 15 minutes. A physician must see all cases of eye contact immediately after eye wash is completed.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing or strongly alkaline (caustic) materials.

Compatibility—Material: Polyethylene-lined containers suitable.

Charge: Group 9 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Keep unprotected personnel away from spill area. Collect material in plastic containers using absorbents, for small spills; flush large spills.

If a spill occurs, call the National Response Center, 800-424-9302.

Remarks:



METHYL FORMATE

Synonyms—Formic acid, methyl ester; Methyl methanoate

United Nations Number..... 1243

CHRIS Code..... MFM

Formula— HCOOCH_3

Appearance—Odor—Colorless liquid; pleasant odor

Boiling Point..... 32°C 89°F

Freezing Point..... -100°C -148°F

Specific Gravity—0.98

Vapor Pressure 20°C (68°F) (mmHg)..... 400

Reid Vapor Pressure (psia)..... ~18

Vapor Pressure 46°C (115°F) (psia)..... ~1250

Vapor Density (Air = 1.0)..... 2.07

Solubility in Water..... Soluble

Chemical Family—Esters

Pollution Category—USEPA..... IMO..... D

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—D

General—Toxic vapors are generated. Very dangerous when exposed to heat, flame or oxidizers. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point ($^\circ\text{F}$)..... -26 ($^\circ\text{C}$)

Flammable Limits..... 5 to 22.7%

Autoignition Temp. ($^\circ\text{F}$)..... 853

Extinguishing Agents..... Dry chemical, alcohol foam, CO_2

Special Fire Procedures..... Water may not be effective. Wear self-contained breathing apparatus, rubber gloves.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 1, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

100

TLV/TWA (ppm)

100

General—Vapor and liquid are irritating to eyes, nose, skin and throat.

Symptoms—Irritation of mucous membranes, narcosis, temporary visual disturbances. Liquid causes skin and eye irritation.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Inhalation—move to fresh air, give artificial respiration or oxygen as necessary.

Eyes—flush with water for 15 minutes. Skin—wash with soap and water. Ingestion—Do not induce vomiting. Get medical help.

REACTIVITY DATA

Stability—Stable. Slow non-hazardous reaction with water to form formic acid and methyl alcohol. Reacts with oxidizers.

Compatibility—Material: Stainless steel, aluminum or lined carbon steel are suitable.

Cargo: Group 34 of compatibility chart

SPILL OR LEAK PROCEDURE

Secure ignition sources. Restrict access. Disperse and flush. Do not flush spill into confined spaces where flammable vapors can accumulate. Wear self-contained breathing apparatus, rubber gloves, goggles or safety glasses.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



METHYL ISOBUTYL KETONE

Synonyms—Hexone; Isobutyl methyl ketone;
Isopropylacetone; 4-Methyl-2-pentanone; MIBK; MIK

United Nations Number..... 1245

Formula— $\text{CH}_3\text{COCH}_2\text{CH}(\text{CH}_3)_2$

Appearance—Odor—Colorless liquid; pleasant odor

Specific Gravity—0.80

Chemical Family—Ketone

Pollution Category—USEPA D IMO D

Applicable Bulk Reg. 46 CFR Subchapter D

CHRIS Code..... MIK

Boiling Point..... 116°C 241°F

..... °C °F

Freezing Point..... -84°C -119°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 10

Reid Vapor Pressure (psia)..... 0.8

Vapor Pressure 46°C (115°F) (psia)..... 1.2

Vapor Density (Air = 1.0)..... 3.45

Solubility in Water..... 2.0%

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Irritating vapors are generated when heated. Dangerous fire hazard when exposed to heat or flame; moderate explosion hazard when vapor exposed to heat or flame.

Flash Point (°F)..... 75

Flammable Limits..... 1.2 to 8.0% at 200°F

Autoignition Temp. (°F)..... 858

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Fire parties must wear respiratory protection. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

0.47

PEL/TWA (ppm)

50

TLV/TWA (ppm)

50

General—Vapor causes eye, nose, throat irritation. Aspirated methyl isobutyl ketone may cause severe lung damage and present a significant hazard. Repeated or prolonged skin contact may cause defatting of the skin with primary irritation resulting.

Symptoms—Headache, dizziness and nausea.

Short Exposure Tolerance—200–400 ppm for 5 minutes has produced eye irritation; 400 ppm for 5 minutes may produce nasal irritation.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. If swallowed, do not induce vomiting. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Will soften many plastics.

Cargo: Group 18 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



METHYL METHACRYLATE

Synonyms—Crystalite; Methacrylate monomer; Methacrylic acid, methyl ester; Methyl methacrylate monomer, inh.; Methyl alpha-methacrylate; Methyl-2-methyl propenoate; 2-Methylpropenoic acid; 2-Propenoic acid, 2-methyl-, methyl ester

United Nations Number..... 1247

CHRIS Code..... MMM

Formula— $\text{CH}_2 = \text{C}(\text{CH}_3)\text{COOCH}_3$

Boiling Point..... 100°C 212°F

Appearance-Odor—Colorless liquid; acrid odor

°C °F

Freezing Point..... -48°C -55°F

Specific Gravity—0.94

°C °F

Chemical Family—Acrylates

Vapor Pressure 20°C (68°F) (mmHg)..... *

Pollution Category—USEPA C IMO D

Reid Vapor Pressure (psia)..... ~0.5

Applicable Bulk Reg. 46 CFR Subchapter..... O

Vapor Pressure 46°C (115°F) (psia)..... 2.02

Vapor Density (Air = 1.0)..... 3.45

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Ignited by heat, sparks, or open flame. Fire may cause violent rupture of tank because of polymerization.

Flash Point (°F)..... 55

Flammable Limits..... 2.1 to 12.5%

Autoignition Temp. (°F)..... 790

Extinguishing Agents..... Foam, carbon dioxide and dry chemicals

Special Fire Procedures..... Cool exposed tanks with water. Wear eye protection, self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

3, 2, 3

0.05

100

100

General—Vapor irritating.

Symptoms—Smarting of the skin and first-degree burns on short exposure and may cause second-degree burns on long exposure.

Short Exposure Tolerance—200 ppm

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Polymerizes readily. Methyl methacrylate will not decompose on prolonged storage if properly inhibited.

Compatibility—Material: Noncorrosive to steel, aluminum or stainless steel.

Cargo: Group 14 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 40 mmHg at 25.5°C.



alpha-METHYLSTYRENE

Synonyms—AMS; Isopropenylbenzene;
1-Methyl-1-phenylethylene; Phenylpropylene

United Nations Number..... 2303

CHRIS Code..... MSR

Formula— $C_9H_8C(CH_3)=CH_2$

Boiling Point..... 167-170°C 333-338°F

Appearance—Odor—Clear yellow liquid; characteristic
aromatic odor

Freezing Point..... -23°C -9°F

Specific Gravity—0.89

Vapor Pressure 20°C (68°F) (mmHg)..... 4.08

Chemical Family—Olefin

Reid Vapor Pressure (psia)..... 0.23

Pollution Category—USEPA..... IMO..... A

Vapor Pressure 46°C (115°F) (psia)..... 0.40

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Vapor Density (Air = 1.0)..... 4.08

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 125 to 135

Flammable Limits..... 1.9 to 6.1%

Autoignition Temp. (°F)..... 1066

Extinguishing Agents..... Dry chemical, foam, CO₂, water fog

Special Fire Procedures..... Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Less than 10

50

50

General—Avoid skin contact. Not known to be absorbed.

Symptoms—Will cause skin irritation if not removed promptly. Breathing considerable quantities may cause headache and/or dizziness.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Skin contact—flush body splashes with plenty of water. Inhalation—remove victim to fresh air. Administer artificial respiration if necessary.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials

Compatibility—Material: May cause rubber to swell.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield and protective clothing. Have all-purpose canister mask available. Secure all sources of ignition.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

METHYL TERT-BUTYL ETHER

Synonyms—tert-Butyl methyl ether; MTBE

United Nations Number..... 2388

Formula— $(CH_3)_3COCH_3$

Appearance—Odor—Clear, colorless liquid; sharp, terpene-like odor

Specific Gravity—0.74 at 20°C

Chemical Family—Alkyl ethers

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code..... MBE

Boiling Point..... 55°C 131°F

°C °F

Freezing Point..... -109°C -164°F

°C °F

Vapor Pressure 20°C (68°F) (mmHg).....

Reid Vapor Pressure (psia)..... 7.4

Vapor Pressure 46°C (115°F) (psia).....

Vapor Density (Air = 1.0)..... 3.1

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—Flammable and, when confined, explosive. Flashback along vapor trail may occur.

Flash Point (°F)..... -14 (cc)

Flammable Limits..... 1.6 to 8.4%

Autoignition Temp. (°F)..... 797

Extinguishing Agents..... Alcohol foam, dry chemical, CO_2

Special Fire Procedures..... Cool exposed tanks with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

Unavailable

0.25

General—Not too toxic, similar to gasoline.

Symptoms—Irritates eyes, skin, mucous membranes. Inhalation: For prolonged exposure, coughing, shortness of breath, dizziness, intoxication. For short exposure, dizziness.

Short Exposure Tolerance—

Exposure Procedures—Inhalation: Remove to fresh air, give oxygen or artificial respiration as needed. Eyes:

Flush with water for at least 15 minutes, hold eyelids open, call physician. Skin: Wash with water. Ingestion:

Do not induce vomiting.

REACTIVITY DATA

Stability—Generally stable. Forms peroxides at much slower rate than most ethers. Reacts with mineral acids, organic acids, other oxidizers.

Compatibility—Material: Compatible with steel, iron, aluminum, copper, magnesium, zinc, neoprene, polyethylene, polypropylene. Incompatible with viton elastomer.

Cargo: Group 41 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Stop release, remove all ignition sources. Dyke to prevent spill from entering sewers (explosion hazard, pollution) and waterways. Remove spill with inert absorbent. Wear goggles or face shield, boots, and use self-contained breathing apparatus if spill large or in confined area.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

1990



MINERAL SPIRITS

Synonyms—Ligroin (in U.S.A.); Naphtha; Petroleum spirits; Turpentine substitute

United Nations Number..... 1300

CHRIS Code..... MNS

Formula—Petroleum distillate, not chemically distinguishable

Appearance-Odor—Water white liquid with gasoline-like odor

Specific Gravity—0.75

Chemical Family—Hydrocarbon mixture

Pollution Category—USEPA _____ IMO 1

Applicable Bulk Reg. 46 CFR Subchapter..... D

Boiling Point..... 83-204°C 200-400°F

..... °C °F

Freezing Point..... †°C °F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 2.55

Reid Vapor Pressure (psia)..... 0.13

Vapor Pressure 46°C (115°F) (psia)..... 0.20

Vapor Density (Air = 1.0)..... 4.0-4.3

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 105 to 140

Flammable Limits..... 0.8 to 6.0%

Autoignition Temp. (°F)..... 540

Extinguishing Agents..... Foam, carbon dioxide, dry chemical

Special Fire Procedures..... Do not use straight hose water stream.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 1, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
200

General—

Symptoms—Inhalation: Mild irritation of respiratory tract. Severe lung irritant. Central nervous system excitement followed by depression.

Short Exposure Tolerance—4000 to 7000 ppm for one hour

Exposure Procedures—Inhalation: Remove victim to fresh air. Administer artificial respiration if necessary.
Ingestion: DO NOT induce vomiting. Eyes: Wash with copious amounts of water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear polyethylene gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



MOLASSES

Synonyms—Treacle

United Nations Number..... 1

Formula—A mixture of sucrose and sugars

CHRIS Code..... 1

Appearance—Dark brown syrupy liquid

Boiling Point..... V. High °C..... °F

..... °C..... °F

Specific Gravity—1.45

Freezing Point..... Varies °C..... °F

..... °C..... °F

Chemical Family—Alcohols, Glycols and Glycol Ethers

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... **

Solubility in Water..... Soluble

Pollution Category—USEPA..... IMO III

Applicable Bulk Reg. 46 CFR Subchapter..... *

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable

Electrical Group—NA

General—Non-flammable and non-combustible.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... Non-flammable

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Non-toxic. Molasses fermentation occurs when molasses is diluted with salt or fresh water and is accelerated by heat. During fermentation CO₂ (with possible traces of ethanol and higher alcohol vapor) is given off, which will produce inhalation hazard in compartment containing molasses residue.

Symptoms—Non-toxic

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air. Skin or eye contact—remove contaminated clothing and flush affected areas gently with water.

REACTIVITY DATA

Stability—Stable. Reacts with conc. nitric acid and conc. sulphuric acid. Ferments when diluted with salt or fresh water.

Compatibility—Material: Mild steel and stainless steel are suitable.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wash area with water after removing bulk of spill by general means.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Unregulated, Table 2, 46 CFR Part 153.

** H₂O vapor only

‡ Unassigned



MORPHOLINE

Synonyms—Diethylene imidoxide; Diethylene oximide;
Diethylenimine oxide; Tetrahydro-1,4-oxazine;
Tetrahydro-2H-1,4-oxazine; Tetrahydro-p-oxazine

United Nations Number..... 2054

Formula— $(CH_2)_5ONH$

CHRIS Code..... MPL

Appearance—Odor—Colorless oily liquid; ammoniacal
odor

Boiling Point..... 128°C..... 262°F

Specific Gravity—1.00

Freezing Point..... -4°C..... 25°F

Chemical Family—Amine

Vapor Pressure 20°C (68°F) (mmHg)..... 7.0

Pollution Category—USEPA..... IMO..... D

Reid Vapor Pressure (psia)..... 0.55

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Vapor Pressure 46°C (115°F) (psia)..... 0.8

Vapor Density (Air = 1.0)..... 3.0

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—Moderate fire hazard when exposed to flame or heat. When heated to decomposition, it emits highly toxic fumes of oxides of nitrogen.

Flash Point (°F)..... 100

Flammable Limits..... 1.8 to 10.8%

Autoignition Temp. (°F)..... 590

Extinguishing Agents..... CO₂, dry chemical, water fog, alcohol foam

Special Fire Procedures..... Provide fire parties with full body and respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 1

Odor Threshold (ppm)
0.01

PEL/TWA (ppm)
20/Skin

TLV/TWA (ppm)
20/Skin

General—Vapor moderately irritating. Liquid causes severe burns.

Symptoms—Burning of throat and eyes; itching or burning of the skin at site of contact.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—This material is more stable than most of the other amines listed in this volume. It is a mild base.

Compatibility—Material: Copper and its alloys and galvanized iron are not compatible.

Cargo: Group 7 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, plastic protective apron, self-contained breathing apparatus. Avoid contact with liquid. Secure ignition sources. Small spills may be washed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



MOTOR FUEL ANTI-KNOCK COMPOUNDS

(containing lead alkyls)

Synonyms—Lead tetraethyl; Lead tetramethyl; TEL;
Tetraethyl lead compounds; Tetramethyl lead
compounds; TML

United Nations Number..... 1849

CHRIS Code..... MFA

Formula— $(C_2H_5)_4Pb$, or $(CH_3)_4Pb$ in mixtures

Appearance—Oily liquid; containing dyes; musty
sweet odor

Specific Gravity—1.5 to 1.7

Chemical Family—Lead alkyls

Pollution Category—USEPA A IMO A

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 83°C 200°F

Freezing Point..... 9°C -16°F

Vapor Pressure 20°C (68°F) (mmHg)..... 5 to 41

Reid Vapor Pressure (psia)..... 0.2-1.7

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 4 to 7

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D or E: Combustible liquid, depending upon flash point.

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame. Dangerous. When heated to decomposition, it emits highly toxic fumes of lead.

Flash Point (°F)..... 89 to 265

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Begins to decompose above 212°F

Extinguishing Agents..... CO_2 , dry chemical, foam, water fog

Special Fire Procedures..... Tanks exposed to fire should be kept cool with a water spray to prevent decomposition of the lead compounds. Because of the high toxicity of the compound and its combustion products, only personnel with full respiratory protection should approach burning antiknock compounds. ALL OTHERS SHOULD BE EVACUATED AS QUICKLY AS POSSIBLE!

HEALTH HAZARD DATA

Health Hazard Ratings

1, 2, 4

Odor Threshold (ppm)

0.2 as lead

PEL/TWA (ppm)

0.075 mg/m³ as lead

TLV/TWA (ppm)

*

General—Prolonged skin contact, ingestion or inhalation of high vapor may result in a toxic psychosis causing anxiety which may progress to mania and death. Class B poison.

Symptoms—Nervousness, irritability, insomnia, dreaming; emotional instability; hallucinations, anorexia, vomiting, constipation, pallor and tremor.

Short Exposure Tolerance—See TLV

Exposure Procedures—Personnel MUST avoid inhaling the vapors or allowing the liquid to touch the skin.

Clothing and other absorbent material in contact with the liquid should be destroyed since they cannot be decontaminated. Liquid spilled onto the skin should be scrubbed off with kerosene at once. Get medical attention.

REACTIVITY DATA

Stability—Relatively stable at ambient temperatures, but it may decompose if heated above 212°F.

Compatibility—Material: May be carried in steel tanks. No chemical effect on common materials but will readily permeate absorbent materials. Avoid contact with oxidizing agents or concentrated acids.

Cargo: Unassigned in compatibility chart. For compatibility assistance, call G-MTH-1 (202-267-1577).

SPILL OR LEAK PROCEDURE

Wear rubber gloves, full protective clothing, eye protection and self-contained breathing apparatus. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * TLV/TWA (ppm)—0.1 to 0.13 mg/m³ as lead
† Unavailable



NAPHTHA: STODDARD SOLVENT

Synonyms—Drycleaners naphtha; Drycleaners safety solvent; Ligroin (in U.S.A.); Mineral spirits; Petroleum solvent; Spotting solvent; Stoddard solvent; White spirits

United Nations Number..... 3

CHRIS Code..... NSS

Formula—Mixture

Boiling Point..... 180-199°C 320-390°F

Appearance—Odor—Colorless liquid; gasoline-like odor

.....°C.....°F

Freezing Point..... 1°C.....°F

Specific Gravity—0.78

.....°C.....°F

Chemical Family—Petroleum oil

Vapor Pressure 20°C (68°F) (mmHg)..... 3.0

Reid Vapor Pressure (psia)..... 0.1

Pollution Category—USEPA _____ **IMO** @ Oil

Vapor Pressure 46°C (115°F) (psia)..... 0.2

Applicable Bulk Reg. 46 CFR Subchapter..... D

Vapor Density (Air = 1.0)..... 1

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Flammable, moderate fire risk.

Flash Point (°F)..... 110 (cc)

Flammable Limits..... 0.8 to 5.0%

Autoignition Temp. (°F)..... 540 (approx.)

Extinguishing Agents..... Foam, dry chemical or CO₂

Special Fire Procedures..... Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

100

100

General—Toxic. Prolonged or repeated skin contact may cause defatting of the skin and may produce dermatitis from daily contact.

Symptoms—Inhalation—Intoxication may result from high vapor concentration.

Short Exposure Tolerance—500 ppm for 30 minutes.

Exposure Procedures—Inhalation: Remove victim to fresh air. Administer artificial respiration if necessary. Ingestion: DO NOT induce vomiting. Eyes: Flush with water for 15 minutes. Call a doctor.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Solvent effects on some paints and rubber. Carbon steel satisfactory.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Wear self-contained breathing apparatus. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

‡ Unassigned



NAPHTHA: VM & P

Synonyms—Light naphtha; Ligroin (in U.S.A.); Naphtha, petroleum; Painters naphtha; Petroleum solvent; Refined solvent naphtha; Solvent naphtha; Varnish makers' & painters' naphtha

United Nations Number..... 1255

CHRIS Code..... NVM

Formula—Mixture

Appearance—Odor—Colorless liquid; gasoline-like odor

Specific Gravity—0.74 to 0.77

Chemical Family—Petroleum oils

Pollution Category—USEPA _____ IMO @ 1

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Boiling Point..... 93–149°C 200–300°F

..... °C °F

Freezing Point..... Low°C °F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... 3

Reid Vapor Pressure (psia)..... 0.12

Vapor Pressure 46°C (115°F) (psia)..... 0.19

Vapor Density (Air = 1.0)..... †

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Flammable, moderate fire risk. Produces suffocating atmosphere of smoke, CO₂, and fumes

Flash Point (°F)..... 20 to 55 (cc)

Flammable Limits..... 0.9 to 6.7%

Autoignition Temp. (°F)..... 450

Extinguishing Agents..... Confined area—CO₂, dry chemical. Open area—foam.

Special Fire Procedures..... Fight like gasoline fire. Water respiratory devices.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 0, 1

Odor Threshold (ppm)
300

PEL/TWA (ppm)
300

TLV/TWA (ppm)
300

General—Will remove oils from skin. Prolonged contact with liquid may produce drying and cracking of the skin, and may produce dermatitis from daily contact. Toxicity by absorption, inhalation, ingestion.

Symptoms—Headache, dizziness, insomnia, coughing, diarrhea, bronchitis and pneumonia, nervousness and irritability.

Short Exposure Tolerance—4000 to 7000 ppm for 1 hour results in development of symptoms of narcosis.

Exposure Procedures—Inhalation: Immediately remove victim from contaminated area. Get medical attention. If splashed in eyes, wash thoroughly.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Solvent effects on some paints and rubbers. Carbon steel not affected. Corrosive in presence of salt water.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Wear self-contained breathing apparatus. Secure all ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



NAPHTHALENE

Synonyms—Camphor tar; Naphthalene; Naphthene; Tar camphor; White tar

United Nations Number ... molten 2304
 crude or 1334
 refined

CHRIS Code NTM

Formula— $C_{10}H_8$

Appearance-Odor—Colorless liquid or white solid; odor of mothballs

Specific Gravity—1.15

Chemical Family—Aromatic hydrocarbon

Pollution Category—USEPA B IMO A

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point 218°C 424°F

..... °C °F

Freezing Point 80°C 176°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) < 1

Reid Vapor Pressure (psia) Low

Vapor Pressure 46°C (115°F) (psia) Low

Vapor Density (Air = 1.0) 4.42

Solubility in Water Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—See "General" comments below.

Electrical Group—D

General—Combustible Grade E solid normally carried in the molten state. When carried molten, it presents a fire hazard comparable to that of a Grade C flammable liquid. Naphthalene vapor or dust can form explosive mixtures with air. Toxic vapors given off in a fire.

Flash Point (°F) 180

Flammable Limits 0.9 to 5.9%

Autoignition Temp. (°F) 979

Extinguishing Agents CO₂, dry chemical, foam, water fog

Special Fire Procedures Do not direct a hose into a tank of molten naphthalene. Otherwise the naphthalene will be spattered about with explosive force. Water or foam must be applied carefully to molten naphthalene to prevent excessive frothing. Wear eye protection, self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 1, 2

Odor Threshold (ppm)

25*

PEL/TWA (ppm)

10

TLV/TWA (ppm)

10

General—Molten liquid is scalding on contact. Vapor is irritating to skin and eyes.

Symptoms—Eye irritation, headache, nausea, profuse perspiration, vomiting.

Short Exposure Tolerance—15 ppm for 5 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention. * NOTE: Detectable odor is greater than the TLV. Exposure to potentially dangerous vapor concentrations can occur before the product can be smelled.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Noncorrosive. Most materials of construction are satisfactory.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Upon spilling, the material will solidify and can be scraped up with nonsparking shovels into a waste container. Naphthalene spilling into water will either solidify and sink, or solidify into a foam and float.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Normally transported at elevated temperatures. See 46 CFR 36—Elevated Temperature Cargoes.



NAPHTHENIC ACIDS

Synonyms—No common synonyms.

United Nations Number..... †

Formula— $C_nH_{2n-2}COOH$ to $C_nH_{2n-10}COOH$ where
 $n=13-28$

Appearance—Odor—Gold to dark red to black liquid;
 penetrating, persistent, putrid odor *

Specific Gravity—0.98 at 20°C

Chemical Family—Organic acids

Pollution Category—USEPA B IMO A

Applicable Bulk Reg. 46 CFR Subchapter D.O

CHRIS Code..... NTI

Boiling Point..... 132-243°C 270-470°F

.....°C.....°F

Freezing Point..... <0°C <0°F

.....°C.....°F

Vapor Pressure 20°C (68°F) (mmHg)..... <0.1

Reid Vapor Pressure (psia)..... <0.1

Vapor Pressure 46°C (115°F) (psia)..... <0.1

Vapor Density (Air = 1.0)..... 0.9

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Combustible liquid.

Flash Point (°F)..... 300

Flammable Limits..... LEL=1% UEL—Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Foam, dry chemical, carbon dioxide

Special Fire Procedures..... Water may be ineffective; cool exposed tanks with water to prevent over
 pressurization and rupture.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

10 mg/m³

General—Mildly hazardous to man; hazardous to aquatic life in low concentrations.

Symptoms—Irritating to eyes, nose, throat. Inhalation: coughing, difficulty in breathing. Skin contact: irritating.
 Ingestion: nausea.

Short Exposure Tolerance—

Exposure Procedures—Inhalation: remove to fresh air. Ingestion: give large quantities of fresh water. Eye contact:
 flush with water until irritation stops. Skin contact: flush with water and soap.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Generally corrosive to metals.

Cargo: Group 4 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact, wear safety glasses or face mask. Dike and remove spilled material. Prevent from reaching
 bodies of water, since it fouls beaches, and taints aquatic life.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Often odorless after processing.

† Unavailable

1990



NEATSFOOT OIL

Synonyms—Babulum oil; Hoof oil

United Nations Number..... †

Formula—Indefinite mixture

Appearance—Odor—Pale yellow oily liquid with a peculiar odor

Specific Gravity—0.91 to 0.92

Chemical Family—Esters

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code..... ONF

Boiling Point..... V. High°C V. High°F

.....°C°F

Freezing Point..... -10-0°C 14-32°F

.....°C°F

Vapor Pressure 20°C (68°F) (mmHg)..... 2.04

Reid Vapor Pressure (psia)..... 0.1

Vapor Pressure 46°C (115°F) (psia)..... 0.15

Vapor Density (Air = 1.0)..... †

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard if exposed to high heat.

Flash Point (°F)..... 430

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 828

Extinguishing Agents..... Dry chemical, foam or carbon dioxide

Special Fire Procedures..... Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Not harmful

Symptoms—None

Short Exposure Tolerance—LD₅₀ above 15 g/kg.

Exposure Procedures—Wash thoroughly with soap and water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield and protective clothing.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

‡ Unassigned



NITRIC ACID (56 to 68%)

Synonyms—Aqua fortis; Azotic acid; Engravers acid;
Engravers oil; Hydrogen nitrate

United Nations Number..... 2031

CHRIS Code..... NCD

Formula— HNO_3

Appearance—Odor—Colorless to yellow liquid, fumes in
moist air; characteristic, choking odor
Specific Gravity—1.35 to 1.41

Boiling Point..... 122°C 251°F

Freezing Point..... -34°C -30°F

Vapor Pressure 20°C (68°F) (mmHg)..... 7.1

Reid Vapor Pressure (psia)..... 2.7

Vapor Pressure 46°C (115°F) (psia)..... 3.6

Vapor Density (Air = 1.0)..... 2.17

Solubility in Water..... Complete

Chemical Family—Inorganic acid

Pollution Category—USEPA C IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as corrosive liquid.

Electrical Group—B (based upon possible hydrogen gas (H_2) generation should a leak or spill occur).

General—Nitric acid will not burn. It will react with many metals, giving off hydrogen gas which is highly flammable. If hydrogen is trapped in confined spaces, it can form an explosive mixture with air. See data sheet for hydrogen. May give off toxic oxides of nitrogen and acid fumes when heated in a fire.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Water

Special Fire Procedures..... If fire results, water will absorb the toxic oxides generated. Fire fighters should wear full protective clothing including respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)
3, 4, 3	Unavailable	2

TLV/TWA (ppm)

General—Breathing of vapors is extremely dangerous. Little warning of danger is at first apparent and initial symptoms are obscure. Liquid burns the skin forming deep ulcers which leave leathery scars.

Symptoms—Vapor: immediate severe skin and lung burns. Liquid: smarting, itching, and yellow discoloration upon skin contact.

Short Exposure Tolerance—15 ppm for 5 minutes.

Exposure Procedures—Remove the affected individual from the contaminated atmosphere and call a physician at once. Keep patient at rest until seen by the physician. In case of eye or skin contact, flush immediately with copious quantities of water while removing contaminated clothing. The eye irrigation should be continued for 15 minutes. Cases involving eye contact and inhalation MUST have medical help!

REACTIVITY DATA

Stability—Reacts violently with numerous organic materials. Decomposes at temperatures near boiling. Soda ash will neutralize residual acid from spills.

Compatibility—Material: Attacks aluminum; compatible with stainless steel and high chrome iron alloys.

Cargo: Group 3 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing, Body shield and self-contained breathing apparatus should be available. Secure ignition sources. Flush cautiously with water. Avoid directing stream into larger pools or pockets of concentrated acid. If possible, cover contaminated surfaces and spill with large quantities of soda ash or sodium bicarbonate. Mix and add water if necessary to effect good mixing. Scoop up slurry. Wash site with soda ash solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



(NOTE: This cargo is currently not permitted to be shipped in bulk in U.S. waters)

NITRIC ACID (95%)

Synonyms—Aqua fortis; Azotic acid; Engravers acid;
Engravers oil; Hydrogen nitrate; Red fuming nitric
acid; White fuming nitric acid

United Nations Number..... 2032

CHRIS Code..... NAC

Formula— HNO_3

Boiling Point..... 94°C 202°F

Appearance—Odor—Water-white to light brown liquid;
acid odor

Freezing Point..... -52°C -61°F

Specific Gravity—1.50

Vapor Pressure 20°C (68°F) (mmHg)..... 33

Chemical Family—Inorganic acid

Reid Vapor Pressure (psia)..... 1.9

Pollution Category—USEPA C IMO C

Vapor Pressure 46°C (115°F) (psia)..... 2.0

Applicable Bulk Reg. 46 CFR Subchapter

Vapor Density (Air = 1.0)..... 2.17

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as corrosive liquid.

Electrical Group—Non-flammable

General—Nitric acid will not burn. It will react with many metals, giving off hydrogen gas which is highly flammable. If hydrogen is trapped in confined spaces, it can form an explosive mixture with air. See data sheet for hydrogen. May give off toxic oxides of nitrogen and acid fumes when heated in a fire.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Water

Special Fire Procedures..... If fire results, water will absorb the toxic oxides generated. Fire fighters must wear full protective clothing including respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings
4, 4, 3

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
2

TLV/TWA (ppm)
2

General—Breathing of vapors is extremely dangerous. Little warning of danger is at first apparent and initial symptoms are obscure. Liquid burns the skin forming deep ulcers which leave leathery scars.

Symptoms—Smarting, itching, and yellow discoloration upon skin contact. If acid is not removed at once, intense pain and severe burns result.

Short Exposure Tolerance—15 ppm for 5 minutes.

Exposure Procedures—Upon skin contact, wash with large amounts of water at once. Remove the affected individual from the contaminated atmosphere and get medical help. In case of eye or skin contact, flush immediately with copious quantities of water while removing contaminated clothing. Eye irrigation should be continued for at least 15 minutes. All cases involving eye contact and inhalation MUST be seen by a physician.

REACTIVITY DATA

Stability—Reacts violently with numerous organic materials. Decomposes at temperatures near boiling. Soda ash will neutralize residual acid from spills.

Compatibility—Material: Compatible with stainless steel or aluminum.

Cargo: Unassigned in compatibility chart. For compatibility assistance, call
G-MTH-1 (202-267-1577)

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Body shield and self-contained breathing apparatus should be available. Secure ignition sources. Flush cautiously with water. Avoid directing stream into larger pools or pockets of concentrated acid. If possible, cover contaminated surfaces and spill with large quantities of soda ash or sodium bicarbonate. Mix and add water if necessary to effect good mixing. Scoop up slurry. Wash site with soda ash solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Bulk shipment of this concentration is not permitted in U.S. waters.



NITROBENZENE

Synonyms—Essence of mirbane; Benzene, nitro-;
Mononitrobenzene; Nitrobenzol; Oil of mirbane

United Nations Number..... 1662

Formula— $C_6H_5NO_2$

CHRIS Code..... NTB

Appearance—Odor—Light yellow green to brown liquid;
similar odor to oil of bitter almonds

Boiling Point..... 211°C 412°F

Specific Gravity—1.20

Freezing Point..... 5°C 41°F

Chemical Family—Nitrocompounds

Vapor Pressure 20°C (68°F) (mmHg)..... 0.20

Reid Vapor Pressure (psia)..... 0.01

Vapor Pressure 46°C (115°F) (psia)..... 0.02

Vapor Density (Air = 1.0)..... 4.24

Pollution Category—USEPA C IMO B

Applicable Bulk Reg. 46 CFR Subchapter..... O

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard; at elevated temperatures, flammable, toxic vapor may be given off.

Flash Point (°F)..... 190

Flammable Limits..... LEL = 1.8% UEL—unavailable

Autoignition Temp. (°F)..... 900

Extinguishing Agents..... Confined area—CO₂, dry chemicals. Open area—foam.

Special Fire Procedures..... Use water to keep fire exposed containers cool. Wear complete rubber protective clothing including eye protection and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

3, 2, 4

0.0047

1/Skin

1/Skin

General—Highly toxic when absorbed thru the skin, inhaled as vapor, or swallowed. This is a blood poison and a nerve poison which is readily absorbed by the body.

Symptoms—"Blue lip" or bluish tinge seen in fingernail beds, lips, lobes of ears; conjunctive, mucous membranes and tongue. Fatigue, headaches, vomiting, general weakness and signs of nervous system involvement.

Short Exposure Tolerance—200 ppm for one hour—no serious disturbance; 40–80 for a few hours—slight symptoms. Absorption may cause death due to nervous system poisoning.

Exposure Procedures—Remove all contaminated clothing, wash skin with soap and water, flush skin for approx. 15 minutes. If swallowed, induce vomiting until vomit fluid is clear. If inhaled, remove victim to fresh air and start oxygen inhalation. Contaminated clothing should be thoroughly washed in soap and water before using again. Get medical help.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 42 of compatibility chart.

SPILL OR LEAK PROCEDURE

Flush areas with large quantities of cold water. Ventilate freely. Hot water can be used to remove some absorbed material. Wear complete protective clothing including eye and respiratory protection.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



o-NITROPHENOL

Synonyms—2-Hydroxynitrobenzene; 2-Nitrophenol; ONP

United Nations Number..... 1663

Formula— $\text{HOC}_6\text{H}_4\text{NO}_2$

CHRIS Code..... NTP

Appearance—Crystalline yellow solid; aromatic sweet odor

Boiling Point..... 214°C 417°F

Specific Gravity—1.49 (solid)

Freezing Point..... 44°C 111°F

Chemical Family—Aromatic nitro compounds

Vapor Pressure 20°C (68°F) (mmHg)..... <1

Reid Vapor Pressure (psia)..... <0.1

Pollution Category—USEPA B IMO B

Vapor Pressure 46°C (115°F) (psia)..... <0.1

Applicable Bulk Reg. 46 CFR Subchapter O

Vapor Density (Air = 1.0).....

Solubility in Water..... 0.25%

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Violently decomposes above 180°C. Can give off toxic nitrogen oxides and unburned vapor when heated or burned.

Flash Point (°F)..... 215

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Water, foam, dry chemical, carbon dioxide, Halon

Special Fire Procedures..... Cool exposed tanks with water spray. Wear self-contained breathing apparatus and full protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

Unavailable

Unavailable

General—Liquid, solid, dust are toxic. When heated or burned, toxic nitrogen oxides and unburned material produced. Harmful to aquatic life even in very low concentrations. Molten material will burn tissue.

Symptoms—Ingestion—headache, nausea, unconsciousness, drowsiness. Inhalation—headache, nausea, unconsciousness, drowsiness, cyanosis, breathing difficulties. Skin—irritation, headache, nausea, unconsciousness, drowsiness (absorbed through skin). Eyes—irritation.

Short Exposure Tolerance—

Exposure Procedures—Ingestion—If conscious, drink water or milk; induce vomiting. If unconscious, do not give liquids or induce vomiting, but keep victim warm. Eye contact—flush with excess water for at least 15 minutes, call physician. Skin contact—wash thoroughly with soap and water—quickly remove material. Inhalation—remove to fresh air, give oxygen or artificial respiration, as necessary.

REACTIVITY DATA

Stability—Stable below 180°C. Keep away from caustics to avoid formation of unstable products. Reacts violently with potassium hydroxide (caustic potash).

Compatibility—Material: Softens rubber and paint. Compatible with mild steel, stainless steel, and polyethylene.

Cargo: Unassigned in the compatibility chart. See Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Avoid liquid, solid, dust. Wear rubber gloves and goggles. If fumes present, use self-contained breathing apparatus. Keep upwind. Stop discharge if possible, dike (including fire fighting water) and prevent from entering waterways.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

1990

2-NITROPROPANE

Synonyms— Isonitropropane; 2-Nitropropane;
Nitropropanes; sec-Nitropropane; 2-NP; Propane,
nitro-

United Nations Number..... 2608

Formula— $C_3H_7NO_2$

CHRIS Code..... NPP

Appearance—Odor—Colorless liquid; odorless

Boiling Point..... 121°C 249°F
°C °F

Specific Gravity—0.99

Freezing Point..... -93°C -135°F
°C °F

Chemical Family—Nitro compounds

Vapor Pressure 20°C (68°F) (mmHg)..... 12.9

Pollution Category—USEPA A IMO 0

Reid Vapor Pressure (psia)..... †

Applicable Bulk Reg. 46 CFR Subchapter..... 0

Vapor Pressure 46°C (115°F) (psia)..... 1.05

Vapor Density (Air = 1.0)..... 3.06

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—Toxic oxides of nitrogen may form in fire. Moderate fire hazard. Decomposes when subjected to high temperature.

Flash Point (°F)..... 103

Flammable Limits..... LEL=2.6% UEL—unavailable

Autoignition Temp. (°F)..... 802

Extinguishing Agents..... Alcohol foam, water spray, CO_2 , dry chemical, foam

Special Fire Procedures..... Water protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 1

300*

10

10

General—Suspected carcinogen. Slight irritation from liquid contact with skin and eyes. Vapor inhalation is irritating to respiratory tract with moderate systemic effect.

Symptoms—Headache, dizziness, nausea, vomiting, diarrhea.

Short Exposure Tolerance—500-1000 ppm for up to one hour.

Exposure Procedures—In case of pulmonary symptoms or cyanosis, remove workers from contaminated area at once; place in bed, rest, use oxygen, if respiratory distress is present, and obtain medical attention.

*NOTE: Detectable odor is greater than the TLV. Exposure to potentially dangerous vapor concentrations can occur before the vapor is detected by smell.

REACTIVITY DATA

Stability—Stable under normal conditions. Decomposes when subjected to high temperatures. Rapid heating to high temperatures may cause an explosion.

Compatibility—Material: Copper and its alloys, wet mild steel, and lead and its pigments are incompatible.

Cargo: Group 42 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear neoprene gloves, plastic protective apron or coat and self-contained breathing apparatus. Provide good ventilation. Secure ignition sources. If possible, cover with soda ash and mix and spray with water. Scoop up. Wash site with soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



o-NITROTOLUENE

Synonyms—2-Methyl nitrobenzene; 2-Nitrotoluene;
Orthonitrotoluene; o-Nitrotoluol; Toluene, orthonitro-

United Nations Number..... 1664

CHRIS Code..... NIE

Formula— $C_7H_7NO_2$

Boiling Point..... 222°C 432°F

Appearance-Odor—Oily light yellow liquid; bitter almond
odor

..... °C °F

Specific Gravity—1.16

Freezing Point..... -4°C 25°F

..... °C °F

Chemical Family—

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... 0.02

Vapor Density (Air = 1.0)..... 4.72

Pollution Category—USEPA C IMO C

Solubility in Water..... Negligible

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Low hazard to heat or open flame; combustible, poisonous gases may be released in fire.

Flash Point (°F)..... 223 (cc)

Flammable Limits..... LEL = 2.2% UEL—unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Water fog, CO₂, dry chemical

Special Fire Procedures..... Wear goggles, self-contained breathing apparatus, rubber gloves. Cool exposed tanks with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 3

Odor Threshold (ppm)

3

PEL/TWA (ppm)

2/Skin

TLV/TWA (ppm)

2/Skin

General—Toxic by ingestion, inhalation or absorption through skin.

Symptoms—Headache, dizziness, difficult breathing, nausea, vomiting, convulsions, irritability. Skin becomes irritated.

Short Exposure Tolerance—200 ppm for 30 minutes.

Exposure Procedures—Remove victim from source of exposure and give rest. If breathing stops give artificial respiration. Remove contaminated clothing and shoes; flush affected areas with water. Call a physician.

REACTIVITY DATA

Stability—Stable. Reacts with sulfuric acid, oxidizers.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 42 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear protective clothing, self-contained breathing apparatus, butyl rubber gloves. Avoid absorption through the skin.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: These data are for the ortho form; the para and meta forms of Nitrotoluene may differ somewhat in specific physical properties.

* Vapor Pressure: 1 mmHg at 50°C.



NONANE

Synonyms— 1-Nonane; n-Nonane

United Nations Number..... 1920

Formula— C_9H_{20}

CHRIS Code..... NAN

Appearance—Odor—Colorless liquid; gasoline-like odor

Boiling Point..... 149°C 300°F

Specific Gravity—0.72

Freezing Point..... -54°C -65°F

Chemical Family—Saturated aliphatic hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 10

Pollution Category—USEPA _____ IMO C*

Reid Vapor Pressure (psia)..... 0.2

Applicable Bulk Reg. 46 CFR Subchapter..... D.O.

Vapor Pressure 46°C (115°F) (psia)..... 0.4

Vapor Density (Air = 1.0)..... 4.41

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 86 (cc)

Flammable Limits..... 0.74 to 2.9%

Autoignition Temp. (°F)..... 545

Extinguishing Agents..... Dry chemical, foam, CO_2

Special Fire Procedures..... Tanks exposed to fire should be kept cool with a water spray. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

200

TLV/TWA (ppm)

200

General—Low toxicity; irritant, narcotic in high concentrations.

Symptoms—Irritation of respiratory tract. Narcotic in high concentrations.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Remove victim to fresh air. Apply artificial respiration if breathing stops. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Compatible with most materials of construction.

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Have all-purpose canister mask available. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Pollution Category C oil-like, 33 CFR 151.49.



1-NONENE

Synonyms—n-Heptylethylene; 1-Nonylene

United Nations Number..... 3

Formula— $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}_2$

Appearance—Odor—Colorless liquid with a pungent hydrocarbon odor
Specific Gravity—0.73

Chemical Family—Olefin

Pollution Category—USEPA _____ IMO B
Applicable Bulk Reg. 46 CFR Subchapter _____ D.Q.

CHRIS Code NNE

Boiling Point 147°C 297°F
..... °C °F

Freezing Point -82°C -115°F
..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) 4.08

Reid Vapor Pressure (psia) 0.21

Vapor Pressure 46°C (115°F) (psia) 0.35

Vapor Density (Air = 1.0) 4.3

Solubility in Water Neatligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F) 85

Flammable Limits 0.7 to 3.9%

Autoignition Temp. (°F) Unavailable

Extinguishing Agents Confined space—dry powder, CO₂. Open area—foam.

Special Fire Procedures Water may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Low toxicity. Effects similar to gasoline and kerosene.

Symptoms—High vapor concentration irritates eyes and respiratory tract; acts as an anesthetic.

Short Exposure Tolerance—Unavailable

Exposure Procedures—If ingested do NOT induce vomiting. Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Materials: Mild steel is suitable; may soften some rubbers, paints, or plastics.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



NONYL PHENOL

Synonyms—No common synonyms.

United Nations Number..... †

Formula— $C_{12}H_{15}O$

CHRIS Code..... NNP

Appearance—Clear, straw-colored syrupy liquid;
phenolic odor, like disinfectant

Boiling Point..... 304°C 579°F

Specific Gravity—0.94

Freezing Point..... -20°C -4°F

Chemical Family—Phenol

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Pollution Category—USEPA IMO A

Reid Vapor Pressure (psia)..... Low

Applicable Bulk Reg. 46 CFR Subchapter D.O

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 7.59

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight hazard, when exposed to heat or flame.

Flash Point (°F)..... 300

Flammable Limits..... LEL = 1% UEL—unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water or foam may cause frothing. Firefighting parties should be provided with full body and respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 2, 1

Unavailable

Unavailable

Unavailable

General—Liquid irritating to skin and eyes.

Symptoms—Skin contact may cause burns and blisters.

Short Exposure Tolerance—Breathing the vapors in a state approaching saturation in room air was not fatal to animals nor was a 4-hour exposure to mists, generated from the chemical heated to 170°C. Eight hours exposure to the mist killed 2 of 6 animals.

Exposure Procedures—Remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—immediately flush affected areas gently with water for 15 minutes. Remove contaminated clothing. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Should be stored in stainless steel. Nonyl phenol picks up iron in plain steel. Copper and its alloys promote color formation.

Cargo: Group 21 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unassigned



NONYL PHENOL SULFIDE

Synonyms—No common synonyms.

United Nations Number..... 1

CHRIS Code..... NPS

Formula—Mixture

Appearance—Odor—Dark brown liquid with mild petroleum odor.

Specific Gravity—0.97

Chemical Family—Petroleum oils

Pollution Category—USEPA _____ IMO #

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Boiling Point 315°C 600°F

Freezing Point -12°C 10°F

Vapor Pressure 20°C (68°F) (mmHg) V. Low

Reid Vapor Pressure (psia) V. Low

Vapor Pressure 46°C (115°F) (psia) V. Low

Vapor Density (Air = 1.0) NP

Solubility in Water Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Moderate fire hazard when exposed to high temperatures. Combustion produces some sulfur dioxide and carbon monoxide. Above 140°F, hydrogen sulfide, a poisonous gas is given off.

Flash Point (°F)..... greater than 200 (cc)

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Carbon dioxide, dry chemicals, water spray or foam.

Special Fire Procedures..... High temperatures create toxic fumes. Keep tanks cool with water spray.

Firefighters should have self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
Unavailable	Unavailable	Unavailable	Unavailable

General—Negligible effects from inhalation, ingestion or skin absorption. Persons hypersensitive to amine derivatives should avoid all exposure.

Symptoms—Mild skin irritation and reddening of skin will occur after prolonged contact with skin.

Short Exposure Tolerance—No cumulative toxic or sensitization effect results from repeated exposure.

Exposure Procedures—Skin—wash affected area with water. Eyes—flush eyes with copious amounts of water. Vapor—no particular hazard at room temperature, but toxicity increases with increase in temperature. If exposed to odorous fumes, get medical help.

REACTIVITY DATA

Stability—Avoid high temperatures (140°F) and prolonged or repeated heating since one component will decompose and give off poisonous hydrogen sulfide.

Compatibility—Material: Has no corrosive or destructive effects on steel, wood or cloth. May soften natural rubber and some paints.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield and self-contained breathing apparatus. Avoid contact with liquid. Secure ignition source.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: This series of products contains about 50% lubricating oils. The remaining compounds, which include nonyl phenol sulfide at concentrations of less than 6%, are oxidation inhibitors or detergent additives.

No Determination

‡ Unassigned



iso-OCTYL ALCOHOL

Synonyms—Alcohol C-8; Dimethyl-1-hexanol;
isooctanol; isooctyl alcohol; 8-Methyl-1-
heptanol; Octanol; iso-Octanol; Oxooctyl
alcohol

United Nations Number..... 1

CHRIS Code..... IOA

Formula— $C_8H_{18}CH_2OH$

Appearance—Odor—Clear liquid; mild odor

Boiling Point..... 171°C 338°F

Freezing Point..... -105°C -157°F

Specific Gravity—0.83

Vapor Pressure 20°C (68°F) (mmHg)..... 3.08

Reid Vapor Pressure (psia)..... 0.02

Vapor Pressure 46°C (115°F) (psia)..... 0.03

Vapor Density (Air = 1.0)..... 4.5

Solubility in Water..... Negligible

Chemical Family—Alcohol

Pollution Category—USEPA..... IMO..... C

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard if exposed to heat or flame.

Flash Point (°F)..... 180

Flammable Limits..... 0.9 to 5.7%

Autoignition Temp. (°F)..... 530

Extinguishing Agents..... Confined area—CO₂, dry chemical. Open—foam.

Special Fire Procedures..... Use water to cool fire exposed tanks.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

50/Skin

TLV/TWA (ppm)

50/Skin

General—Low toxicity; irritation of skin and mucous membranes.

Symptoms—Irritates skin and eyes.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Charge: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



OLEUM (20 to 66% SO₂)

Synonyms—Fuming sulfuric acid; Sulfuric acid, fuming

United Nations Number 1831

CHRIS Code OLM

Formula—H₂SO₄•SO₂

Appearance—Odor—Colorless, oily liquid; sharp, penetrating odor

Specific Gravity—1.88 to 1.98

Chemical Family—Inorganic acid

Pollution Category—USEPA IMO C

Applicable Bulk Reg. 46 CFR Subchapter O

Boiling Point Decomposes °C °F

Freezing Point* -4 on up °C 25 on up °F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) Low

Reid Vapor Pressure (psia) Low

Vapor Pressure 46°C (115°F) (psia) Low

Vapor Density (Air = 1.0) 2.76

Solubility in Water Complete

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as a corrosive liquid.

Electrical Group—B (based upon possible hydrogen gas (H₂) generation should a leak or spill occur)

General—Oleum will not burn. It will react with many metals, giving off hydrogen gas which is highly flammable.

If hydrogen is trapped in confined spaces it can form an explosive mixture with air. See data sheet for hydrogen. May cause fire on contact with combustibles.

Flash Point (°F) Non-flammable

Flammable Limits Non-flammable

Autoignition Temp. (°F) Non-flammable

Extinguishing Agents Not applicable

Special Fire Procedures DO NOT USE WATER to put out a fire if the water can get into oleum. If fire is next to an oleum tank, wear respiratory protection against fumes. Wear full protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

4, 4, 3

Odor Threshold (ppm)

1 mg/m³

PEL/TWA (ppm)

1 mg/m³

TLV/TWA (ppm)

1 mg/m³

General—Vapor extremely irritating. Liquid causes severe burns.

Symptoms—Severe respiratory irritation. Skin burns will result from contact with the liquid.

Short Exposure Tolerance—5 ppm can be tolerated for 5 minutes without permanent damage. Individual sensitivity varies from unpleasant to unbearable from 0.2 to 20 ppm.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical attention as soon as possible.

REACTIVITY DATA

Stability—Reacts violently with water, producing a great deal of heat.

Compatibility—Oleum reacts vigorously with many metals releasing hydrogen. Extremely hazardous in the presence of many materials. Oleum destroys many plastics and rubbers after brief contact. Glass and Teflon, however, are completely compatible.

Cargo: Unassigned in compatibility chart. Compatibility assistance available from G-MTH-1 (202-267-1577). See Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Have body shield available. Cover contaminated surface and spill with sodium bicarbonate or a soda-ash-slaked lime mixture (50-50). Do not scoop up until neutralization is completed.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * The freezing point for 20% SO₂ is about 25°F. It rises with SO₂ concentration to about 95°F at 45%, then falls off to about 30°F at 66%.



OLIVE OIL

Synonyms—Sweet oil

United Nations Number..... 1

Formula—Mixture including oleic, palmitic and linoleic acids

Appearance—Odor—Pale yellow or greenish-yellow liquid; slight characteristic odor.

Specific Gravity—0.91 to 0.92

Chemical Family—Esters

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code 00L

Boiling Point V. High °C _____ °F

Freezing Point † °C _____ °F

Vapor Pressure 20°C (68°F) (mmHg) 2.04

Reid Vapor Pressure (psia) 0.1

Vapor Pressure 46°C (115°F) (psia) 0.15

Vapor Density (Air = 1.0) NP

Solubility in Water Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame.

Flash Point (°F) 437

Flammable Limits Unavailable

Autoignition Temp. (°F) 650

Extinguishing Agents Dry chemical, foam or carbon dioxide.

Special Fire Procedures Water may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 0, 0

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Not pertinent

TLV/TWA (ppm)
Not pertinent

General—Not harmful

Symptoms—None

Short Exposure Tolerance—Non-toxic

Exposure Procedures—Non-toxic. Wash thoroughly with soap and water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo, Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable
‡ Unassigned



(NOTE: This cargo is currently not permitted to be shipped in bulk in U.S. waters)

OXYGEN (liquefied)

Synonyms—Liquid oxygen; LOX

United Nations Number ... compressed 1072
refrigerated 1073

CHRIS Code OXY

Formula—O₂

Appearance—Odor—Light-blue liquid; odorless

Boiling Point -183°C -297°F

..... °C °F

Freezing Point -227°C -376°F

..... °C °F

Specific Gravity—1.14 (at bp)

Chemical Family—

Vapor Pressure 20°C (68°F) (mmHg) V. High

Reid Vapor Pressure (psia) V. High

Vapor Pressure 46°C (115°F) (psia) V. High

Vapor Density (Air = 1.0) 1.1

Solubility in Water 4.5%

Pollution Category—USEPA IMO 988

Applicable Bulk Reg. 46 CFR Subchapter *

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Compressed Gas (LCG). Classified as nonflammable.

Electrical Group—Not applicable

General—Oxygen does not burn but supports combustion vigorously. A combustible material onto which LOX has spilled will burst into flame or explode if exposed to a spark source.

Flash Point (°F) Non-flammable, but supports combustion.

Flammable Limits Non-flammable

Autoignition Temp. (°F) Non-flammable

Extinguishing Agents Use media suitable for substance which is burning.

Special Fire Procedures If the insulation fails on a LOX tank exposed to fire, the tank will explode.

Evacuate firefighters to a safe distance and have them take cover.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

None

Unavailable

Unavailable

General—No hazard for gas. Liquid can cause severe "burns" and tissue damage on contact with skin.

Symptoms—Skin contact with liquid will freeze tissue.

Short Exposure Tolerance—Unavailable

Exposure Procedures—If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention without delay. AVOID SPARKS AND OPEN FLAME.

REACTIVITY DATA

Stability—LOX will flash into vapor at temperatures above -180°F. If unconfined, the vapor will occupy about 860 times the volume of the liquid. If confined, a sudden and large pressure increase will result.

Compatibility—Material: LOX causes all combustible materials to burn vigorously. A spark is not always needed to ignite such a mixture.

Cargo: Unassigned in compatibility chart.

SPILL OR LEAK PROCEDURE

Secure ignition sources, rope off the spill area and call the fire department. Oxygen will quickly boil off. Extreme precaution against sparks must be observed before re-entering the spill area because, unless the spill is in the open with a good breeze blowing, the area will be oxygen-rich for a long time.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Not allowed to be shipped in bulk.

PARAFFIN WAX

Synonyms—Hard wax; Paraffin; Paraffin scale;
Petroleum wax

United Nations Number..... 3

Formula—High weight hydrocarbons (for
example: $C_{25}H_{52}$)

Appearance—Odor—White to yellow translucent
practically odorless, solid

Specific Gravity—0.80 to 0.88

Chemical Family—Saturated hydrocarbon

Pollution Category—USEPA _____ IMO III

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code..... WPF

Boiling Point..... ~ 370°C ~ 698°F
°C °F

Freezing Point..... 42-80°C 108-140°F
°C °F

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reid Vapor Pressure (psia)..... V. Low

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... NP

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible

Electrical Group—D

General—Slight fire hazard if subjected to heat or flame.

Flash Point (°F)..... 380 to 485

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 473

Extinguishing Agents..... Confined area—CO₂, dry chemical pen area—foam, water spray.

Special Fire Procedures..... Water or foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings
Unavailable

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
2 mg/m³ as a fume

TLV/TWA (ppm)
2 mg/m³ as a fume

General—Non-toxic, but possibility of thermal burns from hot liquid.

Symptoms—Non-toxic

Short Exposure Tolerance—Non-toxic

Exposure Procedures—Liquid on skin—remove wax and contaminated clothing and cool affected areas with water. Liquid in eyes—flush eyes gently with clean sea or fresh water. Continue washing for at least 15 minutes. Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with hot liquid. Wear goggles or face shield, protective clothing for hot liquid. Clean or scrape up into containers.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Normally transported at elevated temperatures. See 46 CFR 36—Elevated Temperature Cargoes.
‡ Unassigned



PARALDEHYDE

Synonyms—p-Acetaldehyde; Paracetaldehyde;
2,4,6-Trimethyl-1,3,5-trioxane; 1,3,5-Trioxane,
2,4,6-trimethyl-

United Nations Number..... 1284

Formula— $C_6H_{12}O_3$

CHRIS Code..... PDH

Appearance—Odor—Colorless liquid; aromatic odor

Boiling Point..... 128°C 262°F

°C °F

Specific Gravity—0.994

Freezing Point..... 13°C 55°F

°C °F

Chemical Family—Aldehydes

Vapor Pressure 20°C (68°F) (mmHg)..... 1

Reid Vapor Pressure (psia)..... 1

Vapor Pressure 46°C (115°F) (psia)..... 8.3

Vapor Density (Air = 1.0)..... 4.55

Pollution Category—USEPA C IMO C

Applicable Bulk Reg. 46 CFR Subchapter Q

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—C

General—Toxic fumes are given off when heated. Dangerous when exposed to heat, flame, or oxidizers.

Flash Point (°F)..... 96

Flammable Limits..... LEL = 1.3% UEL—unavailable

Autoignition Temp. (°F)..... 460

Extinguishing Agents..... Alcohol foam, CO_2 or dry chemical

Special Fire Procedures..... Water may be ineffective on fire. Wear full protective clothing and respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 2

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Vapor harmful if inhaled.

Symptoms—Irritation, headache, bronchitis, incoordination, drowsiness, digestive disturbance. Can cause serious eye injury.

Short Exposure Tolerance—4000 ppm fatal to 3 of 6 rats in hours. The lowest toxic dose for humans is 14 mg/kg.

Exposure Procedures—Remove from exposure; give artificial respiration or oxygen if needed. Flush eyes with water for 15 minutes, wash skin with soap and water. Remove contaminated clothing and shoes.

REACTIVITY DATA

Stability—Dangerous when exposed to heat or flame. Can react vigorously with oxidizing materials.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 19 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear protective clothing, goggles and self-contained breathing apparatus. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



PEANUT OIL

Synonyms—Arachis oil; Earthnut oil; Groundnut oil;
Katchung oil

United Nations Number..... 1

Formula—Mixture

Appearance—Odor—Yellow to greenish-yellow liquid with
a peanut-like odor
Specific Gravity—0.92

Chemical Family—Ester

Pollution Category—USEPA _____ IMO D
Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code..... OPN

Boiling Point..... V. High °C _____ °F

Freezing Point..... 3 °C _____ 37 °F

Vapor Pressure 20°C (68°F) (mmHg)..... 2.04

Raid Vapor Pressure (psia)..... 0.1

Vapor Pressure 46°C (115°F) (psia)..... 0.15

Vapor Density (Air = 1.0)..... NP

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid
Electrical Group—D

General—Slight fire hazard if exposed to heat and flame.

Flash Point (°F)..... 540

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 833

Extinguishing Agents..... Dry chemical, foam, or carbon dioxide

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed containers with water.

HEALTH HAZARD DATA

Health Hazard Ratings
Unavailable

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Not pertinent

TLV/TWA (ppm)
Not pertinent

General—Not harmful

Symptoms—None

Short Exposure Tolerance—Not harmful

Exposure Procedures—Non-toxic. Wash thoroughly with soap and water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield and protective clothing. Avoid contact with hot liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ± Unassigned



PENTACHLOROETHANE

Synonyms—Ethane, pentachloride; Ethane,
pentachloro-; Pentalin

United Nations Number..... 1889

CHRIS Code..... PCE

Formula— $\text{CHCl}_2\text{CCl}_3$

Appearance—Odor—Liquid with sweetish chloroform-like
odor

Specific Gravity—1.67

Chemical Family—Halogenated hydrocarbon

Pollution Category—USEPA A IMO B

Applicable Bulk Reg. 46 CFR Subchapter O

Boiling Point..... 162°C 324°F

..... °C °F

Freezing Point..... -29°C -20°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 7.0

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable

Electrical Group—NA

General—Dangerous when heated to decomposition; dehalogenation will produce spontaneously explosive chloroacetylenes.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... Non-flammable

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

Unavailable

Unavailable

General—Highly narcotic. Eye and upper respiratory tract irritant.

Symptoms—Has been indicated as being more narcotic than chloroform. Exposure to this material may cause injury to liver, lungs and kidneys. Has alcohol irritating effect on eyes and upper respiratory tract.

Short Exposure Tolerance—Lethal oral dose of 1.75 g/kg of body weight in dogs.

Exposure Procedures—Vapor—remove victim to fresh air and administer artificial respiration if necessary.

Skin—flush affected areas with water. Eyes—flush with water for 15 minutes. In all cases call a doctor.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are satisfactory.

Charge: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus and protective clothing. Secure all ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 3.4 mmHg at 25°C.

† Unavailable



1,3-PENTADIENE

Synonyms—alpha-Methylvinyl; cis-Pentadiene-1,3;
trans-Pentadiene-1,3; 1-Methylbutadiene; Piperylene

United Nations Number..... 1

Formula— $\text{CH}_2=\text{CHCH}=\text{CHCH}_3$

Appearance—Colorless liquid; faint odor.

Specific Gravity—0.68

Chemical Family—Olefins

Pollution Category—USEPA B IMO C

Applicable Bulk Reg. 46 CFR Subchapter Q

CHRIS Code..... PDE

Boiling Point..... 43°C 108°F

.....°C.....°F

Freezing Point..... -89°C -128°F

.....°C.....°F

Vapor Pressure 20°C (68°F) (mmHg)..... 345

Reid Vapor Pressure (psia)..... 10.9

Vapor Pressure 46°C (115°F) (psia)..... 17.09

Vapor Density (Air = 1.0)..... 2.39

Solubility in Water..... insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—B: Flammable liquid

Electrical Group—D

General—Highly flammable, dangerous fire risk.

Flash Point (°F)..... -20

Flammable Limits..... 1.5 to 8.0%

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Foam, dry chemical, CO₂

Special Fire Procedures..... Water may be ineffective on fire but may be used to cool tanks. Vapor may accumulate in an enclosed area presenting an explosion hazard. Wear self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings
2, 1, 3

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Moderate hazard for vapors, slight for liquid contact, and acute for ingestion.

Symptoms—Dizziness, headache. Irritates eyes, nose and upper respiratory passages.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Remove victim to fresh air. Give artificial respiration or oxygen as necessary. Eyes—flush with water for at least 15 minutes. Remove contaminated clothing immediately.

REACTIVITY DATA

Stability—Polymerization may occur. Must contain inhibitor. Reacts with oxidizers violently.

Compatibility—Material: Dissolves rubber and paint. Stainless steel, aluminum, lined steel and carbon steel are suitable.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Stop discharge if possible. Evacuate area. Secure ignition sources. Stay upwind and use water spray to knock down vapors. Wear self-contained breathing apparatus, rubber gloves and shoes. Do not flush spill into confined spaces where flammable vapors can accumulate.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ± Unassigned



ISO-PENTANE

Synonyms—Ethyl dimethylmethane; Isoamyl hydride;
Isopentane; 2-Methylbutane

United Nations Number..... 1265

CHRIS Code..... IPT

Formula— $(CH_3)_2CHCH_2CH_3$

Appearance—Odor—Colorless, motil, liquid; pleasant
odor

Specific Gravity—0.62

Chemical Family—Saturated hydrocarbons

Pollution Category—USEPA _____ IMO C*

Applicable Bulk Reg. 46 CFR Subchapter _____ D, Q

Boiling Point 28°C 82°F

Freezing Point -159°C -255°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) 510

Reid Vapor Pressure (psia) 20

Vapor Pressure 46°C (115°F) (psia) 27

Vapor Density (Air = 1.0) 2.48

Solubility in Water Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—D

General—Severe explosion hazard in enclosed space in presence of a source of ignition. Electrostatic generation likely. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F) - 70

Flammable Limits 1.4 to 7.6%

Autoignition Temp. (°F) 788

Extinguishing Agents Foam, CO₂, dry chemical

Special Fire Procedures Water may be ineffective on fire. Cool exposed tanks with water. Use water spray to "knock down" vapors.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Liquid irritating to skin and eyes. Inhalation causes slight local irritation. An asphyxiant, also a narcotic in high concentrations resulting in dizziness and drowsiness.

Symptoms—Breathing high concentrations of vapor for some time may cause dizziness, drowsiness.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable. Dangerous reaction possible with oxidizing agents.

Compatibility—Material: Certain plastics are unsuitable.

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear polyethylene gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources. Do not flush spill into confined spaces where flammable vapors can accumulate.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Pollution Category C oil-like, 33 CFR 151.49.

PENTANE

Synonyms—Amyl hydride; Normal pentane; n-Pentane

United Nations Number..... 1285

Formula— $\text{CH}_3(\text{CH}_2)_4\text{CH}_3$

Appearance—Odor—Colorless liquid with gasoline-like odor

Specific Gravity—0.63

Chemical Family—Saturated hydrocarbon

Pollution Category—USEPA—IMO—C

Applicable Bulk Reg. 46 CFR Subchapter..... D.O.

CHRIS Code..... PTA

Boiling Point..... 36°C 97°F

Freezing Point..... -130°C -202°F

Vapor Pressure 20°C (68°F) (mmHg)..... 431

Reid Vapor Pressure (psia)..... 15.5

Vapor Pressure 46°C (115°F) (psia)..... 21.0

Vapor Density (Air = 1.0)..... 2.48

Solubility in Water..... Slightly soluble

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—D

General—Highly dangerous when exposed to heat or flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... -56

Flammable Limits..... 1.4 to 8.5%

Autoignition Temp. (°F)..... 544

Extinguishing Agents..... Foam, dry chemical, carbon dioxide

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed tanks with water. Use water spray to "knock down" vapors.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 1

Odor Threshold (ppm)

10

PEL/TWA (ppm)

600

TLV/TWA (ppm)

600

General—Vapors may cause dizziness or difficult breathing. Liquid is harmful if swallowed.

Symptoms—Low toxicity. Very high concentration of vapors may cause narcosis.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor inhalation—move victim to fresh air. If breathing stops, administer artificial respiration. Liquid—have victim drink plenty of water or milk. DO NOT INDUCE VOMITING. Call a doctor.

REACTIVITY DATA

Stability—Stable. Dangerous reaction possible with oxidizing agents. Keep away from heat, sparks, or open flame.

Compatibility—Material: Mild steel and stainless steel are suitable. Natural rubber will soften and deteriorate rapidly.

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear polyethylene gloves, face shield, protective clothing. Have all purpose canister mask available. For gas leaks keep vapor concentration below explosive mixture range. Secure ignition sources. Do not flush spill into confined spaces where flammable vapors can accumulate.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Pollution Category C oil-like, 33 CFR 151.48.



PERCHLOROETHYLENE

Synonyms—Ethene, tetrachloro-; Ethylene tetrachloride;
Perchloroethylene; Tetrachlorethene;
Tetrachlorethylene; Tetrachloroethylene

United Nations Number..... 1897

CHRIS Code..... PER

Formula— $\text{Cl}_2\text{C} = \text{CCl}_2$, or C_2Cl_4

Appearance—Odor—Colorless liquid; chloroform-like odor

Boiling Point..... 121°C 250°F

..... °C °F

Freezing Point..... -22°C -8°F

..... °C °F

Specific Gravity—1.62

Chemical Family—Unsaturated halogenated
hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... 0.68

Vapor Pressure 46°C (115°F) (psia)..... 1.23

Vapor Density (Air = 1.0)..... 5.83

Pollution Category—USEPA B IMO B

Solubility in Water..... Negligible

Applicable Bulk Reg. 46 CFR Subchapter..... Q

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable

Electrical Group—NA

General—Does not burn. The liquid or vapor in contact with a hot surface or a flame can decompose to form phosgene, which is highly toxic.

Flash Point (°F)..... None

Flammable Limits..... None

Autoignition Temp. (°F)..... None

Extinguishing Agents..... None

Special Fire Procedures..... In case of fire near a perchloroethylene tank, cool the tank with water. Wear self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

20 to 40

25

50

General—Suspected carcinogen. Prolonged, excessive, or repeated exposures to the product in any form are hazardous. Can defat the skin and may produce dermatitis from frequent daily contact.

Symptoms—Headache, dizziness, blurred vision, tears, burning of the eyes, irritation of nose and throat.

Short Exposure Tolerance—200 ppm

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable up to 258°F; at this temperature the product decomposes and gives off poisonous fumes.

Compatibility—Material: Compatible with galvanized iron, black iron or steel.

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, protective clothing. Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 15.8 mmHg at 22°C.



PETROLATUM

Synonyms—Paraffin jelly; Petrolatum jelly; Petroleum jelly; Vaseline; Yellow petrolatum

United Nations Number..... +

CHRIS Code..... PTL

Formula—Mixture of liquid or semi-liquid aliphatic hydrocarbons

Appearance—Colorless to amber, oily translucent; no odor

Specific Gravity—0.82 to 0.85

Boiling Point..... ~150°C ~302°F

Freezing Point..... 38-60°C 100-140°F

Chemical Family—Saturated hydrocarbons

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reid Vapor Pressure (psia)..... V. Low

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... NP

Solubility In Water..... Negligible

Pollution Category—USEPA _____ IMO III

Applicable Bulk Reg. 46 CFR Subchapter _____ D

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible

Electrical Group—NA

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 138

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Confined area—CO₂, dry chemical. Open area—water spray, foam.

Special Fire Procedures..... Water or foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

None

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Non-toxic, but possibility of thermal burns from hot liquid.

Symptoms—Nox-toxic

Short Exposure Tolerance—Non-toxic

Exposure Procedures—Liquid on skin—remove contaminated clothing and cool affected areas with cold water.

Liquid in eye—flush eyes gently with clean sea or fresh water. Continue washing for at least 15 minutes.

Get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with hot liquid. Wear goggles or face shield, protective clothing for hot liquids. Wash away with water. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Normally transported at elevated temperatures. See 48 CFR 36—Elevated Temperature Cargoes.

‡ Unassigned



PHENOL

Synonyms—Benzene, hydroxy-; Carboic acid;
Hydroxybenzene; Monohydroxybenzene;
Oxybenzene; Phenic acid; Phenyl hydroxide;
Phenyl acid

United Nations Number ... motten 2312
solid 1671

CHRIS Code PHN

Formula— C_6H_5OH

Appearance-Odor—Colorless-to-pink solid or thick liquid;
sweet, disinfectant-like odor (like Lysol)

Specific Gravity—1.07

Chemical Family—Phenol

Pollution Category—USEPA C IMO B

Applicable Bulk Reg. 46 CFR Subchapter O

Boiling Point 182°C 359°F

..... °C °F

Freezing Point 41°C 106°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) 0.3

Reid Vapor Pressure (psia) 0.3

Vapor Pressure 46°C (115°F) (psia) 0.8

Vapor Density (Air = 1.0) 3.24

Solubility in Water at 16°C, 6.7%

at 66°C, complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible

Electrical Group—D

General—When heated, it emits toxic and irritating fumes. Moderate fire hazard when exposed to heat or flame.

Flash Point (°F) 185

Flammable Limits 1.7 to 8.6%

Autoignition Temp. (°F) 1319

Extinguishing Agents CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures Where there is danger of skin contact, provide full body protection. Full respiratory protection should be worn by fire parties at all times.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 3, 3

Odor Threshold (ppm)

0.047

PEL/TWA (ppm)

5/Skin

TLV/TWA (ppm)

5/Skin

General—Causes severe burns. Poisonous by skin absorption. Class B poison.

Symptoms—Headache, weakness, ringing of the ears, and irregular breathing. Skin contact will cause white, wrinkled, soft skin at site of contact. Absorption through skin is rapid and can cause death within 30 minutes after exposure.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get victim to a hospital or treatment center as soon as possible. All exposure victims should get medical attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Rubber, aluminum and its alloys, zinc and lead are attacked by phenol.

Cargo: Group 21 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Do not permit anyone near spill unless suitably protected.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Normally transported at elevated temperatures. See 46 CFR 36—Elevated Temperature Cargoes.

* Vapor Pressure: 30.6 mmHg at 25°C.



PHOSPHORIC ACID

Synonyms—Metaphosphoric acid; Orthophosphoric acid; meta-Phosphoric acid; ortho-Phosphoric acid; White phosphoric acid

United Nations Number..... 1805

Formula— H_3PO_4

CHRIS Code..... PAC

Appearance-Odor—Clear, syrupy liquid; practically odorless

Boiling Point..... <130°C <266°F

Specific Gravity—1.83

Freezing Point..... 42°C 108°F

Chemical Family—Inorganic acid

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Pollution Category—USEPA D IMO D

Rcid Vapor Pressure (psia)..... Low

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 3.39

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as corrosive liquid.

Electrical Group—B (based upon possible hydrogen gas (H_2) generation should a leak or spill occur)

General—Phosphoric acid will not burn. It will react with many metals, giving off hydrogen gas which is highly flammable. If hydrogen is trapped in a confined space, it can form an explosive mixture with air. See data sheet for hydrogen.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... Keep tank cool with water spray. Since toxic fumes of oxides of phosphorus are evolved when phosphoric acid is heated to decomposition, fire fighters should be provided with self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 3, 1

Odor Threshold (ppm)
None

PEL/TWA (ppm)
1 mg/m³

TLV/TWA (ppm)
1 mg/m³

General—Causes burns.

Symptoms—Irritation of skin in contact with liquid; burning of eyes.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Skin contact—remove contaminated clothing and flush affected areas gently with large amounts of water. Eye contact—immediately flush eyes gently with water; continue to flush for 15 minutes. Get medical attention.

REACTIVITY DATA

Stability—Stable over a wide temperature range.

Compatibility—Material: Very corrosive to ordinary ferrous metals and alloys particularly at temperatures above 180°F.

Cargo: Group 1 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, protective clothing. Have body shield available. Avoid contact with liquid. Secure ignition sources. Flush spills with large amounts of water or, if possible, cover contaminated surface and spill with sodium bicarbonate, or a soda ash-slaked lime mixture (50-50). Mix and add water, if necessary to form a slurry. Scoop up slurry. Wash site with soda ash solution.

In the event of a major spill, call the National Response Center, 800-424-8802.

Remarks: The information provided is for 100% phosphoric acid.



PHOSPHORUS (White)

Synonyms— White phosphorus; WP; Yellow phosphorus

United Nations Number..... 1381

Formula— P_4

CHRIS Code..... PPW

Appearance—Odor—Waxy, pale-yellow solid; garlic-like odor

Boiling Point..... 279°C 535°F

Specific Gravity—1.82

Freezing Point..... 44°C 111°F

Chemical Family—Phosphorus

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Pollution Category—USEPA X IMO A

Reid Vapor Pressure (psia)..... V. Low

Applicable Bulk Reg. 46 CFR Subchapter Q

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... 4.42

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—Pyrophoric solid

Electrical Group—NA

General—Pyrophoric—ignites spontaneously when exposed to air and burns vigorously. When shipped in bulk, air is kept away by a water blanket. Burning releases dense irritating fumes; intense white smoke is formed.

Flash Point (°F)..... Ignites spontaneously in air

Flammable Limits..... Ignites spontaneously in air

Autoignition Temp. (°F)..... 86

Extinguishing Agents..... EXCLUDE AIR; use water spray, sand, or earth

Special Fire Procedures..... Use suitable respiratory protection. DO NOT use high-pressure water stream, as it may spread molten phosphorus over a wider area. Do not use carbon dioxide extinguisher. Try to smother in fire with sand. Wear full protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

NA, 4, 4

Unavailable

0.1 mg/m³

0.1 mg/m³

General—Causes severe burns. Vapor inhalation is very dangerous. Can be absorbed through the skin.

Symptoms—Weakness and unusual sensitivity of eyes to light. Vapor of burning phosphorus is irritating to nose, throat and lungs. Skin contact causes burns and ulcers.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Skin contact—immediately plunge infected area into water or get victim under a flood-type shower and deluge contacted parts. Large amounts of copper sulfate solution (10–15%) should be applied. Continue this for 3 minutes and then try to wash away the phosphorus particles. Contact a doctor.

REACTIVITY DATA

Stability—Phosphorus must be shipped covered with water, because on exposure to air it ignites spontaneously. Reacts vigorously with oxidizing agents. Incompatible with dry air.

Compatibility—Material:

Cargo: Unassigned in compatibility chart. For compatibility assistance, call G-MTH-1 (202-267-1577).

SPILL OR LEAK PROCEDURE

Wear rubber gloves, protective clothing, large face shield. Avoid contact with the spilled material. Cover with wet sand. Spray with water to keep sand wet. Scoop into buckets or barrel of water. After standing overnight, recover and repackage. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



PHTHALIC ANHYDRIDE

Synonyms—1,2-Benzenedicarboxylic acid anhydride;
1,3-Dioxophalan; 1,3-Isobenzofundione; PAN;
Phthalandione; Phthalic acid anhydride

United Nations Number..... 2214

Formula— $C_8H_4(CO)_2O$

CHRIS Code..... PAN

Appearance-Odor—White or colorless crystals with a mild odor

Boiling Point..... 284°C 544°F
..... °C °F

Specific Gravity—1.53

Freezing Point..... 131°C 268°F
..... °C °F

Chemical Family—Acid anhydride

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 5.1

Solubility in Water..... Slight

Pollution Category—USEPA D IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... D

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible
Electrical Group—D

General—Molten phthalic anhydride will burn if ignited and its vapor may form an explosive mixture with air.

Flash Point (°F)..... 304

Flammable Limits..... 1.7 to 10.4%

Autoignition Temp. (°F)..... 1083

Extinguishing Agents..... Water fog, CO₂, dry chemical

Special Fire Procedures..... Water stream may cause frothing. Steam is an effective extinguishing agent for fighting molten phthalic anhydride fires in tanks.

HEALTH HAZARD DATA

Health Hazard Ratings
2, 3, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
1

TLV/TWA (ppm)
1

General—Local irritant to body tissues, especially moist skin. Vapor irritating to skin, eyes, nose, throat and upper respiratory tract. Molten material causes severe burns.

Symptoms—Coughing, sneezing, burning sensations in nose and throat, increased mucous secretion; on contact, phthalic anhydride is very irritating to wet skin.

Short Exposure Tolerance—25 mg/m³ in air produced some signs of mucous membrane irritation with 30 mg/m³ causing definite eye irritation.

Exposure Procedures—Vapor—remove victim to fresh air; spraying or gargling with water will help relieve nasal or throat irritations; if respiratory distress or violent coughing occurs, administration of oxygen is helpful; call a physician immediately. Skin contact—wash affected area thoroughly with soap and water; remove contaminated clothing and launder before reuse. Eye contact—flush eyes thoroughly with water and irrigate for 15 minutes or more. Call a physician.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Compatible with most materials when dry; however, when wet, phthalic anhydride forms a solution of phthalic acid which attacks ordinary iron and mild steel.

Cargo: Group 11 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Body shield and self-contained breathing apparatus should be available. If possible, cover spill with soda ash or sodium bicarbonate. Mix, and add water if necessary to effect good mixing. Scoop up slurry and wash site with soda ash solution. Secure all ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Normally transported at elevated temperatures. See 46 CFR 36—Elevated Temperature Cargoes.



POLYBUTENE

Synonyms—Butene resins; Polybutylene; Polyisobutene;
Polyisobutylene, plastics, resins & waxes

United Nations Number..... 1

Formula— $C(CH_3)_2CH_2-$

Appearance—Odor—Colorless, odorless, oily liquid

Specific Gravity—0.81 to 0.91 at 15°C

Chemical Family—Olefin

Pollution Category—USEPA..... IMO..... III

Applicable Bulk Reg. 46 CFR Subchapter..... D

CHRIS Code..... PLB

Boiling Point..... V. High°C.....°F

.....°C.....°F

Freezing Point..... †°C.....°F

.....°C.....°F

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reid Vapor Pressure (psia)..... V. Low

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... NP

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Mild fire hazard when exposed to heat or flame.

Flash Point (°F)..... 215 to 470

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... CO₂, dry chemical or foam

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

None

Not pertinent

Not pertinent

General—Non-toxic. Vapor may act as a simple asphyxiant in high concentration.

Symptoms—Non-toxic

Short Exposure Tolerance—Non-toxic

Exposure Procedures—Remove to fresh air, apply artificial respiration if needed.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Charge: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield and protective clothing. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

‡ Unassigned



POLYMETHYLENE POLYPHENYL ISOCYANATE

Synonyms—PAPI

United Nations Number..... †

Formula— $C_{23}H_{12}O_2N_6$

CHRIS Code..... PPI

Appearance—Dark brown liquid; no appreciable odor.

Boiling Point..... ~232°C ~450°F

Specific Gravity—1.2

Freezing Point..... †°C °F

Chemical Family—Isocyanates

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Pollution Category—USEPA..... D

Reid Vapor Pressure (psia)..... V. Low

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... NP

Solubility in Water..... Reacts

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Minor to moderate fire risk due to high flash point. Somewhat self-extinguishing as CO_2 is given off.

Flash Point (°F)..... 425

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Confined area— CO_2 ; self-extinguishing.

Special Fire Procedures..... Wear protective clothing and respiratory protection. Self-extinguishing. Reacts with water to evolve CO_2 and form solid polymer.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

0.4

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

0.01

General—Will discolor skin to brown color, reacting slowly and painlessly if not promptly removed. Additives used are extremely toxic.

Symptoms—Labored breathing, watering of eyes.

Short Exposure Tolerance—Animal tests showed inhalation of 2.2 ppm were fatal to 4 of 6 rats. No toxic effects were observed on skin contact; eye distress was temporary. LD_{50} was 10,000 mg/kg.

Exposure Procedures—Remove victim to fresh air; administer oxygen if breathing is labored. Flush skin with water after removing contaminated clothing. Wash eye with water for at least 15 minutes. Ingestion—Induce vomiting 3 times, follow with quart of milk and a mild cathartic. Get medical help.

REACTIVITY DATA

Stability—Stable. Heat, water, and acids will react to evolve CO_2 .

Compatibility—Material: Not corrosive to mild steel, however, aluminum cannot be used.

Cargo: Group 12 of compatibility chart.

SPILL OR LEAK PROCEDURE

Cover spill with water spray. Cleanup. Secure all ignition sources. Wear protective clothing and possibly respiratory protection.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Storing under a dry inert atmosphere at slight positive pressure to eliminate traces of moisture contamination is imperative.

† Unavailable

‡ Unassigned



PROPANE

Synonyms—Dimethylmethane; Propyl hydride

United Nations Number..... 1978

Formula—C₃H₈

CHRIS Code..... PRP

Appearance—Odor—Colorless gas or liquid; natural-gas odor

Boiling Point..... -42°C -44°F

Specific Gravity—0.53 (liquid)

Freezing Point..... -187°C -305°F

Chemical Family—Saturated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 6800

Pollution Category—USEPA..... IMO 988

Reid Vapor Pressure (psia)..... 190

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

Vapor Pressure 46°C (115°F) (psia)..... 228

Vapor Density (Air = 1.0)..... 1.55

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—D

General—Unless the flow of gas can be stopped, extinguishing a propane fire will permit the accumulation of an explosive concentration of vapor, and subsequent explosion or reflash.

Flash Point (°F)..... less than -64

Flammable Limits..... 2.2 to 9.5%

Autoignition Temp. (°F)..... 842

Extinguishing Agents..... Stop flow of gas; CO₂, dry chemical, water fog

Special Fire Procedures..... Tanks exposed to fire should be kept cool with a continuous spray of water.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

0, 0, 0

5,000 to 20,000*

1000

Unavailable

General—Liquid causes frostbite on skin contact. Cold vapor causes skin damage. Inhalation can lead to asphyxiation

Symptoms—Headache, dizziness, drowsiness. Contact with the liquid will cause frostbite.

Short Exposure Tolerance—A vapor concentration of 10,000 ppm for brief periods has been reported as producing no symptoms

Exposure Procedures—Remove victim to fresh air. Give artificial respiration if breathing stops. Get medical attention. If liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention. *NOTE: Exposure to potentially dangerous vapor concentrations can occur before the product can be detected by smell.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 31 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure all possible sources of ignition and call the fire department. The spilled liquid will boil away rapidly, leaving no residue.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ISO-PROPANOLAMINE

Synonyms—1-Amino-2-propanol; 2-Hydroxypropylamine;
Isopropanolamine; MIPA; Monoisopropanolamine

United Nations Number..... 1

Formula— $\text{CH}_3\text{CHOHCH}_2\text{NH}_2$

CHRIS Code..... MPA

Appearance—Odor—Colorless liquid; slight ammoniacal
odor

Boiling Point..... 160°C 320°F

Specific Gravity—0.96

Freezing Point..... 1°C 34°F

Chemical Family—Amine

Vapor Pressure 20°C (68°F) (mmHg)..... 0.51

Reid Vapor Pressure (psia)..... 0.05

Pollution Category—USEPA..... IMO—C

Vapor Pressure 46°C (115°F) (psia)..... 0.08

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Vapor Density (Air = 1.0)..... 2.59

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Irritating vapors given off when heated. Moderate fire hazard when exposed to heat or flame; can react with oxidizing materials.

Flash Point (°F)..... 165

Flammable Limits..... 2.2 to 12% (approximate)

Autoignition Temp. (°F)..... 706 (estimated)

Extinguishing Agents..... Dry chemical, water spray, alcohol foam, or carbon dioxide

Special Fire Procedures..... Wear goggles, self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 2, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Single short exposure to skin may cause considerable irritation. Liquid expected to burn eyes. Inhalation causes very slight respiratory irritation.

Symptoms—Nose and throat irritation.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—in case of skin contact, wash well with soap and water. For eye contact, wash with large amounts of water.

REACTIVITY DATA

Stability—Stable; forms soaps with organic acids.

Compatibility—Material: Will remove paint, swells rubber; recommend type 304 stainless steel clad tanks.

Cargo: Group 8 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



PROPANOLAMINE

Synonyms—3-Amino-1-propanol; 3-Hydroxypropylamine;
3-Propanolamine; 1-Propanol, 3-amino-

United Nations Number..... †

Formula— C_3H_7NO

CHRIS Code..... PLA

Appearance—Odor—Light yellow to colorless liquid; fishy
odor

Boiling Point..... 168°C 334°F

Freezing Point..... 12°C 54°F

Specific Gravity—0.982

Vapor Pressure 20°C (68°F) (mmHg)..... 2.1

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 2.59

Chemical Family—Amino-alcohol

Pollution Category—USEPA..... IMO C

Applicable Bulk Reg. 46 CFR Subchapter..... O

Solubility in Water..... Soluble

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 175

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Alcohol foam, dry powder, CO_2

Special Fire Procedures..... Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Moderately irritating to skin and eyes.

Symptoms—Irritation of mucous membranes and respiratory tract. Severe exposure results in blisters and burns.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Remove victim to fresh air. Give artificial respiration or oxygen as necessary. Flush eyes and skin well with water. Remove contaminated clothing. Wash out mouth with water if ingested.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Copper and copper alloys are readily corroded.

Cargo: Group 8 of compatibility chart

SPILL OR LEAK PROCEDURE

Wear self-contained breathing apparatus and rubber gloves. Absorb material on vermiculite, sweep up, mix with dry caustic, wrap in paper and burn in an incinerator. Wash spill site.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

‡ Unassigned



(NOTE: This cargo is currently not permitted to be shipped in bulk in U.S. waters)

beta-PROPIOLACTONE

Synonyms—Hydracrylic acid, beta-lactone;
2-Oxetanone; Propanolide; beta-Propionolactone

United Nations Number..... +

CHRIS Code..... PLT

Formula— $\text{OCH}_2\text{CH}_2\text{CO}$

Appearance—Odor—Colorless liquid; irritating odor

Boiling Point..... 155°C 311°F

Freezing Point..... -33°C -28°F

Specific Gravity—1.15

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reid Vapor Pressure (psia)..... +

Vapor Pressure 46°C (115°F) (psia)..... 0.17

Vapor Density (Air = 1.0)..... 2.5

Solubility in Water..... Soluble

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—Not applicable

General—Combustible; containers may explode in fire. Vapors of unburned material are very toxic.

Flash Point (°F)..... 165 (cc)

Flammable Limits..... LEL=2.9% UEL=unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Water, dry chemical, foam, CO_2

Special Fire Procedures..... Wear self-contained breathing apparatus, full protective clothing, rubber gloves to prevent all contact with liquid. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 3, 4

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

29 CFR 1910.1013

TLV/TWA (ppm)

0.5

General—Suspected carcinogen. Vapor moderately irritating. Liquid is a fairly severe skin irritant. Poison. Get medical attention after all exposures to this compound.

Symptoms—Inhalation—irritation of nose, throat and respiratory tract. Liquid causes eye irritation and tears. Skin contact results in irritation and blistering. Ingestion—mouth and stomach burns.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Inhalation—move victim to fresh air. Give artificial respiration or oxygen as necessary.

Eyes—flush with water for 15 minutes. Skin—flush with water. Fluid from blisters will cause additional blisters. Ingestion—give large amounts of water, induce vomiting.

REACTIVITY DATA

Stability—Stable but at elevated temperatures can polymerize.

Compatibility—Material:

Cargo: Group 18 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear full protective clothing. Avoid any contact whatsoever. Wear self-contained breathing apparatus and rubber gloves. Disperse and flush large spills.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Bulk shipment not permitted.

† Unavailable

‡ Unassigned



PROPIONALDEHYDE

Synonyms—Methyl acetalddehyde; Propanal; Propionic aldehyde; Propyl aldehyde; Propylic aldehyde

United Nations Number..... 1275

Formula— C_3H_6CHO

CHRIS Code..... PAD

Appearance—Odor—Colorless liquid with suffocating and fruity odor

Boiling Point..... 47°C 117°F

Specific Gravity—0.80

Freezing Point..... -79°C -112°F

..... °C °F

Chemical Family—Aldehyde

Vapor Pressure 20°C (68°F) (mmHg)..... 258

Reid Vapor Pressure (psia)..... 5.7

Vapor Pressure 46°C (115°F) (psia)..... 14

Vapor Density (Air = 1.0)..... 2.0

Pollution Category—USEPA _____ IMO —D—

Applicable Bulk Reg. 46 CFR Subchapter D—

Solubility in Water 22%

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—Extreme fire hazard due to low flash point. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Reacts vigorously with oxidizers.

Flash Point (°F)..... 15 to 19

Flammable Limits..... 2.9 to 17%

Autoignition Temp. (°F)..... 405

Extinguishing Agents..... Carbon dioxide, dry chemical and alcohol foam.

Special Fire Procedures..... Keep tanks cool with water spray. Provide fire fighters with self-contained breathing apparatus and protective clothing. Fire may be difficult to control due to ease with which vapor is re-ignited. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 1, 2

Odor Threshold (ppm)

1

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Liquid irritating to skin and causes eye injury. Vapor inhalation dangerous.

Symptoms—Dizziness, drowsiness.

Short Exposure Tolerance—8,000 ppm

Exposure Procedures—Skin contact should be thoroughly washed off with soap and water. In case of liquid contact of the eyes, flush eyes with water for at least 15 minutes then obtain medical treatment.

REACTIVITY DATA

Stability—Highly reactive. Normally stored under nitrogen blanket. Reacts vigorously with oxidizers.

Compatibility—Material: Either stainless steel or aluminum are suitable materials. Tanks may be coated with phenolic resin.

Cargo: Group 19 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Secure ignition sources. If possible, cover with sodium bisulfite ($NaHSO_3$). Add small amount of water and mix. Scoop up. Wash site with soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:

PROPIONIC ACID

Synonyms—Ethane carboxylic acid; Ethylformic acid; Methacetic acid; Methylacetic acid; Propanoic acid

United Nations Number..... 1848

CHRIS Code..... PNA

Formula— $\text{CH}_3\text{CH}_2\text{COOH}$

Boiling Point..... 141°C 286°F

Appearance-Odor—Clear, colorless liquid; pungent odor

°C °F

Freezing Point..... -21°C -6°F

Specific Gravity—0.995

°C °F

Chemical Family—Organic acid

Vapor Pressure 20°C (68°F) (mmHg)..... 2.5

Reid Vapor Pressure (psia)..... 0.2

Vapor Pressure 46°C (115°F) (psia)..... 0.3

Vapor Density (Air = 1.0)..... 2.56

Solubility in Water..... Complete

Pollution Category—USEPA D IMO D

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Ignited by heat and open flame.

Flash Point (°F)..... 140

Flammable Limits..... 2.9 to 14.8%

Autoignition Temp. (°F)..... 955

Extinguishing Agents..... Alcohol foam, water spray, CO_2 , dry chemical

Special Fire Procedures..... Provide fire fighters with goggles, self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

2, 3, 2

Unavailable

10

10

General—Vapor extremely irritating. Liquid causes severe burns.

Symptoms—Causes burns on the skin, particularly mucous membranes (mouth, nose) and eyes.

Short Exposure Tolerance—Unavailable.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical attention.

REACTIVITY DATA

Stability—Stable. When heated, emits acid fumes.

Compatibility—Material: Corrosive.

Cargo: Group 4 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Body shield and self-contained breathing apparatus should be available. Avoid contact with liquid. Secure ignition sources. If possible, cover spill with soda ash or sodium bicarbonate. Mix and add water if necessary to effect good mixing, scoop up slurry and wash site with soda ash solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



PROPIONIC ANHYDRIDE

Synonyms—Methylacetic anhydride; Propanoic acid anhydride; Propanoic anhydride; Propionyl oxide

United Nations Number..... 2496

Formula— $(CH_3CH_2CO)_2O$

Appearance—Odor—Colorless liquid; pungent odor

Specific Gravity—1.01

Chemical Family—Organic acid

Pollution Category—USEPA—D IMO—C

Applicable Bulk Reg. 46 CFR Subchapter Q

CHRIS Code PAH

Boiling Point 169°C 336°F

Freezing Point -45°C -49°F

Vapor Pressure 20°C (68°F) (mmHg) 1.0

Reid Vapor Pressure (psia) Low

Vapor Pressure 46°C (115°F) (psia) Low

Vapor Density (Air = 1.0) 4.49

Solubility in Water

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame; more of a health hazard than a fire or stability hazard.

Flash Point (°F) 165

Flammable Limits 1.48 to 11.9%

Autoignition Temp. (°F) 600

Extinguishing Agents Carbon dioxide or dry chemical

Special Fire Procedures DO NOT USE WATER as extinguishing media; propionic anhydride reacts slowly with water to form propionic acid—reaction rate increases with temperature.

HEALTH HAZARD DATA

Health Hazard Ratings

3, 2, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Vapors irritating when inhaled. Liquid irritating to skin on contact. May produce sensitization effects.

Symptoms—Respiratory irritation, skin irritation.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victims to fresh air; apply artificial respiration if breathing stops. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water. Get medical attention if discomfort persists.

REACTIVITY DATA

Stability—Decomposes on contact with water. Can react with oxidizing materials.

Compatibility—Material: Noncorrosive to aluminum or stainless steel.

Cargo: Group 11 of compatibility chart.

SPILL OR LEAK PROCEDURE

Have self-contained breathing apparatus available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Reacts with water to form propionic acid.



PROPIONITRILE

Synonyms—Cyanoethane; Ether cyanatus; Ethyl cyanide; Hydrocyanic ether; Propanenitrile; Propionic nitrile

United Nations Number..... 2404

CHRIS Code..... PCN

Formula— C_3H_5N

Appearance-Odor—Brown liquid; pungent odor

Boiling Point..... 97°C 207°F
..... °C °F

Specific Gravity—0.78

Freezing Point..... -92°C -133°F
..... °C °F

Chemical Family—Nitriles

Vapor Pressure 20°C (68°F) (mmHg)..... 39

Pollution Category—USEPA _____ IMO C

Reld Vapor Pressure (psia)..... 1.6

Applicable Bulk Reg. 46 CFR Subchapter..... O

Vapor Pressure 46°C (115°F) (psia)..... 2.4

Vapor Density (Air = 1.0)..... 1.4

Solubility in Water..... Soluble

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Produces toxic gases of hydrogen cyanide, nitrogen oxides, and carbon monoxide when heated or near open flame.

Flash Point (°F)..... 54

Flammable Limits..... 3.1 to 14.0%

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Alcohol foam, dry chemical, CO₂

Special Fire Procedures..... Cool exposed tanks with water. Wear self-contained breathing apparatus and full protective clothing including boots.

HEALTH HAZARD DATA

Health Hazard Ratings
3, 2, 3

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—May be fatal if absorbed through skin. Liquid causes burns.

Symptoms—Dizziness, nausea, rapid pulse, respiratory distress, cyanosis, coma. May be fatal if inhaled, swallowed or absorbed through skin.

Short Exposure Tolerance—LD₅₀ for rats in a 4 hour period was less than 1.6 gm/l.

Exposure Procedures—Antidote is amyl nitrite. Always have a cyanide kit at hand. Remove to fresh air. Administer artificial respiration or oxygen as necessary.

See Medical Kit Information, Appendix B

REACTIVITY DATA

Stability—Stable. Incompatible with strong acids and alkalis.

Compatibility—Material:

Cargo: Group 37 of compatibility chart.

SPILL OR LEAK PROCEDURE

Keep people away. Secure sources of ignition. Shut off leak if without risk. Stay upwind. Wear self-contained breathing apparatus and full protective clothing including boots. For large spills, dike and pump into salvage tanks. Use water spray to knock down vapors. Prevent run off to sewers.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



ISO-PROPYL ACETATE

Synonyms—Acetic acid, isopropyl ester; Isopropyl acetate; Isopropyl ester of acetic acid; 2-Propyl acetate; sec-Propyl acetate

United Nations Number..... 1220

Formula— $\text{CH}_3\text{COOCH}(\text{CH}_3)_2$

CHRIS Code..... IAC

Appearance—Odor—Colorless liquid; pleasant, fruity odor

Boiling Point..... 90°C 194°F

..... °C °F

Specific Gravity—0.88

Freezing Point..... -73°C -99°F

..... °C °F

Chemical Family—Ester

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... 2.0

Vapor Pressure 46°C (115°F) (psia)..... 3.1

Vapor Density (Air = 1.0)..... 3.52

Pollution Category—USEPA _____ IMO III

Applicable Bulk Reg. 46 CFR Subchapter _____ D

Solubility in Water..... Moderate

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous. Keep away from heat and open flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 60

Flammable Limits..... 1.8 to 7.8%

Autoignition Temp. (°F)..... 860

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Use of dry chemical where it can get into a tank of isopropyl acetate is not recommended. Fires involving spills outside of tanks can be extinguished with dry chemical.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

100

250

250

General—Vapors harmful.

Symptoms—Dizziness and drowsiness.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Hydrolyzes (reacts with water) on standing to form acetic acid and isopropyl alcohol. The presence of bases (alkalis) speeds up the reaction. Reacts vigorously with oxidizing agents.

Compatibility—Material: Softens or dissolves many plastics.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 49 mmHg at 17°C.



n-PROPYL ACETATE

Synonyms—Acetic acid, n-propyl ester; Propylacetate

United Nations Number..... 1276

Formula— $\text{CH}_3\text{COOC}_3\text{H}_7$

Appearance—Odor—Colorless liquid; pleasant, fruity odor

Specific Gravity—0.87

Chemical Family—Ester

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code..... PAT

Boiling Point..... 102°C 215°F

Freezing Point..... -92°C -134°F

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... 1.3

Vapor Pressure 46°C (115°F) (psia)..... 1.9

Vapor Density (Air = 1.0)..... 3.52

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous, when exposed to heat or flame.

Flash Point (°F)..... 70

Flammable Limits..... 1.7 to 8.0%

Autoignition Temp. (°F)..... 842

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Use of dry chemical where it can get into a tank of propyl acetate is not recommended. Fires involving spills outside of tanks can be extinguished with dry chemical. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 1, 2

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

200

TLV/TWA (ppm)

200

General—Liquid causes slight irritation on contact. Vapor inhalation results in irritation of mucous membranes with moderate systemic effect.

Symptoms—Sleepiness, fatigue, and retarded respiration rate.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Hydrolyzes (reacts with water) on standing to form acetic acid and n-propyl alcohol. The presence of bases (alkalis) speeds up the reaction. Reacts vigorously with oxidizing agents.

Compatibility—Material: Softens or dissolves many plastics.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources. Small spills may be washed away with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 30 mmHg at 28.8°C.



ISO-PROPYL ALCOHOL

Synonyms—Alcohol C-3; Dimethyl carbinol; IPA;
Isopropanol; Isopropyl alcohol; Petrohol;
2-Propanol; sec-Propyl alcohol; Rubbing alcohol

United Nations Number..... 1219

Formula— $(CH_3)_2CHOH$

CHRIS Code..... IPA

Appearance-Odor—Colorless liquid; sharp, somewhat
unpleasant odor

Boiling Point..... 82°C 182°F

Specific Gravity—0.79

..... °C °F

Freezing Point..... -88°C -128°F

..... °C °F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... 33

Reid Vapor Pressure (psia)..... 1.4

Vapor Pressure 46°C (115°F) (psia)..... 3.0

Vapor Density (Air = 1.0)..... 2.07

Pollution Category—USEPA _____ IMO III

Solubility in Water..... Complete

Applicable Bulk Reg. 46 CFR Subchapter..... D

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous. Keep away from heat and open flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 53

Flammable Limits..... 2.0 to 12.0%

Autoignition Temp. (°F)..... 750

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Cool tank with water spray. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 0, 2

200

400

400

General—Acts as a local irritant and in high concentrations as a narcotic. Prolonged or repeated skin contact may cause defatting of the skin and may produce dermatitis from daily contact. Severely irritating to the eyes and may cause eye injury if not removed promptly.

Symptoms—Dizziness and sleepiness; eyes, nose, and throat irritation.

Short Exposure Tolerance—400 ppm for 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air. Apply artificial respiration if needed. Eye contact—wash eyes gently for 15 minutes with fresh water. Get medical attention for eye contact.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Aluminum, especially at elevated temperatures is unsuitable.

Cargo: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-9802.

Remarks:



n-PROPYL ALCOHOL

Synonyms—Alcohol C-3; Ethyl carbinol; Propanol;
1-Propanol; n-Propanol; Propyl alcohol; Propyl
alcohol normal; Propyl alcohol

United Nations Number..... 1274

CHRIS Code..... PAL

Formula— C_3H_7OH

Boiling Point..... 97°C 207°F

Appearance—Odor—Colorless liquid; alcohol-like odor

Freezing Point..... -127°C -197°F

Specific Gravity—0.80

..... °C °F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... 0.87

Vapor Pressure 46°C (115°F) (psia)..... 1.2

Vapor Density (Air = 1.0)..... 2.07

Solubility in Water..... Complete

Pollution Category—USEPA—..... IMO—III

Applicable Bulk Reg. 46 CFR Subchapter..... D

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Dangerous, when exposed to heat or flame.

Flash Point (°F)..... 85

Flammable Limits..... 2.0 to 13.5%

Autoignition Temp. (°F)..... 700

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water fog

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 0, 2

Unavailable

200

200/skin

General—Vapor inhalation causes slight irritation of mucous membranes with moderate narcotic effect resulting in dizziness, drowsiness.

Symptoms—Salivation, retching, vomiting.

Short Exposure Tolerance—400 ppm to 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air. Apply artificial respiration if needed. Eye contact—wash eyes gently for 15 minutes with water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Charge: Group 20 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 10 mmHg at 14.7°C.



ISO-PROPYLAMINE

Synonyms—2-Aminopropane; Isopropylamine;
Monoisopropylamine; 2-Propanamine

United Nations Number..... 1221

Formula— $(\text{CH}_3)_2\text{CHNH}_2$

CHRIS Code..... IPP

Appearance—Odor—Colorless liquid; pungent, irritating,
typical amine odor
Specific Gravity—0.69

Boiling Point..... 32°C 90°F
..... °C °F
Freezing Point..... -95°C -139°F
..... °C °F

Chemical Family—Amine

Vapor Pressure 20°C (68°F) (mmHg).....
Reid Vapor Pressure (psia)..... 18.2
Vapor Pressure 46°C (115°F) (psia)..... 23.1
Vapor Density (Air = 1.0)..... 2.03
Solubility in Water..... Soluble

Pollution Category—USEPA _____ IMO C
Applicable Bulk Reg. 46 CFR Subchapter _____ Q

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid
Electrical Group—D

General—Toxic oxides of nitrogen may form in fire. Readily forms explosive mixtures with air. Fires are difficult to control because of the ease of re-ignition of the vapor.

Flash Point (°F)..... -35

Flammable Limits..... 2.3 to 10.4%

Autoignition Temp. (°F)..... 756

Extinguishing Agents..... Water spray is particularly effective, CO_2

Special Fire Procedures..... Considerable caution is indicated in approaching iso-propylamine fires and particularly in extinguishment as an explosive mixture may exist immediately following extinguishment and is readily re-ignited. Self-contained breathing equipment with full face piece is required.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
3, 2, 4	Unavailable	5	5

General—Isopropylamine liquid and vapor are irritating to the skin, producing typical alkali burns. Vapors will irritate eyes and lungs.

Symptoms—Vapor—nose, throat, and lung irritation; severe eye irritation or burns.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Skin contact—remove all contaminated clothing, flood affected areas with large quantities of water, wash all affected skin thoroughly; if any evidence of skin burning is noted, a physician should be seen. Inhalation—remove patient to fresh air; nose and throat irritation may be relieved by spraying or gargling with water. If patient is unconscious, apply artificial respiration.

REACTIVITY DATA

Stability—Unstable—highly flammable, readily ignited by static sparks of relatively low energy.

Compatibility—Material: Can be handled safely in steel equipment; severely corrodes aluminum, copper, and copper-based alloys (except Monel).

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, all-purpose canister respirator, and protective clothing. Secure ignition sources. If possible, cover spill with sodium bisulfate. Spray with water and wash up with large excess of water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 500 mmHg at 22°C.



PROPYLAMINE

Synonyms—1-Aminopropane; Monopropylamine;
1-Propanamine; n-Propylamine; mono-n-Propylamine

United Nations Number..... 1277

CHRIS Code PRA

Formula— $\text{CH}_3(\text{CH}_2)_2\text{NH}_2$

Appearance—Odor—Colorless liquid with a pungent
ammoniacal odor when concentration is high
Specific Gravity—0.72

Boiling Point 49°C 120°F
Freezing Point -82°C -118°F

Chemical Family—Amine

Vapor Pressure 20°C (68°F) (mmHg) 250
Reid Vapor Pressure (psia) 10.4
Vapor Pressure 46°C (115°F) (psia) 14.1
Vapor Density (Air = 1.0) 2.0
Solubility in Water Soluble

Pollution Category—USEPA D IMO C
Applicable Bulk Reg. 46 CFR Subchapter O

FIRE & EXPLOSION HAZARD DATA

Grade—B: Flammable liquid
Electrical Group—D

General—Quite flammable. Emits toxic and irritating vapors when heated. Vapor is heavier than air and may travel to a source of ignition and flash back.

Flash Point (°F) -35
Flammable Limits 2.0 to 10.4%
Autoignition Temp. (°F) 804
Extinguishing Agents Carbon dioxide, dry chemical or alcohol foam.
Special Fire Procedures Water may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
3, 3, 0	Unavailable	5*	5*

General—A severe eye, skin and respiratory irritant. Highly toxic when ingested or inhaled.

Symptoms—Severe irritation of skin, eyes and respiratory tract.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Skin—wash with soap and water, then flush area with water. Eyes—flush with copious amounts of water. Vapor—remove victim to fresh air. Administer artificial respiration if necessary. In all cases call a doctor.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Glass and stainless steel.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear full skin protection and self-contained breathing apparatus. Secure ignition sources. Add sodium bisulfate and spray with water. Then clean up.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * PEL and TLV based upon iso-Propylamine.



PROPYLENE

Synonyms—Methylethene; Methylethylene; Propene

United Nations Number..... 1077

Formula— $\text{CH}_2\text{CH} = \text{CH}_2$

Appearance—Odor—Colorless gas, liquid under pressure;
characteristic olefin (gassy) odor

Specific Gravity—0.52 at 20°C

Chemical Family—Olefin

Pollution Category—USEPA _____ IMO Q88

Applicable Bulk Reg. 46 CFR Subchapter D, Q

CHRIS Code..... PPL

Boiling Point..... -48°C -54°F

Freezing Point..... -185°C -301°F

Vapor Pressure 20°C (68°F) (mmHg) 7840

Reid Vapor Pressure (psia)..... 227.2

Vapor Pressure 46°C (115°F) (psia)..... 273.0

Vapor Density (Air = 1.0)..... 1.48

Solubility in Water..... 45 ml gas/100 ml water

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—D

General—As with all gas fires, the only effective method of extinguishing is to shut off the fuel supply. Otherwise a more dangerous situation, the formation of an explosive mixture can result.

Flash Point (°F)..... -182

Flammable Limits..... 2.0 to 11.0%

Autoignition Temp. (°F)..... 927

Extinguishing Agents..... Stop flow of gas; water fog

Special Fire Procedures..... Tanks exposed to fire should be kept cool with a water spray.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 0, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Simple asphyxiant. Absence of adequate warning indications such as strong odor or pronounced irritation of mucous membranes of eyes and nose introduces possibility of exposure to hazardous concentrations. Contact with the liquid may cause frostbite.

Symptoms—Dizziness, sleepiness

Short Exposure Tolerance—Mixture of 6.4% propylene and 26% oxygen inhaled for 2 1/4 minutes produces mild intoxication, drowsiness, tingling of the skin, and inability to concentrate.

Exposure Procedures—Remove victim to fresh air. Apply artificial respiration if breathing stops. Contact with liquid may cause frostbite. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Stable at ordinary temperatures.

Compatibility—Material: Usual materials of construction may be used.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Have all-purpose canister mask available. Shut off ignition sources. Call the fire department. If product does not catch fire, it will soon boil off.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



PROPYLENE OXIDE

Synonyms—1,2-Epoxypropane; Methyloxirane; Propene oxide

United Nations Number..... 1280

Formula— $\text{CH}_2\text{OCHCH}_3$

CHRIS Code..... POX

Appearance—Colorless liquid; ether-like odor

Boiling Point..... 34°C 94°F

Specific Gravity—0.86

Freezing Point..... -112°C -170°F

Chemical Family—Alkalene oxide

Vapor Pressure 20°C (68°F) (mmHg)..... 449

Pollution Category—USEPA—B IMO—D

Reid Vapor Pressure (psia)..... 18.0

Applicable Bulk Reg. 46 CFR Subchapter..... O

Vapor Pressure 46°C (115°F) (psia)..... 22.0

Vapor Density (Air = 1.0)..... 2.00

Solubility in Water..... 59%

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid
Electrical Group—B

General—An extremely reactive, flammable liquid with a wide explosive range. Ignited by heat, sparks or open flame. Flashback along vapor trail may occur. Fire or contamination may cause violent rupture of tank.

Flash Point (°F)..... -35

Flammable Limits..... 1.8 to 38.5%

Autoignition Temp. (°F)..... 869

Extinguishing Agents..... Stop flow of gas; large volumes of water, CO_2 , alcohol foam.

Special Fire Procedures..... If a fire breaks out near a propylene oxide tank, keep tank cool with a water spray. Explosion hazard requires approaching a burning tank with caution.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
3, 2, 2	200*	20	20

General—Suspected carcinogen. Vapor harmful. Liquid causes eye burns. Liquid or water solutions absorbed into clothing, particularly shoes, cause delayed skin burns.

Symptoms—Nausea, vomiting and irritation to eyes and respiratory passages.

Short Exposure Tolerance—2000 ppm for 4 hours.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

*Note: Detectable odor is greater than the TLV. Exposure to potentially dangerous vapor concentration can occur before product can be detected by smell.

REACTIVITY DATA

Stability—Polymerizes violently with catalysts such as acids, bases, and certain salts. Reacts violently with chlorine and with ammonia.

Compatibility—Material: Avoid copper and other acetylide-forming metals.

Cargo: Group 16 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, large heavy face shield, (if in doubt, use body shield also), self-contained breathing apparatus. Avoid contact with liquid. Secure ignition sources. Do not flush spill into confined spaces where flammable vapors can accumulate.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Must be shipped with inert pad.



ISO-PROPYL ETHER

Synonyms—Diisopropyl ether; Diisopropyl oxide;
2-Isopropoxypropane; Isopropyl ether;
2,2'Oxybis[propane]

United Nations Number..... 1159

CHRIS Code..... IPE

Formula— $(CH_3)_2CHOCH(CH_3)_2$

Boiling Point 68°C 154°F

Appearance-Odor—Colorless, volatile liquid with an
ethereal odor

..... °C °F

Specific Gravity—0.72

Freezing Point -88°C -128°F

..... °C °F

Chemical Family—Ether

Vapor Pressure 20°C (68°F) (mmHg)..... 119

Reid Vapor Pressure (psia)..... High

Vapor Pressure 46°C (115°F) (psia)..... 6.64

Vapor Density (Air = 1.0)..... 3.5

Pollution Category—USEPA IMO D

Solubility in Water..... Negligible

Applicable Bulk Reg. 46 CFR Subchapter Q

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid
Electrical Group—D

General—Highly flammable, dangerous fire risk. Severe explosion risk when exposed to heat or flame.
Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... -18 (cc)

Flammable Limits..... 1.4 to 21%

Autoignition Temp. (°F)..... 830

Extinguishing Agents..... Carbon dioxide, alcohol foam, water fog, dry chemical

Special Fire Procedures..... Cool tanks with water spray. Keep surroundings cool to reduce the amounts
of vapors produced. The danger of reignition is high.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
500

TLV/TWA (ppm)
250

General—Toxic by ingestion and inhalation. Strong irritant. Prolonged or repeated skin contact may cause
dermatitis.

Symptoms—Unavailable

Short Exposure Tolerance—Animal tests showed 8000 ppm for 4 hours resulted in a 0% death rate, a trace of
eye injury, and no skin irritation.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, administer artificial respiration. Skin
or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes.
Get medical attention.

REACTIVITY DATA

Stability—In presence of air, may form peroxide which will explode if heated, or on impact.

Compatibility—Materials: Steel is not affected.

Cargo: Group 41 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, large heavy face shield (body shield if necessary). Have self-contained breathing
apparatus available. Avoid contact with liquid. Secure ignition sources. Notify police, harbor master, and fire
department. Ether will float downstream or spread out and create severe fire hazard.

If a spill occurs, call the National Response Center, 800-424-5802.

Remarks:



PYRIDINE

Synonyms—Azabenzene, Azine

United Nations Number..... 1282

Formula—HCN(CH)₅

CHRIS Code..... PRD

Appearance—Odor—Yellow to colorless liquid;
nauseating, unpleasant odor

Specific Gravity—0.98

Boiling Point..... 115°C 239°F

Freezing Point..... -42°C -44°F

Chemical Family—Amine

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... 0.77

Vapor Pressure 46°C (115°F) (psia)..... 1.3

Vapor Density (Air = 1.0)..... 2.72

Pollution Category—USEPA C IMO D

Applicable Bulk Reg. 46 CFR Subchapter O

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Highly toxic fumes given off upon decomposition. Fire hazard high, when exposed to heat or flame.

Explosion hazard severe, in the form of vapor, when exposed to flame or spark. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 68

Flammable Limits..... 1.8 to 12.4%

Autoignition Temp. (°F)..... 900

Extinguishing Agents..... Alcohol foam, dry chemical, CO₂

Special Fire Procedures..... Keep tanks cool with water spray. Provide fire fighters with self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 2, 1

Odor Threshold (ppm)

0.021

PEL/TWA (ppm)

5

TLV/TWA (ppm)

5

General—Liquid mildly irritating to the skin and can be absorbed through the skin. Vapor inhalation results in slight irritation of airway with slight anaesthetic effect.

Symptoms—Nausea, headache, insomnia, nervous symptoms, low back or abdominal discomfort.

Short Exposure Tolerance—Very disagreeable odor at 30 ppm. Exposure averaging 125 ppm, four hours per day for one to two weeks give rise to symptoms.

Exposure Procedures—Vapor—remove from exposure, use artificial respiration if necessary, and obtain medical attention. Skin contact—remove contaminated clothing and wash skin thoroughly with large amounts of water. Eye contact—irrigate eyes with water for at least 15 minutes.

REACTIVITY DATA

Stability—Stable. Possibility of a dangerous reaction with acid anhydrides.

Compatibility—Material: Copper and its alloys and some synthetic rubbers are unsuitable.

Cargo: Group 9 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear boots, rubber gloves, rubber or plastic coat, and self-contained breathing apparatus. Extinguish sources of ignition. If possible, cover large spills with sand and soda ash mixture (90–10). Mix and shovel into a carboard box.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 20 mmHg at 25°C.



ROSIN OIL

Synonyms—Codoil; Resin oil; Retinol; Rosinol

United Nations Number.....1286

CHRIS Code.....QRN

Formula—Mixture

Appearance—White to brown liquid with a pinetree

pitch odor

Specific Gravity—0.98 to 1.11

Chemical Family—Hydrocarbon mixture

Pollution Category—USEPA _____ IMO B

Applicable Bulk Reg. 46 CFR Subchapter _____ D, Q

Boiling Point.....300-400°C 572-750°F

.....°C.....°F

Freezing Point.....†°C.....°F

.....°C.....°F

Vapor Pressure 20°C (68°F) (mmHg).....0.04

Reid Vapor Pressure (psia).....Low

Vapor Pressure 46°C (115°F) (psia).....0.15

Vapor Density (Air = 1.0).....NP

Solubility in Water.....Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame.

Flash Point (°F).....255 to 390

Flammable Limits.....Unavailable

Autoignition Temp. (°F).....648

Extinguishing Agents.....Dry chemical, foam or CO₂

Special Fire Procedures.....Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 2, 2

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Toxicity unavailable

Symptoms—Unavailable

Short Exposure Tolerance—Unavailable

Exposure Procedures—Unavailable

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield and protective clothing. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



SODIUM CHLORATE SOLUTION, 50%

Synonyms—Chlorate of soda; Soda chloric acid, sodium salt

United Nations Number..... 2428

Formula— NaClO_3

CHRIS Code..... SDP

Appearance—Yellow liquid; odorless

Boiling Point..... 170°C 338°F

Specific Gravity—1.5

Freezing Point..... 19°C 65°F

Chemical Family—

Vapor Pressure 20°C (68°F) (mmHg)..... †

Reid Vapor Pressure (psia)..... †

Pollution Category—USEPA _____ IMO III

Vapor Pressure 46°C (115°F) (psia)..... †

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Vapor Density (Air = 1.0)..... †

Solubility in Water..... Soluble

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as an oxidizer.

Electrical Group—NA

General—Decomposes at high temperatures. Acts as an oxidizer. Not flammable but supports combustion.

Flash Point (°F).....

Flammable Limits..... Non-flammable solution

Autoignition Temp. (°F).....

Extinguishing Agents.....

Special Fire Procedures..... Contact with organic substances, sulfur, sulfides, powdered metals, phosphorous or ammonium compounds can cause fire and explosion. Sodium chlorate supplies its own oxygen for combustion. Use copious amounts of water.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 1, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Irritating to the skin and eyes. No hazard from vapors. Not absorbed through the skin.

Symptoms—Ingestion results in abdominal pain, nausea, vomiting, and cyanosis.

Short Exposure Tolerance— LD_{50} for rats is 1200 mg/kg. Ingestion of 15 to 30 grams may be fatal.

Exposure Procedures—For ingestion induce vomiting if victim is conscious. Flush skin and eyes with large amounts of water.

REACTIVITY DATA

Stability—Stable, but product decomposes at 300°F and liberates oxygen.

Compatibility—Material: Stainless steel or lined steel are preferred; carbon steel and aluminum are suitable for several years service.

Cargo: Unassigned in compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Coveralls and rubber boots should be worn. Clothing becomes dangerously flammable when soaked with chlorates. Use no leather. Dried leather, such as shoes, become highly flammable in contact with sodium chlorate. Secure all sources of ignition. Flush spills or leaks with water. Do not let spill area dry until it has been determined that there is no chlorate left in the area.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



SODIUM DICHROMATE SOLUTION, 70%

Synonyms—Sodium bichromate; Sodium dichromate solution

United Nations Number.....†

CHRIS Code.....SDL

Formula— $\text{Na}_2\text{Cr}_2\text{O}_7$

Appearance—Odor—Clear, red-orange liquid; no odor

Boiling Point.....114°C 238°F

.....°C°F

Freezing Point.....-38°C -36°F

.....°C°F

Specific Gravity—1.69

Chemical Family—Oxidizer

Vapor Pressure 20°C (68°F) (mmHg).....†

Reid Vapor Pressure (psia).....†

Vapor Pressure 46°C (115°F) (psia).....†

Vapor Density (Air = 1.0).....†

Pollution Category—USEPA A IMO C

Applicable Bulk Reg. 46 CFR Subchapter O

Solubility in Water.....Complete

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as an oxidizer.

Electrical Group—NA.

General—Non-flammable, but releases oxygen when heated. May ignite combustible materials upon contact.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... Non-flammable

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

None—No odor

PEL/TWA (ppm)

0.05 mg/m³ as

chromium

TLV/TWA (ppm)

0.05 mg/m³ as

chromium

General—Even small quantities are highly toxic if ingested or absorbed through the skin. If heated to the boiling point will generate toxic spray. Some allergic responses. May cause lung cancer.

Symptoms—Contact—Extremely irritating to eyes and skin. Mist—Damage to mucous membranes, irritation to respiratory system.

Short Exposure Tolerance—Very irritating at low concentrations of mist.

Exposure Procedures—Get medical attention. Skin—Flush with soap and water for 15 minutes, remove contaminated clothing. Eyes—Flush with water for at least 15 minutes. Ingestion—Drink a quart of water, induce vomiting. If unconscious, do not attempt to give victim liquids or attempt vomiting.

REACTIVITY DATA

Stability—Generally stable. Oxidizer reacts with reducing agents and many organics and inorganics. May ignite finely divided combustibles.

Compatibility—Material: Suitable: Mild steel, stainless steel, aluminum. Unsuitable: Copper, zinc, tin, brass, bronze, organic linings.

Cargo: Unassigned in the compatibility chart. See Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Avoid all contact, including breathing mists. Dike area, absorb on vermiculite or sand, place in a sealed metal container, dispose. Flush area with water. Don't allow into waterways. Wear protective clothing including goggles, gloves, boots and, if mists present, respirator.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

1990



SODIUM HYDROSULFIDE SOLUTION, 45%

Synonyms—Sodium bisulfide; sodium hydrogen sulfide;
Sodium mercaptan; Sodium sulfhydrate

United Nations Number..... 2849

Formula— $\text{NaHS}/\text{Na}_2\text{S}/\text{H}_2\text{O}$

CHRIS Code..... SHR

Appearance—Odor—Dark amber liquid with a rotten egg
odor

Boiling Point..... 140°C 284°F

Specific Gravity—1.26 to 1.28

Freezing Point..... 40°C 105°F

Chemical Family—Caustics

Vapor Pressure 20°C (68°F) (mmHg)..... 17.3

Reid Vapor Pressure (psia)..... 0.95

Pollution Category—USEPA— D IMO— B

Vapor Pressure 46°C (115°F) (psia)..... 1.51

Applicable Bulk Reg. 46 CFR Subchapter Q

Vapor Density (Air = 1.0)..... 1.17

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—NA

General—Moderate fire hazard due to hydrogen sulfide, a poisonous, highly flammable gas liberated when exposed to heat or flame.

Flash Point (°F)..... 73

Flammable Limits..... 4.3 to 45.5%

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Carbon dioxide

Special Fire Procedures..... Wear self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable*

Unavailable

Unavailable

General—Poisonous hydrogen sulfide may be evolved; this evolution increases with temperature. Solution itself is a skin irritant.

Symptoms—Rapid or irregular breathing, coughing, throat irritation, bluish color, dizziness, faintness, and weak irregular pulse. Skin contact will cause a caustic type burn.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air. 100% oxygen inhalation is recommended. Skin—flush area with water. Eyes—flush with copious amounts of water. In all cases call a doctor.

* NOTE: The odor (rotten egg) of hydrogen sulfide gas should not be used as a warning, since its presence may deaden the sense of smell.

REACTIVITY DATA

Stability—Stable. Solution is mildly alkaline.

Compatibility—Material: Corrosive to steel above 150°F. Avoid use of aluminum.

Cargo: Group 5 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, boots, and goggles, and full skin protection. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



SODIUM HYPOCHLORITE SOLUTION, 15%

Synonyms—Chlorox; Hypochlorite, solutions; Javelle water; Liquid bleach; Sodium hypochlorite

United Nations Number..... 1791

Formula—NaOCl

CHRIS Code..... SHP

Appearance—Odor—Green to yellow watery liquid; bleaching liquid odor

Boiling Point..... °C °F

Specific Gravity—1.21 to 1.24

Freezing Point..... °C °F

Chemical Family—Caustic

Vapor Pressure 20°C (68°F) (mmHg)..... †

Pollution Category—USEPA B IMO C

Reid Vapor Pressure (psia)..... †

Applicable Bulk Reg. 46 CFR Subchapter Q

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... †

Solubility in Water..... Soluble

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as an oxidizer.

Electrical Group—NA.

General—May decompose in fire generating irritating chlorine gas. Containers may explode in fire due to pressure buildup.

Flash Point (°F)..... Non-flammable

Flammable Limits.....

Autoignition Temp. (°F)..... Not pertinent

Extinguishing Agents..... Water spray, fog, foam, dry chemical, CO₂, or agents suitable for materials in surrounding fire.

Special Fire Procedures..... Cool tanks with water. Wear full protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

Unavailable

Unavailable

General—Severe irritation, burns, and/or corrosion from liquid. Vapor may cause severe respiratory tract irritation and pulmonary edema.

Symptoms—Toxicity and corrosivity depend upon concentration. Higher concentration of industrial grades are more damaging than concentration of household bleach (approx. 5.25% min.).

Short Exposure Tolerance—

Exposure Procedures—If ingested, DO NOT INDUCE vomiting, give large quantities of milk. Skin or eye contact: Flush areas with water for 15 minutes and consult physician.

REACTIVITY DATA

Stability—Stable, but stability decreases with concentration, heat, light, decrease in pH and contamination by metals. Strong oxidizer.

Compatibility—Material: Incompatible with steel, cast iron, 12 and 17% chromium steel, monel, nickel, inconel, aluminum, brass, silicon, bronze

Cargo: Group 5 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves and rubber safety shoes, goggles or full face shield, and respiratory protection. Disperse and flush spilled or leaking material.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Decomposes above 110°C (230°F).

† Unavailable



SORBITOL

Synonyms—D-Glucitol; L-Gulitol;
1,2,3,4,5,6-Hexanehexol; Sorbicolan; Sorbit; Sorbo;
Sorbol; Sorbostyl

United Nations Number..... †

CHRIS Code..... SBT

Formula— $\text{CH}_2\text{OH}(\text{CHOH})_4\text{CH}_2\text{OH}$

Boiling Point..... V. High °C..... °F

Appearance—Odor—White, odorless crystalline powder
with a faint sweet taste.

Freezing Point..... 110 °C..... 230 °F

Specific Gravity—1.49 at 150°C. (liquid)

..... °C..... °F

Chemical Family—Glycol

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reld Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 3.2

Solubility in Water..... **

Pollution Category—USEPA—..... IMO—III

Applicable Bulk Reg. 46 CFR Subchapter..... *

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard if exposed to heat or flame

Flash Point (°F)..... greater than 150

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Water

Special Fire Procedures..... Use water to cool fire exposed tanks to avoid combustion.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

None

Not pertinent

Not pertinent

General—No threat of damage from vapor inhalation since the volatility of sorbitol is so low.

Symptoms—Hot liquid will burn skin.

Short Exposure Tolerance—Not applicable.

Exposure Procedures—Treat for burns resulting from contact with hot liquids.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Mild or stainless steel is acceptable.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with hot liquid. Wear goggles or face shield, protective clothing for hot liquid. Stop discharge if possible.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Unregulated, Table 2, 46 CFR Part 153.

** Very soluble in hot water

† Unassigned



SOYBEAN OIL

Synonyms—Chinese bean oil; Soyabean oil; Soy oil

United Nations Number..... 1

Formula—Mixture

Appearance—Odor—Pale yellow liquid; weak odor

Specific Gravity—0.92 to 0.93

Chemical Family—Esters

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter D

CHRIS Code..... OSB

Boiling Point..... V. High °C _____ °F

Freezing Point..... -20 °C _____ °F

Vapor Pressure 20°C (68°F) (mmHg)..... 2.04

Reid Vapor Pressure (psia)..... 0.19

Vapor Pressure 46°C (115°F) (psia)..... 0.16

Vapor Density (Air = 1.0)..... NP

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame.

Flash Point (°F)..... 540

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 833

Extinguishing Agents..... Dry chemical, foam or carbon dioxide

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed containers with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Not pertinent

PEL/TWA (ppm)

Not pertinent

TLV/TWA (ppm)

Not pertinent

General—Not harmful.

Symptoms—None

Short Exposure Tolerance—Does not penetrate skin in harmful amounts.

Exposure Procedures—Non-toxic. Wash thoroughly with soap and water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable. Will soften some paints and rubber.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield and protective clothing. Secure all ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



SPERM OIL

Synonyms—Whale sperm oil

United Nations Number..... ‡

Formula—Indefinite

CHRIS Code..... OSP

Appearance—Odor—Light yellow oily liquid; characteristic odor

Boiling Point..... V. High °C °F

°C °F

Freezing Point..... † °C °F

°C °F

Specific Gravity—0.87 to 0.88

Vapor Pressure 20°C (68°F) (mmHg)..... 2.0

Reid Vapor Pressure (psia)..... 0.1

Vapor Pressure 46°C (115°F) (psia)..... 0.15

Vapor Density (Air = 1.0).....

Solubility in Water..... Insoluble

Chemical Family—

Pollution Category—USEPA _____ IMO D

Applicable Bulk Reg. 46 CFR Subchapter _____ D

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame.

Flash Point (°F)..... 428

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 586

Extinguishing Agents..... Carbon dioxide, dry chemical

Special Fire Procedures..... Water foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

0, 1, 0

Unavailable

Unavailable

Unavailable

General—Toxicity probably low. Details unavailable.

Symptoms—Unavailable

Short Exposure Tolerance—Unavailable

Exposure Procedures—Flush affected areas with plenty of water; wash thoroughly with soap and water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 33 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield and protective clothing.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

‡ Unassigned



STYRENE MONOMER

Synonyms—Cinnamene; Cinnamol; Ethynylbenzene;
Phenylethylene; Styrene; Styrol; Styrolene;
Vinylbenzene

United Nations Number..... 2055

CHRIS Code..... STY

Formula— $C_8H_8CHCH_2$

Appearance—Odor—Colorless liquid; sweet odor when
pure; sharp disagreeable odor when impure
Specific Gravity—0.92

Boiling Point..... 145°C..... 293°F

Freezing Point..... -30°C..... -23°F

..... °C..... °F

Chemical Family—Olefin

Vapor Pressure 20°C (68°F) (mmHg)..... 6.0

Reid Vapor Pressure (psia)..... 0.27

Vapor Pressure 46°C (115°F) (psia)..... 0.4

Vapor Density (Air = 1.0)..... 3.6

Pollution Category—USEPA C IMO B

Applicable Bulk Reg. 46 CFR Subchapter..... O

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Ignited by heat and open flame. Fire or contamination may cause violent rupture of tank.

Flash Point (°F)..... 100

Flammable Limits..... 1.1 to 6.1%

Autoignition Temp. (°F)..... 914

Extinguishing Agents..... CO_2 , dry chemical, water fog, foam

Special Fire Procedures..... Avoid breathing vapors. Provide body and respiratory protection. Keep tanks cool with water spray.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 2, 2

Odor Threshold (ppm)

0.15

PEL/TWA (ppm)

50

TLV/TWA (ppm)

50/Skin

General—Suspected carcinogen. Vapor very irritating to eyes, moderately irritating to respiratory tract with moderate systemic effect. Liquid irritating to skin.

Symptoms—Weakness, dizziness, nausea, and sleepiness.

Short Exposure Tolerance—10,000 ppm may be fatal in 30 to 60 minutes.

Exposure Procedures—Vapors—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Soap, if available, should be used on affected skin areas. Get medical attention.

REACTIVITY DATA

Stability—Will readily form peroxides which catalyze polymerization unless inhibited. Heat, light, and strong acids also catalyze polymerization reaction.*

Compatibility—Material: Most materials of construction are suitable. Do not use copper or its alloys. Styrene can be polymerized at explosive rates by certain contaminants.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Even the inhibited product, when heated above 125°F, can polymerize with the generation of so much heat that ignition is possible.



SULFUR (molten)

Synonyms—Brimstone; Sulfur; Sulphur

United Nations Number ... molten
solid

2448
1350

CHRIS Code SXX

Formula—S

Appearance—Odor—Yellow-to-brown solid; amber liquid
above 238°F; sharp choking SO₂ fumes usually
present

Specific Gravity—1.80 at 265°F (liquid); density of solid
sulfur is 2.07 g/cc

Chemical Family—Element

Pollution Category—USEPA IMO III

Applicable Bulk Reg. 46 CFR Subchapter O

Boiling Point 444°C 832°F
..... °C °F
Freezing Point 114°C 238°F
..... °C °F

Vapor Pressure 20°C (68°F) (mmHg) V. Low

Reid Vapor Pressure (psia) V. Low

Vapor Pressure 46°C (115°F) (psia) V. Low

Vapor Density (Air = 1.0) Negligible

Solubility in Water Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid (when carried in molten state)

Electrical Group—C

General—Sulfur in the molten state gives off hydrogen sulfide (H₂S) gas, which is poisonous and highly
flammable. The rate of gas evolution depends on conditions, particularly the amount of hydrocarbon
impurities present.

Flash Point (°F) 335 to 370

Flammable Limits Unavailable

Autoignition Temp. (°F) 374 to 428

Extinguishing Agents CO₂, dry chemical, steam, water fog

Special Fire Procedures Do not direct a solid stream of water into burning liquid sulfur or a steam
explosion may result. When sulfur burns, sulfur dioxide (SO₂) is given off. This gas is highly toxic, so
firefighting personnel must be provided with respiratory protection.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 1

*

TLV for H₂S, 10

TLV for H₂S, 10

General—Liquid causes severe thermal burns.

Gas is poisonous by inhalation.

TLV for SO₂, 2

TLV for SO₂, 2

Symptoms—H₂S—headache, nausea, dizziness; loss of sense of smell. SO₂—severe eye and respiratory
irritation.

Short Exposure Tolerance—200 ppm for 10 minutes. 100 ppm for 30 minutes. 50 ppm for one hour.

Exposure Procedures—Remove victim to fresh air. If breathing stops, apply artificial respiration. Oxygen,
administered by trained personnel, is often helpful. Body contact with hot liquid sulfur can cause severe
scalding. Do not try to remove the solidified sulfur from such a burn. Get medical attention.

*NOTE: Odor alone does not give adequate warning of dangerous H₂S concentrations.

REACTIVITY DATA

Stability—Stable except in contact with oxidizing agents or reactive metals. The rate of H₂S gas evolution from
molten sulfur increases with agitation.

Compatibility—Material: Liquid sulfur is not corrosive to steel, but corrodes copper and its alloys. Moist sulfur is
corrosive to steel.

Cargo: Unassigned in compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with hot liquid. Wear heavy work gloves, goggles or face shield, protective clothing for hot
liquid. Have self-contained breathing apparatus available. Secure ignition sources. A major spill of liquid sulfur
into navigable waters will solidify and sink, presenting no unusual hazards.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: See 46 CFR 36—Elevated Temperature Cargoes.



SULFUR DIOXIDE

Synonyms—Sulfur dioxide, liquefied; Sulfurous anhydride; Sulfurous oxide

United Nations Number..... 1079

Formula— SO_2

CHRIS Code..... SFD

Appearance—Odor—Compressed liquefied gas with sharp irritating odor.

Boiling Point..... -10°C 14°F
..... $^\circ\text{C}$ $^\circ\text{F}$

Specific Gravity—1.45 (at -10°C)

Freezing Point..... -75°C -104°F
..... $^\circ\text{C}$ $^\circ\text{F}$

Chemical Family—Acid anhydride

Vapor Pressure 20°C (68°F) (mmHg)..... 2488

Raid Vapor Pressure (psia)..... 84

Pollution Category—USEPA _____ IMO gas

Vapor Pressure 46°C (115°F) (psia)..... 108

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Vapor Density (Air = 1.0)..... 2.2

Solubility in Water..... *

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Compressed Gas (LCG)

Electrical Group—NA

General—Non-flammable, but in a fire, tanks may rupture and release irritating, toxic sulfur dioxide.

Flash Point ($^\circ\text{F}$)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. ($^\circ\text{F}$)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... Cool exposed tanks with water. Wear eye protection and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings
4, 1, 4

Odor Threshold (ppm)
3

PEL/TWA (ppm)
2

TLV/TWA (ppm)
2

General—Liquid can cause frostbite. Vapor is very irritating to the eyes and lungs even at low concentrations.

Symptoms—Vapor—causes irritation of eyes and lungs with severe choking. Liquid will cause frostbite.

Short Exposure Tolerance—20 ppm for 5 minutes.

Exposure Procedures—Vapor—remove victim to fresh air. Administer oxygen if possible. Skin—flush skin with water. Eyes—wash with water for 15 minutes. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. Get medical attention.

REACTIVITY DATA

Stability—Reacts with water to form sulfurous acid, H_2SO_3 .

Compatibility—Material: The acidic reaction with water corrodes aluminum and some other metals.

Cargo: Unassigned in compatibility chart. For compatibility assistance, call G-MTH-1 (202-267-1577).

SPILL OR LEAK PROCEDURE

Wear rubber gloves, eye protection, self-contained breathing apparatus, and protective clothing. Try to shut off leak.

If a spill occurs, call the National Response Center, 800-424-6302.

Remarks: * Reacts with water to form sulfurous acid, H_2SO_3 .



SULFURIC ACID

Synonyms—Battery acid; Chamber acid; Fertilizer acid;
Oil of vitriol

United Nations Number..... 1830

Formula— H_2SO_4

CHRIS Code..... SFA

Appearance—Odor—Colorless-to-brown oily liquid; no
odor unless hot, then the odor is choking

Specific Gravity—1.56 to 1.84

Boiling Point..... 340°C 644°F

Freezing Point..... 10°C 50°F

Chemical Family—Inorganic acid

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 3.4

Pollution Category—USEPA C IMO C

Applicable Bulk Reg. 46 CFR Subchapter O

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable. Classified as a corrosive liquid.

Electrical Group—B (based upon possible hydrogen gas (H_2) generation should a leak or spill occur)

General—Sulfuric acid will not burn. It will react with many metals, giving off hydrogen gas which is highly flammable. If hydrogen is trapped in confined spaces, it can form an explosive mixture with air. See data sheet for hydrogen.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... DO NOT USE WATER to put out a fire if the water can get into concentrated sulfuric acid. In case of a fire next to a sulfuric acid tank, use respiratory protection against fumes.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 4, 2

Odor Threshold (ppm)

Greater than 1 mg/m³

PEL/TWA (ppm)

1 mg/m³

TLV/TWA (ppm)

1 mg/m³

General—Liquid causes severe burns with destruction of tissue. Vapor very irritating.

Symptoms—The inhalation hazard is slight at ordinary temperatures. The skin on which acid is spilled may feel hot or it may sting or itch.

Short Exposure Tolerance—10 mg/m³ for 5 minutes; 5 mg/m³ for 10 minutes; 2 mg/m³ for 30 minutes.

Exposure Procedures—Drench with water. Remove contaminated clothing and flow water onto affected area for 15 minutes. For eye contact, immediately flush eye with large amounts of water for 15 minutes. Get medical attention.

REACTIVITY DATA

Stability—Stable, but can react very easily with many other materials.

Compatibility—Material: Highly corrosive to most metals; particularly at concentrations below 60°Be. May cause wood or cellulose to ignite.

Cargo: Group 2 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Have body shield available. Avoid contact with liquid. Secure ignition sources because of the possibility of hydrogen gas generation. If possible, cover spill with sodium bicarbonate or soda ash-slaked lime mixture (50–50). Mix and add water to form a slurry. Scoop up slurry. Wash site with soda ash solution. Otherwise flush cautiously with water. Avoid directing stream into larger pools or pockets of concentrated acid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: CAUTION—Never add water to the acid, otherwise spattering will occur. If dilution is required, always add the acid very carefully to the water. The acid is heavier than water. Thus, the heat of solution will be more uniformly dissipated, and spattering will be avoided.



TALL OIL

Synonyms—Liquid rosin; Talloil; Tallol

United Nations Number..... †

Formula—Mixture of rosin acids

Appearance—Yellow, oily liquid; acrid odor

Specific Gravity—0.95 to 1.00

Chemical Family—

Pollution Category—USEPA _____ IMO B

Applicable Bulk Reg. 46 CFR Subchapter D.Q

CHRIS Code..... OTL

Boiling Point..... V. High °C _____ °F

Freezing Point..... † °C _____ °F

Vapor Pressure 20°C (68°F) (mmHg)..... 1.5

Reid Vapor Pressure (psia)..... 0.1

Vapor Pressure 46°C (115°F) (psia)..... 0.15

Vapor Density (Air = 1.0)..... NP

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame.

Flash Point (°F)..... 380

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Foam, dry chemical or CO₂

Special Fire Procedures..... Water may be ineffective on fire. Use water to cool exposed tanks.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Avoid contact with liquid.

Symptoms—Skin contact will cause minor reddening.

Short Exposure Tolerance—Not pertinent

Exposure Procedures—Skin—flush affected areas with plenty of water; wash thoroughly with soap and water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, face shield and protective clothing.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

‡ Unassigned



TALLOW

Synonyms—Edible tallow; inedible tallow; Tallow oil

United Nations Number..... 1

CHRIS Code..... TLO

Formula—Fats containing C₁₆ to C₁₈

Appearance—Odor—Dark yellow liquid with a waxy odor

Boiling Point..... V. High °C..... °F

..... °C..... °F

Specific Gravity—0.85 to 0.89 at 70°C

Freezing Point..... 2-7 °C..... °F

..... °C..... °F

Chemical Family—Esters

Vapor Pressure 20°C (68°F) (mmHg)..... 2.0

Reid Vapor Pressure (psia)..... 0.1

Vapor Pressure 46°C (115°F) (psia)..... 0.2

Vapor Density (Air = 1.0)..... NP

Solubility in Water..... Negligible

Pollution Category—USEPA..... IMO..... D

Applicable Bulk Reg. 46 CFR Subchapter..... D

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame.

Flash Point (°F)..... 509

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Foam, water, CO₂, or dry chemical

Special Fire Procedures..... Water may be ineffective. Cool exposed containers with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Not pertinent

Unavailable

Not pertinent

Not pertinent

General—Non-toxic, but possibility of thermal burns from hot liquid.

Symptoms—Non-toxic.

Short Exposure Tolerance—Hot liquid can burn eyes and skin.

Exposure Procedures—Treat burns caused by hot liquid.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material:

Cargo: Group 34 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield and protective clothing for hot liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



1,1,2,2-TETRACHLOROETHANE

Synonyms—Acetylene tetrachloride; Ethane,
1,1,2,2-tetrachloro-; Tetrachloroethane;
sym-Tetrachloroethane

United Nations Number..... 1702

CHRIS Code..... TEC

Formula— $\text{Cl}_2\text{CHCHCl}_2$

Boiling Point..... 146°C 295°F

Appearance—Odor—Clear to slightly yellow liquid with
chloroform-like odor

Freezing Point..... -44°C -47°F

Specific Gravity—1.60

Vapor Pressure 20°C (68°F) (mmHg)..... 13.0

Chemical Family—Halogenated hydrocarbons

Reid Vapor Pressure (psia)..... 0.5

Pollution Category—USEPA B IMO B

Vapor Pressure 46°C (115°F) (psia)..... 1.0

Applicable Bulk Reg. 46 CFR Subchapter Q

Vapor Density (Air = 1.0)..... 5.8

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—Non-flammable

Electrical Group—NA

General—Non-flammable, corrosive liquid. When heated, it emits highly toxic decomposition products.

Flash Point (°F)..... Non-flammable

Flammable Limits..... Non-flammable

Autoignition Temp. (°F)..... Non-flammable

Extinguishing Agents..... Non-flammable

Special Fire Procedures..... Wear self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

0.5

1/Skin

1/Skin

General—Suspected carcinogen. A powerful narcotic and liver poison.

Symptoms—Ingestion—vomiting, diarrhea. Acute intoxication with unconsciousness, cyanosis, loss of reflexes and death. Inhalation—can be absorbed by lungs. Fatal after repeated inhalation.

Short Exposure Tolerance—10 ppm for 30 minutes.

Exposure Procedures—Inhalation—remove to fresh air and, if necessary, administer artificial respiration.

Ingestion—induce vomiting. Eyes—flush with water for 15 minutes. Skin—remove clothing and wash skin with soap and warm water. In all cases call a doctor.

REACTIVITY DATA

Stability—Stable.

Compatibility—Materials: May attack some forms of plastics.

Cargo: Group 38 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus and protective clothing. Secure all sources of ignition. Absorb with vermiculite and clean up. Wash site with soap and water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



TETRAETHYLENE GLYCOL

Synonyms—bis[2-(2-Hydroxyethoxy)ethyl]ether; TEG;
3,6,9-Trioxaundecanol, 11-diol

United Nations Number..... †

CHRIS Code..... TTG

Formula— $\text{HO}(\text{C}_2\text{H}_4\text{O})_3\text{C}_2\text{H}_4\text{OH}$

Appearance—Odor—Colorless to pale-straw colored
liquid; sweet odor

Specific Gravity—1.13

Chemical Family—Glycol ether

Pollution Category—USEPA-..... IMO- III

Applicable Bulk Reg. 46 CFR Subchapter..... D

Boiling Point..... 327°C 621°F

.....°C.....°F

Freezing Point..... -6°C -21°F

.....°C.....°F

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 8.7

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Slight fire hazard when exposed to heat or flame.

Flash Point (°F)..... 345

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Alcohol foam, CO_2 , water, dry chemical

Special Fire Procedures..... Water may cause frothing. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Low to no toxicity; no skin, ingestive or inhalation effects.

Symptoms—Unavailable

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—No spontaneous decomposition, not dangerously reactive.

Compatibility—Material: Steel or stainless steel recommended.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



TETRAETHYLENE PENTAMINE

Synonyms—1,11-Diamino-3,6,9-triazaundecane

United Nations Number..... 2320

Formula— $\text{NH}_2(\text{CH}_2\text{CH}_2\text{NH})_3\text{CH}_2\text{CH}_2\text{NH}_2$

Appearance—Odor—Viscous liquid; amine odor

Specific Gravity—1.00

Chemical Family—Amine

Pollution Category—USEPA _____ IMO Q

Applicable Bulk Reg. 46 CFR Subchapter _____ Q

CHRIS Code..... TTP

Boiling Point..... 333°C 631°F

Freezing Point..... -30°C -22°F

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 6.8

Solubility in Water..... Appreciable

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—When heated to decomposition, it emits toxic fumes of nitrogen compounds.

Flash Point (°F)..... 325

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 572

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam

Special Fire Procedures..... Firefighters should wear full-protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

1, 2, 2

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Liquid causes severe eye and skin burns

Symptoms—Burning eyes and skin.

Short Exposure Tolerance—An 8 hour exposure to a saturated vapor-air mixture caused no deaths.

Exposure Procedures—Skin or eye contact: Remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical attention as soon as possible.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Avoid copper and copper alloys.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear butyl rubber gloves, face shield or all-purpose canister respirator, protective clothing. If possible cover spill with sodium bisulfate. Spray with water and wash up.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



TETRAHYDROFURAN

Synonyms—Diethylene oxide; Furan, tetrahydro-;
Tetramethylene oxide; THF

United Nations Number..... 2058

CHRIS Code THF

Formula— (C_4H_8O)

Appearance—Odor—Colorless liquid; ether-like odor

Specific Gravity—0.89

Chemical Family—Ether

Pollution Category—USEPA C IMO D

Applicable Bulk Reg. 46 CFR Subchapter D

Boiling Point 66°C 150°F

Freezing Point -108°C -162°F

Vapor Pressure 20°C (68°F) (mmHg) 142

Reid Vapor Pressure (psia) 7.7

Vapor Pressure 46°C (115°F) (psia) 8.5

Vapor Density (Air = 1.0) 1.35

Solubility in Water Appreciable

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—Dangerous fire hazard; moderate explosion hazard. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F) 6

Flammable Limits 2.0 to 11.8%

Autoignition Temp. (°F) 610

Extinguishing Agents CO_2 , dry chemical, alcohol foam, water spray.

Special Fire Procedures Gives off toxic fumes when heated. Provide respiratory protection for firefighters. Water may be ineffective.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

400*

PEL/TWA (ppm)

200

TLV/TWA (ppm)

200

General—Liquid irritating on contact. Vapor inhalation causes severe irritation of mucous membranes with strong narcotic action resulting in severe headache and drowsiness.

Symptoms—Irritation of eyes and mucous membranes; headache or drowsiness.

Short Exposure Tolerance—500 ppm for 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention. Exposure to a potentially dangerous vapor concentration can occur before the product is detected by smell.

REACTIVITY DATA

Stability—May form explosive peroxides upon storage or exposure to light. Should be stabilized to prevent peroxide formation.

Compatibility—Material: This compound dissolves rubber.

Cargo: Group 41 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear polyethylene gloves, protective clothing and face shield. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * NOTE: Detectable odor is greater than the TLV. Exposure to a potentially dangerous vapor concentration can occur before the product is detected by smell.



TETRAHYDRONAPHTHALENE

Synonyms—1,2,3,4-Tetrahydronaphthalene; Tetralin;
Tetraline; Tetrap; Tetranap

United Nations Number..... †

Formula— $C_{10}H_{12}$

CHRIS Code..... THN

Appearance—Odor—Colorless liquid; odor similar to
turpentine

Boiling Point..... 206°C 402°F

.....°C.....°F

Specific Gravity—0.98

Freezing Point..... -25°C -13°F

.....°C.....°F

Chemical Family—Aromatic hydrocarbons

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... 0.02

Vapor Pressure 46°C (115°F) (psia)..... 0.04

Vapor Density (Air = 1.0)..... 4.55

Pollution Category—USEPA..... IMO C*

Solubility in Water..... Insoluble

Applicable Bulk Reg. 46 CFR Subchapter..... D, O

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 172

Flammable Limits..... LEL=0.8%, at 100°C. UEL=5.0%, at 150°C.

Autoignition Temp. (°F)..... 722

Extinguishing Agents..... Foam, carbon dioxide, dry chemical

Special Fire Procedures..... Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

Unavailable

Unavailable

Unavailable

General—Vapor irritating at high concentrations.

Symptoms—Vapor causes headache, vomiting, eye irritation, and coughing. Skin contact is irritating.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Ingestion—induce vomiting. Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Fairly stable but will, however, polymerize and oxidize giving rise to discoloration and resinous material.

Compatibility—Material: Some rubber and plastics unsuitable.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear polyethylene gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Pollution Category C oil-like, 33 CFR 151.49.

† Unassigned



TOLUENE

Synonyms—Benzene, methyl-; Methacide;
Methylbenzene; Methylbenzol; Phenylmethane;
Toluol

United Nations Number..... 1294

CHRIS Code..... TOL

Formula— $C_6H_5CH_3$

Appearance—Odor—Colorless liquid; benzene-like odor

Specific Gravity—0.87

Chemical Family—Aromatic hydrocarbon

Pollution Category—USEPA—C IMO—C*

Applicable Bulk Reg. 46 CFR Subchapter..... D.O.

Boiling Point..... 111°C 231°F

Freezing Point..... -95°C -139°F

Vapor Pressure 20°C (68°F) (mmHg)..... **

Reid Vapor Pressure (psia)..... 1.1

Vapor Pressure 46°C (115°F) (psia)..... 1.5

Vapor Density (Air = 1.0)..... 3.14

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous fire hazard when exposed to heat or flame; moderate explosion hazard when exposed to flame.

Flash Point (°F)..... 45

Flammable Limits..... 1.27 to 7.0%

Autoignition Temp. (°F)..... 1026

Extinguishing Agents..... CO₂, dry chemical, foam, water fog

Special Fire Procedures..... Fight the same as a petroleum fire. The vapors are more toxic than those of petroleum and should be avoided. A fire should be fought in the same manner as any Grade C flammable petroleum product.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
1, 1, 2	0.17	100	100

General—Liquid slightly irritating, Vapor inhalation has moderate narcotic effect causing dizziness and headache, with severe fatigue and mental confusion.

Symptoms—Nausea, dizziness and headache. The victim may appear to be drunk.

Short Exposure Tolerance—Inhalation of 600 ppm for 30 minutes has caused severe fatigue, mental confusion, nausea, dizziness and headache.

Exposure Procedures—Ingestion—do NOT induce vomiting. Vapor—remove victim to fresh air; If breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Rubber exposed to toluene will swell, soften, and deteriorate. Most metals are compatible with toluene.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear plastic gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Pollution Category C oil-like, 33 CFR 151.49.

** Vapor Pressure: 28 mmHg at 25°C.



TOLUENEDIAMINE

Synonyms—Benzenediamine, ar-methyl-;
2,4-Diaminotoluene; 2,4-Tolamine;
2,4-Toluenediamine; 4-m-Toluenediamine;
m-Toluenediamine; Tolylenediamine;
2,4-Tolylenediamine; m-Tolylenediamine

United Nations Number..... †

CHRIS Code..... TDA

Formula— $\text{CH}_3\text{C}_6\text{H}_4(\text{NH}_2)_2$

Boiling Point..... 283°C 541°F

Appearance-Odor—Colorless crystals; ammonia-like
odor

..... °C °F

Specific Gravity—Unavailable

Freezing Point..... 88°C 190°F

..... °C °F

Chemical Family—Aromatic amines

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... †

Pollution Category—USEPA A IMO C

Vapor Pressure 46°C (115°F) (psia)..... †

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Vapor Density (Air = 1.0)..... †

Solubility in Water..... Soluble

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—NA

General—Toxic gases, NH_3 , CO , oxides of Nitrogen, released by high temperature or combustion.

Flash Point (°F)..... 284

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... 842

Extinguishing Agents..... Water, CO_2 , foam

Special Fire Procedures..... Use complete protective clothing and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

Unavailable

Unavailable

General—Suspected carcinogen. Causes thermal burns in molten state. Toxic to the liver and central nervous system.

Symptoms—Irritation and blisters upon contact.

Short Exposure Tolerance— LC_{50} for rats in 1 hour was 5.3 mg/1.

Exposure Procedures—Remove to fresh air, administer artificial respiration or oxygen as necessary. Flush eyes thoroughly with water for 15 minutes. Wash skin with luke warm, not hot water.

REACTIVITY DATA

Stability—

Compatibility—Material: Incompatible with aluminum, copper, zinc, brass and bronze.

Cargo: Group 9 of compatibility chart.

SPILL OR LEAK PROCEDURE

Evacuate area. Avoid contact with hot liquid. Wear full protective equipment and self-contained breathing apparatus. Contain spill and allow to solidify. Scoop into drums. Rinse down area with water. Prevent entry into sewers or water courses.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 1 mmHg at 107°F.

† Unavailable

‡ Unassigned



TOLUENE DIISOCYANATE

Synonyms—Benzene, 1,3-diisocyanatomethyl-;
2,4-Diisocyanatotoluene; TDI; 2,4-Toluene
diisocyanate; Toluene-2,4-diisocyanate; 2,4-Tolulene
diisocyanate; 2,4-Tolylene diisocyanate; m-Tolylene
diisocyanate

Formula— $\text{H}_3\text{CC}_6\text{H}_3(\text{NCO})_2$

Appearance—Odor—Clear, faintly yellow liquid; strong
pungent odor
Specific Gravity—1.21

Chemical Family—Aromatic isocyanate

Pollution Category—USEPA B IMO C
Applicable Bulk Reg. 46 CFR Subchapter Q

	251°C	484°F
	°C	°F
Freezing Point	18°C	57°F
	°C	°F
Vapor Pressure 20°C (68°F) (mmHg)		Low
Reid Vapor Pressure (psia)		Low
Vapor Pressure 46°C (115°F) (psia)		Low
Vapor Density (Air = 1.0)		6.0
Solubility in Water		Reacts

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid
Electrical Group—D

General—Highly toxic nitrogen dioxide gas is produced when this product burns.

Flash Point (°F)..... 270
Flammable Limits..... 0.9 to 9.5%
Autoignition Temp. (°F)..... above 300
Extinguishing Agents..... CO₂; dry chemical, water fog
Special Fire Procedures..... Provide firefighters with full body and respiratory protection. Do not allow water to get into a tank of toluene diisocyanate.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
3, 3, 4	0.4	0.005	0.005

General—Suspected carcinogen. Liquid extremely harmful by skin absorption. Vapor inhalation severely irritating to nose and throat. Repeated exposure to low concentration can lead to respiratory problems and severe dermatitis.

Symptoms—Burning at site of contact. Vapor inhalation causes intense irritation of nose and throat. Inhalation can also cause asthma-like symptoms, which may not appear for several hours after exposure.

Short Exposure Tolerance—0.5 ppm are irritating to nose and throat for brief exposures.

Exposure Procedures—Ingestion—do NOT induce vomiting. Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, is often helpful. Skin or eye contact—immediately flush affected parts gently with water while removing contaminated clothing. Continue to flush for 15 minutes. Get medical help promptly.

See Medical Kit Information, Appendix B

REACTIVITY DATA

Stability—Product will react with water and even the moisture in the air in excess of 100 ppm, evolving CO₂ and heat. Can react violently with amines, alcohols and acids.

Compatibility—Material: Stainless steel, nickel and aluminum are satisfactory construction materials. Avoid copper and copper alloys. Mild steel may be used if it is clean and entirely free of rust and moisture.

Cargo: Group 12 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, protective clothing, self-contained breathing apparatus, protective shoes. Avoid contact with the liquid. Keep unprotected personnel away from spill area. May mix with vermiculite, sodium bicarbonate, or sand. Pack in cardboard box and burn in open pit using crumpled paper and wood splinters as fuel. Wash site with soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



1,2,4-TRICHLOROBENZENE

Synonyms—Trichlorobenzenes, liquid;
unsym-Trichlorobenzene; 1,2,4-Trichlorobenzol

United Nations Number..... 2321

CHRIS Code..... TCB

Formula— $C_6H_3Cl_3$

Appearance—Odor—Colorless liquid; aromatic odor

Specific Gravity—1.45

Chemical Family—Aromatic halocarbon

Pollution Category—USEPA B IMO B

Applicable Bulk Reg. 46 CFR Subchapter..... Q

Boiling Point..... 213°C 415°F

.....°C.....°F

Freezing Point..... 19°C 63°F

.....°C.....°F

Vapor Pressure 20°C (68°F) (mmHg)..... 1.0

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 6.26

Solubility In Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame. Gives off hydrogen chloride gas.

Flash Point (°F)..... 230

Flammable Limits..... 1.3 to 7.1%

Autoignition Temp. (°F)..... 1180

Extinguishing Agents..... Carbon dioxide, dry chemical or foam

Special Fire Procedures..... Water spray may be used to control small fires. Cool exposed tanks with water. Wear self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 2

Odor Threshold (ppm)
3

PEL/TWA (ppm)
5

TLV/TWA (ppm)
5

General—Moderately toxic by ingestion and inhalation, superficial burns to the skin.

Symptoms—Repeated exposure can lead to liver, kidney, spleen damage. Coughing, watering eyes.

Short Exposure Tolerance—Animal studies have shown that 756 mg/kg killed 50% of the population, effecting the liver, kidney and spleen.

Exposure Procedures—Skin and eyes—flush affected areas with plenty of water. Vapor—remove victim to fresh air. If conscious, have victim take water or milk and induce vomiting if swallowed. Administer artificial respiration if necessary. Call a doctor.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Most rubbers are not compatible

Cargo: Group 36 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear plastic gloves, self-contained breathing apparatus, protective clothing. Absorb spill with vermiculite, sodium bicarbonate, or soda ash-sand mixture (10–80). After absorption of spill the mixture may be packaged in cardboard containers and burned in an open pit. Wash site thoroughly with strong soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



1,1,1-TRICHLOROETHANE

Synonyms—Chloroethene; Ethane, 1,1,1-trichloro-;
Methyl chloroform; 1,1,1-TCE

United Nations Number..... 2831

CHRIS Code..... TCE

Formula— CH_2Cl_3

Appearance—Odor—Colorless liquid; sweetish,
chloroform-like odor
Specific Gravity—1.46

Boiling Point..... 74°C 185°F

..... $^\circ\text{C}$ $^\circ\text{F}$

Freezing Point..... 2°C 36°F

..... $^\circ\text{C}$ $^\circ\text{F}$

Chemical Family—Halogenated compound

Vapor Pressure 20°C (68°F) (mmHg)..... 100

Reid Vapor Pressure (psia)..... 4.0

Vapor Pressure 46°C (115°F) (psia)..... 4.8

Vapor Density (Air = 1.0)..... 4.6

Pollution Category—USEPA—C IMO—B

Applicable Bulk Reg. 46 CFR Subchapter..... O.**

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—None assigned.

Electrical Group—D

General—Does not burn readily but can produce a dangerous "flash" when vapors are exposed to a high-energy spark sources in a confined space. When in contact with hot metal or a flame, methyl chloroform can decompose to form phosgene, which is highly toxic.

Flash Point ($^\circ\text{F}$)..... Unavailable

Flammable Limits..... 7 to 16% (approximate value for flash described above)

Autoignition Temp. ($^\circ\text{F}$)..... 932

Extinguishing Agents..... Dry chemical, foam or CO_2

Special Fire Procedures..... Wear eye protection, self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

100

350

350

General—Vapor inhalation gives moderate irritation of air passages plus moderate narcotic effect. Prolonged or repeated skin contact may cause defatting of the skin and may produce dermatitis from daily contact.

Symptoms—Dizziness, headache, nausea, and drowsiness.

Short Exposure Tolerance—1500 ppm

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Begins to decompose at 350°F . May decompose to hydrogen chloride and other toxic products.

Compatibility—Material: The uninhibited grade is corrosive to aluminum, although the inhibited grade may be used with aluminum and any common construction metals at temperatures up to 175°F .

Cargo: Group 36 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves and protective clothing. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * The commercial inhibited product has a boiling range of 160 – 190°F .

** Unregulated, Table 2, 46 CFR 153.



1,1,2-TRICHLOROETHANE

Synonyms—Ethane trichloride; Ethane, 1,1,2-trichloro-; beta-T; 1,1,2-TCE; beta-Trichlorethane; Vinyl trichloride

United Nations Number..... 1

Formula—CH₂ClCHCl₂

CHRIS Code..... TCM

Appearance—Odor—Colorless liquid; sweet, chloroform-like odor

Boiling Point..... 114°C 237°F

°C °F

Specific Gravity—1.43 at 25°C

Freezing Point..... -38°C -36°F

°C °F

Chemical Family—Chlorinated hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... 18.8

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 4.55

Pollution Category—USEPA..... B IMO..... B

Solubility in Water..... 0.45% at 20°C

Applicable Bulk Reg. 46 CFR Subchapter..... Q

FIRE & EXPLOSION HAZARD DATA

Grade—None assigned

Electrical Group—D

General—Very low degree of flammability. Normally will not burn, but will in fire of other fuel or with strong initiator (large spark, welding torch), will give off toxic and irritating gases, including hydrogen chloride, chlorine, and/or phosgene.

Flash Point (°F)..... None measurable due to low degree of combustibility

Flammable Limits..... 6 to 15.5%

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Dry chemical, foam, CO₂

Special Fire Procedures..... Cool exposed tanks with water. Provide respiratory protection for fire parties.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

Unavailable

10/Skin

10/Skin

General—Suspected carcinogen. Very toxic, much more so than 1,1,1-trichloroethane. Central nervous system depressant. Toxic to liver and kidneys. Prolonged or repeated skin contact may cause defatting of the skin and may produce dermatitis from daily contact.

Symptoms—Eyes—irritation, discomfort, soreness. Skin—irritation. Inhalation—irritation, drowsiness, unconsciousness. Ingestion—headache, lassitude, coma.

Short Exposure Tolerance—Short term exposures near 2000 ppm cause central nervous system depression, distorts equilibrium

Exposure Procedures—Eye—flush with water for at least 15 minutes, call physician. Skin—wash with soap and water for at least 15 minutes. Inhalation—remove to fresh air, give oxygen or artificial respiration as needed. Ingestion—call physician.

REACTIVITY DATA

Stability—Generally stable; decomposes when heated. Reacts with strong oxidizers, strong caustics, and active metals to cause fires and explosions.

Compatibility—Material: Attacks some plastics, rubbers, coatings. Reacts with aluminum.

Cargo: Group 36 of the compatibility chart

SPILL OR LEAK PROCEDURE

Wear protective clothing, self-contained breathing apparatus, and full face shield. Stop release, dike spill, collect with inert absorbant, dispose in sanitary landfill.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable

1990



TRICHLOROETHYLENE

Synonyms—Chlorylen; Ethene, trichloro-; Ethinyl trichloride; Ethylene trichloride; Tri; Trichloroethene

United Nations Number..... 1710

Formula— $\text{ClHC}=\text{CCl}_2$

CHRIS Code..... TCL

Appearance—Odor—Colorless liquid; chloroform-like odor

Boiling Point..... 87°C 189°F

Specific Gravity—1.47

Freezing Point..... -87°C -124°F

Chemical Family—Halogenated compound

Vapor Pressure 20°C (68°F) (mmHg)..... 57.8

Reid Vapor Pressure (psia)..... 2.5

Pollution Category—USEPA B IMO B

Vapor Pressure 46°C (115°F) (psia)..... 3.5

Applicable Bulk Reg. 46 CFR Subchapter Q

Vapor Density (Air = 1.0)..... 4.54

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—None assigned.

Electrical Group—D

General—Although trichloroethylene does not ignite readily, it can flash under certain conditions. A high-energy ignition source is one of the necessary factors. The liquid or vapor on contact with hot metal or a flame can decompose to form phosgene, which is highly toxic.

Flash Point ($^\circ\text{F}$)..... Practically non-flammable

Flammable Limits..... Variable at high temperatures

Autoignition Temp. ($^\circ\text{F}$)..... 770

Extinguishing Agents..... Dry chemical, carbon dioxide, or foam

Special Fire Procedures..... Tanks should be cooled by a water spray to prevent vaporization. Wear eye protection, self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

50

50

50

General—Suspected carcinogen. Vapor inhalation leads to slight irritation of airway with moderate systemic effect. Prolonged or repeated skin contact may cause defatting of the skin and may produce dermatitis from daily contact.

Symptoms—Headache, nausea, eye and throat irritation, drowsiness.

Short Exposure Tolerance—150 ppm for 30 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—In the presence of a strong alkali it reacts to form a gas which will ignite or explode spontaneously.

Compatibility—Material: Stabilized trichloroethylene may be used in the presence of air, water and light with any of the common construction metals at temperatures up to 248°F .

Cargo: Group 36 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, protective clothing, self-contained breathing apparatus. Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



1,2,3-TRICHLOROPROPANE

Synonyms—Allyl trichloride; Trichlorohydrin;
Trichloropropane

United Nations Number..... †

CHRIS Code..... TCN

Formula— $\text{CH}_2\text{Cl}-\text{CHCl}-\text{CH}_2\text{Cl}$

Appearance—Odor—Amber liquid; chloroform-like odor

Specific Gravity—1.39

Chemical Family—Halogenated hydrocarbon

Pollution Category—USEPA _____ IMO B

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Boiling Point..... 157°C 315°F

.....°C.....°F

Freezing Point..... -15°C 58°F

.....°C.....°F

Vapor Pressure 20°C (68°F) (mmHg)..... 1.5

Reid Vapor Pressure (psia)..... 0.11

Vapor Pressure 46°C (115°F) (psia)..... 0.15

Vapor Density (Air = 1.0)..... 5.9

Solubility in Water..... <0.5%

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard; releases toxic HCl and other chlorides when heated.

Flash Point (°F)..... 174

Flammable Limits..... 3.27 to 12.6%

Autoignition Temp. (°F)..... 579

Extinguishing Agents..... Water fog, water blanket, CO₂, foam, dry chemical

Special Fire Procedures..... Wear self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

5

10

10/Skin

General—Can cause permanent injury.

Symptoms—Skin—irritation, dermatitis, blistering. Eyes—watering, permanent injury. Inhalation—anesthesia, irritation of respiratory tract, moderate narcotic effects, drowsiness, dizziness.

Short Exposure Tolerance—

Exposure Procedures—Get medical attention. Contact—flush eyes and skin with water. Inhalation—remove to fresh air. Ingestion—induce vomiting if conscious.

REACTIVITY DATA

Stability—Generally stable. Decomposes when heated, may decompose in contact with aluminum, reacts vigorously with oxidizing materials.

Compatibility—Material: Swells rubber. Suitable: Steel. Unsuitable: Aluminum.

Cargo: Group 36 of compatibility chart

SPILL OR LEAK PROCEDURE

Avoid contact. Wear goggles, rubber gloves, and self-contained breathing apparatus. Absorb with sand.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



TRICRESYL PHOSPHATE

Synonyms—o-Cresyl phosphate; Phosphoric acid, tris(methylphenyl)ester; TCP; TOCP; Tolyphosphate; Tri-o-cresyl phosphate; Tri-o-tolyl phosphate; Tritolyl phosphate

United Nations Number ... >3% ortho 2574

CHRIS Code <1% ortho isomer TCP
 1% or more ortho isomer TCO

Formula— $(\text{CH}_3\text{C}_6\text{H}_4)_3\text{PO}_4$

Boiling Point 410°C 770°F
 °C °F

Appearance—Odor—Colorless liquid; slight odor

Freezing Point -32°C -25°F
 °C °F

Specific Gravity—1.17

Vapor Pressure 20°C (68°F) (mmHg) V. Low

Chemical Family—

Reid Vapor Pressure (psia) †

Pollution Category—USEPA _____ IMO A

Vapor Pressure 46°C (115°F) (psia) V. Low

Applicable Bulk Reg. 46 CFR Subchapter Q

Vapor Density (Air = 1.0) 12.7

Solubility in Water Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight hazard when exposed to heat or flame. Will decompose at extremely high temperatures releasing toxic PO_x gases.

Flash Point (°F) 437

Flammable Limits Unavailable

Autoignition Temp. (°F) 725

Extinguishing Agents CO_2 , dry chemical

Special Fire Procedures Water may be ineffective on fire. Cool exposed tanks with water. Wear protective clothing, goggles or face shield and self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings
 1, 0, 4

Odor Threshold (ppm)
 Unavailable

PEL/TWA (ppm)
 Unavailable

TLV/TWA (ppm)
 0.01/Skin

General—Vapor slight hazard due to low vapor pressure. Liquid extremely toxic when ingested.

Symptoms—Vapors may irritate eyes at high temperatures. Ingestion causes severe damage to central nervous system.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Ingestion—induce vomiting and call a physician. Skin or eye contact—for eyes flush with water for 15 minutes; for skin, wash with soap and water.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials when heated to decomposition.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear protective clothing, goggles or face shield. Remove ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



TRIDECANOL

Synonyms—Alcohol C-13; Isotridecanol; Isotridecyl alcohol; Oxotridecyl alcohol; 1-Tridecanol; Tridecyl alcohol

United Nations Number..... 1

CHRIS Code..... TDN

Formula— $C_{13}H_{26}CH_2OH$

Boiling Point..... 274°C 525°F

Appearance-Odor—Water-white liquid with pleasant alcoholic aroma

.....°C.....°F

Specific Gravity—0.85

Freezing Point..... 31°C 87°F

.....°C.....°F

Chemical Family—Alcohol

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Pollution Category—USEPA-..... IMO- III

Vapor Pressure 46°C (115°F) (psia)..... Low

Applicable Bulk Reg. 46 CFR Subchapter..... D

Vapor Density (Air = 1.0)..... 6.9

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Slight fire hazard when exposed to heat or flame.

Flash Point (°F)..... 250

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Alcohol foam, water spray, dry powder, CO₂

Special Fire Procedures..... Water or foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 0, 0

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Possibility of some adverse effects from liquid contact with skin.

Symptoms—Inhalation hazard is slight. Skin contact causes minor irritation. Eye contact causes severe irritation.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently wash affected areas with water.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Aluminum unsuitable.

Cargo: Group 20 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



1-TRIDECENE

Synonyms—Olefin C-13; Undecylethylene

United Nations Number..... ‡

Formula— $\text{CH}_3(\text{CH}_2)_{10}\text{CH} = \text{CH}_2$

Appearance—Odor—Colorless liquid with a mild pleasant odor

Specific Gravity—0.77

Chemical Family—Olefin

Pollution Category—USEPA _____ IMO III

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code..... TDC

Boiling Point..... 233°C 451°F

Freezing Point..... -24°C -11°F

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... Low

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—D

General—Moderate fire hazard if exposed to heat or flame.

Flash Point (°F)..... ~175

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Dry chemical, foam or CO_2

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Unavailable

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Data are lacking; however, it appears that the 1-Tridecene is relatively non-hazardous.

Symptoms—Unavailable

Short Exposure Tolerance—Unavailable

Exposure Procedures—Liquid may irritate the eyes. After skin or eye contact, flush with water for 15 minutes.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



TRIETHANOLAMINE

Synonyms—2,2',2''-Nitrioltriethanol; TEA;
Triethylamine; Tri(hydroxyethyl)amine;
Tri(2-hydroxyethyl)amine; Trihydroxytriethylamine;
Tris(hydroxyethyl)amine; Trolamine

United Nations Number..... +

Formula—(HOC₂H₄)₃N

CHRIS Code..... TEA

Appearance—Odor—Colorless, oily liquid; slight ammonia-like odor

Boiling Point..... 343°C 650°F

..... °C °F

Specific Gravity—1.13

Freezing Point..... 19°C 68°F

..... °C °F

Chemical Family—Amine

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 5.14

Pollution Category—USEPA D

Solubility in Water..... Complete

Applicable Bulk Reg. 46 CFR Subchapter Q

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Slight hazard, when exposed to heat or flame. The oxidation products are poisonous.

Flash Point (°F)..... 365

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... CO₂, dry chemical, alcohol foam, water fog

Special Fire Procedures..... Keep tanks cool with a spray of water. Provide respiratory protection for fire parties.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

0, 1, 1

Unavailable

Unavailable

Unavailable

General—Liquid causes irritation and burns to skin and eyes on contact.

Symptoms—Itching or burning of skin at site of contact. If inhaled, the respiratory passages will be irritated.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Wash spill from the skin with water. If liquid has splashed in the eyes, wash them with water for 15 minutes and get medical attention.

REACTIVITY DATA

Stability—Begins to decompose at 450°F.

Compatibility—Material: Copper and its alloys are corroded.

Cargo: Group B of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, protective clothing. Avoid contact with liquid. Cover spill with sodium bisulfate. Spray with excess water and wash up. Wash area with soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: Partly to lower the high freezing point, the commercial product is a mixture of triethanolamine with up to 25% diethanolamine and 5% ethanolamine. The resulting mixture will have properties that vary somewhat from those shown.

† Unassigned



TRIETHYLAMINE

Synonyms—N,N-Diethylethanamine; TEN

United Nations Number..... 1296

Formula— $(C_2H_5)_3N$

Appearance—Odor—Colorless liquid; ammoniacal odor

Specific Gravity—0.73

Chemical Family—Amine

Pollution Category—USEPA D IMO C

Applicable Bulk Reg. 46 CFR Subchapter Q

CHRIS Code..... TEN

Boiling Point..... 89°C 192°F

Freezing Point..... -115°C -175°F

Vapor Pressure 20°C (68°F) (mmHg)..... 59.5

Reid Vapor Pressure (psia)..... 2.3

Vapor Pressure 46°C (115°F) (psia)..... 2.5

Vapor Density (Air = 1.0)..... 3.49

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—Dangerous, keep away from heat or open flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 25

Flammable Limits..... 1.2 to 8.0%

Autoignition Temp. (°F)..... 842

Extinguishing Agents..... Alcohol foam, CO₂, dry chemical

Special Fire Procedures..... Use water to keep fire-exposed containers cool. If a leak or spill has not ignited, use water spray to disperse the vapors and to protect personnel attempting to stop leak. Water spray may be used to flush spills and to dilute, rendering non-flammable.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 2, 2

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

10

TLV/TWA (ppm)

10

General—Liquid dangerously absorbed through skin. Vapor inhalation harmful. It is one of the most severe eye irritants and permanent injury may follow eye contact despite prompt treatment efforts.

Symptoms—Liquid causes eye injury and skin irritation.

Short Exposure Tolerance—Less than 100 ppm for humans for 30 minutes. A 4 hour exposure was lethal to 1/8 of rats tested.

Exposure Procedures—In case of contact with eyes or skin, immediately flush with plenty of water for at least 15 minutes; for eyes, get medical attention. Remove contaminated clothing and shoes at once.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Copper and its alloys are incompatible with triethylamine.

Cargo: Group 7 of compatibility chart.

SPILL OR LEAK PROCEDURE

If possible, wear butyl rubber gloves, face shield or all-purpose canister respirator, and full-protective clothing. Secure ignition sources. Cover spill with sodium bisulfate. Spray with water and wash up.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



TRIETHYLBENZENE

Synonyms—1,3,5-Triethylbenzene; sym-Triethylbenzene

United Nations Number..... +

CHRIS Code..... TEB

Formula— $C_6H_5(CH_2CH_3)_3$

Boiling Point..... 216°C 421°F

Appearance—Odor—Clear, colorless liquid; weak aromatic odor

..... °C °F

Specific Gravity—0.86

Freezing Point..... -70°C -94°F

..... °C °F

Chemical Family—Aromatic hydrocarbon

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reld Vapor Pressure (psia)..... 0.03

Pollution Category—USEPA _____ IMO A

Vapor Pressure 46°C (115°F) (psia)..... 0.05

Applicable Bulk Reg. 46 CFR Subchapter D.O.

Vapor Density (Air = 1.0)..... 5.6

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid
Electrical Group—D

General—Moderate fire hazard when exposed to heat or flame.

Flash Point (°F)..... 181

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Foam, carbon dioxide or dry chemical

Special Fire Procedures..... Water may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 1

Unavailable

Unavailable

Unavailable

General—

Symptoms—Slight smarting of the eyes or respiratory system if present in high concentrations.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



TRIETHYLENE GLYCOL

Synonyms—Di-beta-hydroxyethoxyethane; 2,2'-Ethylene dioxibis(ethanol); 2,2'-Ethylene dioxidiethanol; Ethylene glycol dihydroxydiethyl ether; Glycol bis(hydroxyethyl)ether; TEG; Triglycol

United Nations Number..... 1

Formula— $(CH_2OCH_2CH_2OH)_2$

CHRIS Code..... TEG

Appearance-Odor—Colorless liquid with a slight, sweet odor

Boiling Point..... 278°C 533°F

Specific Gravity—1.12

.....°C.....°F

Freezing Point..... -7°C 19°F

.....°C.....°F

Chemical Family—Glycol ether

Vapor Pressure 20°C (68°F) (mmHg)..... V. Low

Reid Vapor Pressure (psia)..... V. Low

Vapor Pressure 46°C (115°F) (psia)..... V. Low

Vapor Density (Air = 1.0)..... 5.17

Pollution Category—USEPA..... IMO III

Solubility in Water..... Complete

Applicable Bulk Reg. 46 CFR Subchapter..... D

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Slight fire hazard when exposed to heat or flame. Moderate explosion hazard when vapor is exposed to flame, spark or heat source.

Flash Point (°F)..... 350 (cc)

Flammable Limits..... 0.9 to 9.2%

Autoignition Temp. (°F)..... 700

Extinguishing Agents..... Carbon dioxide, dry chemical, or alcohol foam

Special Fire Procedures..... Water or foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings

0, 0, 0

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Considered non-toxic under normal handling conditions.

Symptoms—Liquid is a skin irritant. Vapor is a lung and upper respiratory tract irritant.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Skin—flush eyes and skin with water. Vapor—remove victim to fresh air and administer artificial respiration. Call a doctor.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



TRIETHYLENETETRAMINE

Synonyms—N,N'-bis(2-Aminoethyl)ethylenediamine;
TETA; Trien

United Nations Number..... 2259

CHRIS Code TET

Formula— $H_2N(C_2H_4NH)_3H$

Appearance—Odor—Moderately viscous, amber liquid;
ammonia-like odor

Specific Gravity—0.98

Chemical Family—Amine

Pollution Category—USEPA IMO D

Applicable Bulk Reg. 46 CFR Subchapter O

Boiling Point 278°C 532°F

Freezing Point -35°C -31°F

Vapor Pressure 20°C (68°F) (mmHg) Low

Reid Vapor Pressure (psia) Low

Vapor Pressure 46°C (115°F) (psia) Low

Vapor Density (Air = 1.0) 5.04

Solubility in Water Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Slight fire hazard when exposed to heat or flame. No spontaneous heating.

Flash Point (°F) 290

Flammable Limits Unavailable

Autoignition Temp. (°F) 642

Extinguishing Agents Alcohol foam, carbon dioxide or dry chemical

Special Fire Procedures Water or foam may cause frothing. Fire fighters to wear self-contained breathing apparatus, goggles and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 2, 1

Odor Threshold (ppm)

Unavailable

PEL/TWA (ppm)

Unavailable

TLV/TWA (ppm)

Unavailable

General—Liquid causes severe burns to skin and eyes with only slight contact. Vapor causes primary skin irritation and dermatitis.

Symptoms—Vapor—skin irritation, dermatitis; nausea, faintness, anxiety. Liquid—severe skin burns.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material: Aluminum or stainless steel are suitable.

Cargo: Group 7 of compatibility chart. See also Appendix I—Exceptions to the Chart.

SPILL OR LEAK PROCEDURE

Wear butyl rubber gloves, face shield or all-purpose canister respirator, protective clothing. Avoid contact with liquid. Cover spill with sodium bisulfate. Wash up with water. Wash site with soap solution.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



TRIPROPYLENE GLYCOL

Synonyms—No common synonyms.

United Nations Number..... 1

Formula— $\text{HO}(\text{C}_3\text{H}_7\text{O})_2\text{C}_3\text{H}_7\text{OH}$

Appearance—Odor—Colorless liquid; odorless

Specific Gravity—1.02

Chemical Family—Glycol ether

Pollution Category—USEPA _____ IMO III

Applicable Bulk Reg. 46 CFR Subchapter _____ D

CHRIS Code..... TGC

Boiling Point..... 267°C 513°F

Freezing Point..... Super cools °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... <0.01

Relat Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Vapor Density (Air = 1.0)..... 6.63

Solubility in Water..... Complete

FIRE & EXPLOSION HAZARD DATA

Grade—E: Combustible liquid

Electrical Group—C

General—Slight fire hazard when exposed to heat or flame.

Flash Point (°F)..... 285

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Water, foam, carbon dioxide or dry chemical

Special Fire Procedures..... Water or foam may cause frothing.

HEALTH HAZARD DATA

Health Hazard Ratings
0, 0, 0

Odor Threshold (ppm)
None

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—No hazard under ordinary conditions of handling.

Symptoms—Unavailable

Short Exposure Tolerance—Unavailable

Exposure Procedures—Unavailable

REACTIVITY DATA

Stability—Stable. Can react with oxidizing materials.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 40 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



TURPENTINE

Synonyms—D.D. turpentine; Gum spirits; Gum turpentine; Oil of turpentine; Spirits of turpentine; Steam distilled turpentine; Sulfate turpentine; Sulfate wood turpentine; Turps; Wood turpentine

United Nations Number..... 1299

CHRIS Code..... TPT

Formula—Mostly $C_{10}H_{16}$

Boiling Point..... 150–160°C 302–320°F

Appearance-Odor—Colorless liquid; smells like oil-base paint

..... °C °F

Specific Gravity—0.85 to 0.87

Freezing Point..... °C °F

Chemical Family—Olefin

Vapor Pressure 20°C (68°F) (mmHg)..... *

Pollution Category—USEPA _____ IMO B

Reid Vapor Pressure (psia)..... 0.26

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

Vapor Pressure 46°C (115°F) (psia)..... 0.40

Vapor Density (Air = 1.0)..... 4.84

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid
Electrical Group—D

General—Gives off acid fumes when heated. Moderate fire hazard. Forms heavy black smoke and soot. Flashback along vapor trail may occur. Vapor may explode in an enclosed area.

Flash Point (°F)..... 95

Flammable Limits..... LEL=0.8% UEL—Unavailable

Autoignition Temp. (°F)..... 488

Extinguishing Agents..... CO₂, dry chemical, water fog, foam

Special Fire Procedures..... A tank exposed to fire should be kept cool with a spray of water.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
100

TLV/TWA (ppm)
100

General—Vapor inhalation harmful. Liquid irritating on contact.

Symptoms—Prickling sensation of eyes, dizziness, acceleration of pulse, respiratory irritation and nausea.

Short Exposure Tolerance—750 to 1000 ppm for several hours caused eye irritation, headache, dizziness, nausea and acceleration of pulse; 1878 ppm for one to four hours is toxic to man.

Exposure Procedures—Remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Under certain conditions (large surface area exposed to air) turpentine can undergo spontaneous heating.

Compatibility—Material: Almost any metal is suitable. Ordinary rubber is attacked and should not be used for gaskets or fittings.

Cargo: Group 30 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear polyethylene gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 5 mmHg at 25°C.



UREA-AMMONIUM NITRATE SOLUTION

(more than 2% free ammonia)

Synonyms—Solar nitrogen solution; UAN-Nitrogen solution; UAN solution

United Nations Number..... +

Formula— $\text{NH}_2\text{CONH}_2, \text{NH}_4\text{NO}_3, \text{NH}_3, \text{H}_2\text{O}$ mixtures

CHRIS Code..... UAS

Appearance—Odor—Colorless liquid; slight ammonia-like odor

Boiling Point..... 100°C 212°F

Specific Gravity—1.3

Freezing Point..... 0°C 32°F

Chemical Family—

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... Varies

Pollution Category—USEPA..... IMO C

Vapor Pressure 46°C (115°F) (psia)..... Varies

Applicable Bulk Reg. 46 CFR Subchapter..... O

Vapor Density (Air = 1.0)..... Varies

Solubility in Water..... Soluble

FIRE & EXPLOSION HAZARD DATA

Grade—None assigned.

Electrical Group—D

General—No direct fire hazard until water evaporates. Thermal decomposition yields toxic ammonia, carbon monoxide, and nitrogen oxide gases.

Flash Point (°F)..... pure ammonium nitrate-urea solution is not flammable.

Flammable Limits..... for ammonia 16 to 25%

Autoignition Temp. (°F)..... for ammonia 1205

Extinguishing Agents..... Water

Special Fire Procedures..... Do not use CO_2 , dry chemical, foam extinguishers. Dry ammonia in contact with combustibles increases potential for fire. If confined an explosion will result. Use self-contained breathing apparatus and stay upwind.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

0, 1, 1

~45 for NH_3 , NH_4OH

**

General—Urea itself is non-toxic. Solution will produce irritation due to ammonia being present.

Symptoms—Prolonged contact will produce mild irritation, blisters or rash. Eyes will become painful. Ingestion results in nausea, vomiting, intestinal bleeding, coma, convulsions, and or death.

Short Exposure Tolerance—100 ppm for 30 minutes (ammonia gas). Lethal dose of ammonium nitrate is 10–15 grams.

Exposure Procedures—Wash skin or eyes with water. For ingestion seek medical assistance promptly. Induce vomiting after two glasses of water only if conscious. Monitor breathing. Remove to fresh air.

REACTIVITY DATA

Stability—Stable. Reacts with oxidizing material, combustible material, wood chips, organic materials, sulfur, metal, finely subdivided lead, zinc, galvanized iron, or acids.

Compatibility—Material:

Cargo: Group 6 of compatibility chart.

SPILL OR LEAK PROCEDURE

Contain material to prevent contamination of land or water. Allow water to evaporate, scoop up remaining residue. Flush area with water to remove remaining traces. Avoid mixing or contact with organic or combustible materials. Spontaneous combustion may occur.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: The more than 2% free ammonia normally requires shipment under pressure (0–30 psia at 104°F).

* Vapor Pressure: 15 mmHg at 77°F.

** NO_2 —5 ppm; CO —50 ppm; NH_3 —25 ppm; NH_4OH —1 ppm

‡ Unassigned



ISO-VALERALDEHYDE

Synonyms—Isovaleral; Isovaleraldehyde; Isovaleric aldehyde; 3-Methylbutanal; 3-Methylbutyraldehyde

United Nations Number..... 2058

CHRIS Code..... IVA

Formula— $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CHO}$

Boiling Point..... 92°C 198°F

Appearance—Odor—Colorless liquid; weakly suffocating odor

Freezing Point..... -51°C -60°F

Specific Gravity—0.80

Vapor Pressure 20°C (68°F) (mmHg)..... *

Chemical Family—Aldehyde

Reid Vapor Pressure (psia)..... ?

Pollution Category—USEPA _____ IMO C

Vapor Pressure 46°C (115°F) (psia)..... High

Applicable Bulk Reg. 46 CFR Subchapter _____ Q

Vapor Density (Air = 1.0)..... 2.86

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—When heated, it emits acrid fumes. Ignited by heat, sparks or open flame. Vapor forms explosive mixtures with air. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 49

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... CO_2 , dry chemical, water fog, alcohol foam

Special Fire Procedures..... Water may be ineffective on fire. Wear self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 2, 1

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Vapor irritating to skin and mucous membranes.

Symptoms—Include coughing, sneezing, burning and tearing of eyes, salivation, and all signs of irritation of the mucous membranes.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Wash immediately with soap and water after skin contact. Contact of the liquid with the eyes can cause permanent injury if prompt treatment is not given. Wash eyes with clear water; obtain medical treatment.

REACTIVITY DATA

Stability—Reacts with itself and also undergoes the condensation reaction in the presence of strong bases.

Compatibility—Material: Compatible with stainless steel or aluminum.

Cargo: Group 19 of compatibility chart.

SPILL OR LEAK PROCEDURE

Avoid contact with liquid. Wear rubber gloves, goggles or face shield, and protective clothing. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 50 mmHg at approx. 25°C.

1 Unavailable



n-VALERALDEHYDE

Synonyms—Amyl aldehyde; Pentanal; Valeral; Valeric aldehyde

United Nations Number..... 2058

CHRIS Code..... VAL

Formula— $\text{CH}_3(\text{CH}_2)_3\text{CHO}$

Appearance—Odor—Colorless liquid with a fruity odor

Boiling Point..... 103°C 217°F

..... °C °F

Freezing Point..... -91°C -132°F

..... °C °F

Specific Gravity—0.81

Vapor Pressure 20°C (68°F) (mmHg)..... 26

Reid Vapor Pressure (psia)..... 1.2

Vapor Pressure 46°C (115°F) (psia)..... 1.8

Vapor Density (Air = 1.0)..... 2.96

Solubility in Water..... Slight

Chemical Family—Aldehyde

Pollution Category—USEPA..... IMO..... D

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—C

General—Flash back along trail may occur. Vapor may explode in a closed area.

Flash Point (°F)..... 54

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Carbon dioxide, dry chemicals, foam, water spray

Special Fire Procedures..... Wear self-contained breathing apparatus and protective clothing as protection against acid fumes. Water may be ineffective on fire.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

Unavailable

50

50

General—Vapor is flammable and very irritating. Liquid causes severe burns.

Symptoms—Vapor—severe irritation of air passages with headache and rapid heart beat, eye irritation. Liquid causes severe skin and eye irritation on contact.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—immediately flood affected area with water for at least 15 minutes. Remove contaminated clothing.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Stainless steel or aluminum are recommended.

Cargo: Group 19 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Secure ignition sources. Cover spill with sodium bisulfite (NaHSO_3). Add small amount of water and mix. Scoop up. Wash site with soap solution.

If a spill occurs, call the National Response Center, 800-424-8902.

Remarks:



VINYL ACETATE

Synonyms—Acetic acid, ethenyl ester; Acetic acid, vinyl ester; VAM; Vinyl acetate monomer; Vinyl A monomer; Vy Ac

United Nations Number..... 1301

Formula— $\text{CH}_3\text{COOCH}=\text{CH}_2$

CHRIS Code..... VAM

Appearance-Odor—Colorless liquid; sweet odor

Boiling Point..... 73°C 163°F
..... °C °F

Specific Gravity—0.94

Freezing Point..... -100°C -148°F
..... °C °F

Chemical Family—Vinyl acetate

Vapor Pressure 20°C (68°F) (mmHg)..... 90

Reid Vapor Pressure (psia)..... 3.7

Vapor Pressure 46°C (115°F) (psia)..... 5.8

Vapor Density (Air = 1.0)..... 2.97

Solubility in Water..... 2%

Pollution Category—USEPA D **IMO** C

Applicable Bulk Reg. 46 CFR Subchapter O

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid
Electrical Group—D

General—When heated, acrid vapors are given off. Ignited by heat, sparks or open flame. Fire may cause violent rupture of tank due to polymerization.

Flash Point (°F)..... 18

Flammable Limits..... 2.6 to 13.4%

Autoignition Temp. (°F)..... 801

Extinguishing Agents..... CO_2 , dry chemical, alcohol foam, water spray.

Special Fire Procedures..... If fire parties must work in confined quarters, provide respiratory protection. Keep tank cool with a water spray.

HEALTH HAZARD DATA

Health Hazard Ratings	Odor Threshold (ppm)	PEL/TWA (ppm)	TLV/TWA (ppm)
1, 1, 2	0.12	10	10

General—Liquid irritating to skin and eyes. Vapor inhalation causes slight narcotic effect.

Symptoms—Dizziness, drowsiness.

Short Exposure Tolerance—Unavailable

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Polymerizes readily if not inhibited. Heat can start the reaction. Emits acrid fumes when heated to decomposition. Can react vigorously with oxidizing materials.

Compatibility—Material: Most of the usual materials of construction are suitable.

Cargo: Group 13 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources. Flush area with water spray.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



VINYL CHLORIDE

Synonyms—Chloroethene; Chloroethylene; Ethene, chloro-; Ethylene monochloride; Monochloroethene; Monochloroethylene; VC; VCL; VCM; Vinyl chloride monomer; Vinyl C monomer

United Nations Number..... 1086

CHRIS Code..... VCM

Formula— $\text{CH}_2=\text{CHCl}$

Appearance—Odor—Colorless liquid or gas; sweet odor

Boiling Point..... -14°C 7°F

Freezing Point..... -160°C -245°F

Specific Gravity—0.91

Vapor Pressure 20°C (68°F) (mmHg)..... 2580

Reid Vapor Pressure (psia)..... 75

Vapor Pressure 46°C (115°F) (psia)..... 95

Vapor Density (Air = 1.0)..... 2.15

Solubility in Water..... Slight

Chemical Family—Vinyl halide

Pollution Category—USEPA X IMO 088

Applicable Bulk Reg. 46 CFR Subchapter O

FIRE & EXPLOSION HAZARD DATA

Grade—Liquefied Flammable Gas (LFG)

Electrical Group—D

General—Dangerous fire hazard. Unless the flow of gas can be stopped, putting out a vinyl chloride fire will permit accumulation of an explosive vapor concentration with increased danger of reflash. Heat decomposes vinyl chloride to form highly toxic phosgene gas. Heat can also cause vinyl chloride to polymerize with explosive force.

Flash Point (°F)..... -108

Flammable Limits..... 3.6 to 33%

Autoignition Temp. (°F)..... 882

Extinguishing Agents..... Stop flow of gas; CO_2 , dry chemical, water fog

Special Fire Procedures..... Cool tank with water spray. Provide self-contained breathing apparatus and protective clothing for fire-fighting personnel.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 1, 2

Odor Threshold (ppm)

260*

PEL/TWA (ppm)

29 CFR 1910.1017

TLV/TWA (ppm)

5

General—Human carcinogen. Vapor harmful. Liquid or cold gas may cause skin or eye injury similar to frostbite.

Symptoms—Dizziness and drowsiness. Frostbitten areas will look white.

Short Exposure Tolerance—500 ppm for 5 minutes.

Exposure Procedures—Remove victim to fresh air. If breathing stops, apply artificial respiration. If the liquid has spilled onto the skin, points of contact may be frostbitten; handle gently and protect from mechanical damage. DO NOT RUB. In case of eye contact, flood eye gently with water for 15 minutes. Get medical attention.*

REACTIVITY DATA

Stability—Polymerizes in presence of air, sunlight or heat.

Compatibility—Material: Steel is satisfactory. However, contact with copper or other acetylide-forming metals may form explosive compounds.

Cargo: Group 35 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, protective clothing. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * NOTE: Detectable odor is greater than the TLV. Exposure to potentially dangerous vapor concentrations can occur before the vapor is detected by smell.



VINYL ETHYL ETHER

Synonyms—Ethoxyethene; Ethyl viny ether; EVE;
Vinamar

United Nations Number..... 1302

CHRIS Code..... VEE

Formula— $\text{CH}_2=\text{CHOC}_2\text{H}_5$

Appearance—Odor—Colorless liquid; disagreeable odor

Specific Gravity—0.763

Chemical Family—Ethers

Pollution Category—USEPA _____ IMO C

Applicable Bulk Reg. 46 CFR Subchapter _____ O

Boiling Point..... 37°C 99°F

Freezing Point..... -115°C -175°F

Vapor Pressure 20°C (68°F) (mmHg)..... 426

Reid Vapor Pressure (psia)..... †

Vapor Pressure 46°C (115°F) (psia)..... †

Vapor Density (Air = 1.0)..... 2.48

Solubility in Water..... Slight

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid
Electrical Group—C

General—Extremely flammable; may form explosive peroxides. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... less than -50 (cc)

Flammable Limits..... 1.7 to 28%

Autoignition Temp. (°F)..... 395

Extinguishing Agents..... Alcohol foam, foam, CO_2 , dry chemical.

Special Fire Procedures..... Wear goggles and self-contained breathing apparatus. Water may be ineffective on fire. Cool exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings
1, 1, 2

Odor Threshold (ppm)
Unavailable

PEL/TWA (ppm)
Unavailable

TLV/TWA (ppm)
Unavailable

General—Vapor or liquid may be irritating to skin and eyes. Concentrated vapors result in rapid anesthetic effect and loss of consciousness.

Symptoms—Excitement followed by unconsciousness and respiratory paralysis. Prolonged skin contact causes dermatitis.

Short Exposure Tolerance—Data not available.

Exposure Procedures—Remove from area and administer artificial respiration or oxygen if necessary. Flush affected areas with large amounts of water.

REACTIVITY DATA

Stability—Can react vigorously with oxidizing materials.

Compatibility—Material:

Cargo: Group 13 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear goggles, self-contained breathing apparatus, rubber gloves. Stay upwind, knock vapors down with water spray. Secure ignition sources as dangerous peroxides form upon heating.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: † Unavailable



VINYLDENE CHLORIDE

Synonyms—1,1-Dichloroethene; 1,1-Dichloroethylene;
asym-Dichloroethylene; Ethene, 1,1-dichloro-

United Nations Number..... 1303

CHRIS Code..... VCI

Formula— $C_2H_2Cl_2$

Appearance—Odor—Colorless liquid; sweet odor

Specific Gravity—1.21

Chemical Family—Vinyl halide

Pollution Category—USEPA B IMO B

Applicable Bulk Reg. 46 CFR Subchapter Q

Boiling Point..... 32°C 89°F

..... °C °F

Freezing Point..... -123°C -189°F

..... °C °F

Vapor Pressure 20°C (68°F) (mmHg)..... *

Reid Vapor Pressure (psia)..... 18.3

Vapor Pressure 46°C (115°F) (psia)..... 24

Vapor Density (Air = 1.0)..... 3.34

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—A: Flammable liquid

Electrical Group—D

General—Dangerous fire hazard; extremely flammable. Combustion products include hydrogen chloride and poisonous phosgene. Fire may result in violent rupture of tank due to polymerization.

Flash Point (°F)..... 0

Flammable Limits..... 5.8 to 16.0%

Autoignition Temp. (°F)..... 1058

Extinguishing Agents..... Carbon dioxide, dry chemical, foam, water fog

Special Fire Procedures..... Keep tank cool with water spray. Wear eye protection, self-contained breathing apparatus and protective clothing.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

2, 2, 3

500 to 1000

1

5

General—Suspected carcinogen. Liquid irritating on contact. Vapor harmful and has narcotic effect.

Symptoms—Dizziness, nausea, and sleepiness. Liquid causes skin burns and eye irritation.

Short Exposure Tolerance—Inhalation of 4000 ppm rapidly produces symptoms of drunkenness; unconsciousness may follow shortly afterward.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Will polymerize if exposed to heat and air. This commodity must be inhibited for shipment.

Compatibility—Material: Copper and copper alloys are unsuitable.

Cargo: Group 35 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, self-contained breathing apparatus, and protective clothing. Avoid contact with liquid. Secure ignition sources. Do not flush spill into confined spaces where flammable vapors can accumulate.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Vapor Pressure: 400 mmHg at 14.4°C.



VINYL TOLUENE

Synonyms—Methylstyrene; para-Methylstyrene;
Tolylethylene

United Nations Number..... 2018

Formula— $\text{CH}_2\text{CHC}_6\text{H}_5$

CHRIS Code..... VNT

Appearance—Odor—Colorless liquid with a disagreeable
odor

Boiling Point..... 168°C 334°F
°C °F

Specific Gravity—0.90

Freezing Point..... -77°C -107°F
°C °F

Chemical Family—Olefin

Vapor Pressure 20°C (68°F) (mmHg)..... 4.9

Reid Vapor Pressure (psia)..... 0.07

Vapor Pressure 46°C (115°F) (psia)..... 0.12

Vapor Density (Air = 1.0)..... 4.08

Solubility in Water..... Slight

Pollution Category—USEPA..... IMO..... A

Applicable Bulk Reg. 46 CFR Subchapter..... O

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Combustion may evolve toxic gases such as carbon monoxide. Moderate fire hazard when exposed to heat or flame. Fire may cause violent rupture of tank due to polymerization.

Flash Point (°F)..... 127

Flammable Limits..... 0.8 to 11%

Autoignition Temp. (°F)..... 914

Extinguishing Agents..... CO_2 , foam, water fog

Special Fire Procedures..... Wear goggles and self-contained breathing apparatus. Cool fire exposed tanks with water.

HEALTH HAZARD DATA

Health Hazard Ratings

2, 1, 1

Odor Threshold (ppm)

above 10

PEL/TWA (ppm)

100

TLV/TWA (ppm)

50

General—Irritation; narcotic.

Symptoms—Liquid—skin irritation, blistering. Vapor—eye and nasal irritation.

Short Exposure Tolerance—400 ppm for 5 minutes.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently wash affected areas with water.

REACTIVITY DATA

Stability—May polymerize if exposed to heat and uninhibited. Can react with oxidizing materials.

Compatibility—Material: Usual materials of construction are suitable.

Cargo: Group 13 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear rubber gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks:



O-XYLENE

Synonyms—Benzene, dimethyl-; 1,2-Dimethyl benzene;
Orthoxylene; ortho-Xylene; Xylol

United Nations Number..... 1307

Formula— $C_8H_{10}(CH_3)_2$

CHRIS Code..... XLO

Appearance—Odor—Colorless liquid; benzene-like
aromatic odor

Boiling Point..... 144°C 292°F

Specific Gravity—0.89

Freezing Point..... -25°C -13°F

Chemical Family—Aromatic hydrocarbons

Vapor Pressure 20°C (68°F) (mmHg)..... **

Reid Vapor Pressure (psia)..... 0.28

Pollution Category—USEPA C IMO C*

Vapor Pressure 46°C (115°F) (psia)..... 0.40

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

Vapor Density (Air = 1.0)..... 3.66

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate fire hazard, when exposed to heat or flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 90

Flammable Limits..... 1.1 to 7.0%

Autoignition Temp. (°F)..... 867

Extinguishing Agents..... CO₂, dry chemical, foam, water fog

Special Fire Procedures..... Water may be ineffective but water should be used to keep fire-exposed containers cool. If a leak or spill has not ignited, use water spray to disperse the vapors and to protect personnel attempting to stop a leak. Water spray may be used to flush spills away from exposures.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

0.05

100

100

General—Vapor inhalation harmful. Liquid irritating.

Symptoms—Headache, dizziness, staggering, nausea, and drowsiness.

Short Exposure Tolerance—Narcosis in animals begins with inhalations of 2300–3500 ppm. Instances of unconsciousness in humans from severe exposures have been described, but the specific concentrations were unknown.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Most materials of construction are satisfactory. Rubber will swell and soften after prolonged exposure.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear polyethylene gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Pollution Category C oil-like, 33 CFR 151.49.

** Vapor Pressure: 10 mmHg at 32.1°C.



m-XYLENE

Synonyms—Benzene, dimethyl-; 1,3-Dimethyl benzene;
Metaxylene; meta-Xylene; Xylo!

United Nations Number..... 1307

CHRIS Code..... XLM

Formula— $C_6H_4(CH_3)_2$

Boiling Point..... 139°C 282°F

Appearance—Colorless liquid; benzene-like
aromatic odor

Freezing Point..... -47°C -53°F

Specific Gravity—0.87

Vapor Pressure 20°C (68°F) (mmHg)..... **

Chemical Family—Aromatic hydrocarbons

Reid Vapor Pressure (psia)..... 0.34

Pollution Category—USEPA C IMO C*

Vapor Pressure 46°C (115°F) (psia)..... 0.51

Applicable Bulk Reg. 46 CFR Subchapter D, O

Vapor Density (Air = 1.0)..... 3.66

Solubility in Water..... Insoluble

FIRE & EXPLOSION HAZARD DATA

Grade—C: Flammable liquid

Electrical Group—D

General—Dangerous fire hazard and moderate explosion hazard when exposed to heat or flame. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.

Flash Point (°F)..... 77

Flammable Limits..... 1.1 to 7.0%

Autoignition Temp. (°F)..... 982

Extinguishing Agents..... Foam, CO₂, dry chemical

Special Fire Procedures..... Water may be ineffective but water should be used to keep fire-exposed containers cool. If a leak or spill has not ignited, use water spray to disperse the vapor and to protect personnel attempting to stop a leak. Water spray may be used to flush spills away.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

0.05

100

100

General—Vapor inhalation has moderate systemic effect resulting in possible loss of consciousness.

Symptoms—Headache, confusion, nausea, dizziness. Dermatitis may result from repeated skin exposure.

Short Exposure Tolerance—Narcosis in animals begins with inhalations of 2300-3500 ppm. Instances of unconsciousness in humans from severe exposures has been described, but the specific concentrations were unknown. 300 ppm is the suggested short term inhalation limit.

Exposure Procedures—Remove from exposure; remove contaminated clothing, cleanse skin, and eyes. Artificial respiration should be started immediately if breathing has stopped.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Softens rubber; not corrosive to most metals.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear polyethylene gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources. Wash up with water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Pollution Category C oil-like, 33 CFR 151.49.

** Vapor Pressure: 10 mmHg at 28.3°C.



p-XYLENE

Synonyms—Benzene, dimethyl-; 1,4-Dimethyl benzene;
Paraxylene; para-Xylene; Xylol

United Nations Number..... 1307

Formula— $C_6H_4(CH_3)_2$

CHRIS Code..... XLP

Appearance—Odor—Colorless liquid; benzene-like
aromatic odor

Boiling Point..... 138°C 281°F

Specific Gravity—0.86

Freezing Point..... 13°C 56°F

Chemical Family—Aromatic hydrocarbons

Vapor Pressure 20°C (68°F) (mmHg)..... **

Reid Vapor Pressure (psia)..... 0.34

Vapor Pressure 46°C (115°F) (psia)..... 0.51

Vapor Density (Air = 1.0)..... 3.66

Pollution Category—USEPA C IMO C*

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D: Combustible liquid

Electrical Group—D

General—Moderate fire hazard, when exposed to heat or flame

Flash Point (°F)..... 81

Flammable Limits..... 1.1 to 7.0%

Autoignition Temp. (°F)..... 870

Extinguishing Agents..... CO₂, dry chemical foam, water fog

Special Fire Procedures..... Water may be ineffective but water should be used to keep fire-exposed containers cool. If a leak or spill has not ignited, use water spray to disperse the vapors and to protect men attempting to stop a leak. Water spray may be used to flush spills away from exposures.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

1, 1, 2

0.05

100

100

General—Vapor inhalation harmful.

Symptoms—Headache, dizziness, nausea.

Short Exposure Tolerance—Narcosis in animals begins with inhalation of 2300–3500 ppm. Instances of unconsciousness in humans from severe exposures have been described, but the specific concentrations were unknown.

Exposure Procedures—Vapor—remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact—remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability—Stable.

Compatibility—Material: Most materials of construction are suitable. Rubber exposed to xylene will swell, soften and eventually deteriorate.

Cargo: Group 32 of compatibility chart.

SPILL OR LEAK PROCEDURE

Wear polyethylene gloves, face shield, protective clothing. Have all-purpose canister mask available. Avoid contact with liquid. Secure ignition sources.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: * Pollution Category C oil-like, 33 CFR 151.49.

** Vapor Pressure: 10 mmHg at 28.3°C.



ZINC DIALKYLDITHIOPHOSPHATE

Synonyms—Zinc dihexyldithiophosphate; Zinc dihexylphosphorodithioate

United Nations Number..... 3

Formula—Indefinite

CHRIS Code..... ZDP

Appearance—Odor—Light yellow liquid; sweet odor

Boiling Point..... Decomposes °C..... °F

..... °C..... °F

Specific Gravity—1.10 to 1.12 at 20°C (liquid); 1.6 at 20°C (solid)

Freezing Point..... Pour point 18 °C..... °F

..... °C..... °F

Chemical Family—Unassigned

Vapor Pressure 20°C (68°F) (mmHg)..... Low

Reid Vapor Pressure (psia)..... Low

Vapor Pressure 46°C (115°F) (psia)..... Low

Pollution Category—USEPA..... IMO..... A

Vapor Density (Air = 1.0).....

Applicable Bulk Reg. 46 CFR Subchapter..... D, Q

Solubility in Water..... Negligible

FIRE & EXPLOSION HAZARD DATA

Grade—D or E: Combustible liquid

Electrical Group—NA

General—Hydrogen sulfide vapors may be evolved if the material is heated in excess of 150°F.

Flash Point (°F)..... ~ 150

Flammable Limits..... Unavailable

Autoignition Temp. (°F)..... Unavailable

Extinguishing Agents..... Dry chemical, CO₂

Special Fire Procedures..... Fire fighters should be equipped with self-contained breathing apparatus.

HEALTH HAZARD DATA

Health Hazard Ratings

Odor Threshold (ppm)

PEL/TWA (ppm)

TLV/TWA (ppm)

Unavailable

0.7

10 ppm (H₂S)

10 ppm (H₂S)

General—Irritating on prolonged contact with the skin; severe swelling and destruction of tissue may result in a few hours. There is no inhalation hazard at room temperature. Skin penetration is high, but there is no hazard.

Symptoms—Red, swollen skin; coughing.

Short Exposure Tolerance—Skin penetration at toxic levels—3.16 milliliters per 1000 grams of body weight; no illness in 6 hour exposure. Minimum concentration found fatal after one hour exposure—600 ppm (H₂S).

Exposure Procedures—Unavailable.

REACTIVITY DATA

Stability—Antioxidant, may decompose with evolution of H₂S if heated about 150°F. Contamination by acid may set up conditions for evolution of H₂S. Contamination by water effects stability.

Compatibility—Material: No corrosive or destructive effect on steel, wood or cloth. Normal materials may be used; may soften natural rubber and some paints.

Cargo: Group 34 of compatibility chart.

SPILL OR LEAK PROCEDURE

Rubber protective clothing, self-contained breathing apparatus, etc. Cover with soda ash. Clean up and neutralize with diluted hydrochloric acid and wash with excess water.

If a spill occurs, call the National Response Center, 800-424-8802.

Remarks: ‡ Unassigned



SYNONYM INDEX

Many chemicals have several names. Of these, one may be a common name and several are chemical names. Many chemicals also use trade names.

In this book an attempt was made to list the data sheets by the names most likely to be used. Trade names were omitted in most cases.

An attempt was made to list every synonym likely to be in use in the bulk shipping industry.

In listing these chemicals, a single-letter, greek-letter or a numerical prefix was ignored in alphabetizing.

To Find

Look Up

A

p-Acetaldehyde
Acetic acid anhydride
Acetic acid, butyl ester
Acetic acid, iso-butyl ester
Acetic acid, ethenyl ester

Paraldehyde
Acetic anhydride
n-Butyl acetate
iso-Butyl acetate
Vinyl acetate

Acetic acid, ethyl ester
Acetic acid glacial
Acetic acid, isopropyl ester
Acetic acid, methyl ester
Acetic acid, 1-methylpropyl ester

Ethyl acetate
Acetic acid
iso-Propyl acetate
Methyl acetate
sec-Butyl acetate

Acetic acid, n-propyl ester
Acetic acid, sec-butyl ester
Acetic acid, vinyl ester
Acetic aldehyde
Acetic ester

n-Propyl acetate
sec-Butyl acetate
Vinyl acetate
Acetaldehyde
Ethyl acetate

Acetic ether
Acetic oxide
Acetylene tetrachloride
Acetyl oxide
Acroleic acid

Ethyl acetate
Acetic anhydride
1,1,2,2-Tetrachloroethane
Acetic anhydride
Acrylic acid

Acrylamide monomer

Acrylamide solution



To Find**Look Up**

Acrylic acid amide
Acrylic acid, iso-butyl ester
Acrylic acid, n-butyl ester
Acrylic acid, ethyl ester

Acrylamide solution
iso-Butyl acrylate
n-Butyl acrylate
Ethyl acrylate

Acrylic acid, 2-ethylhexyl ester
Acrylic acid, isodecyl ester
Acrylic acid, methyl ester
Acrylic amide
Albone

2-Ethylhexyl acrylate
iso-Decyl acrylate
Methyl acrylate
Acrylamide solution
Hydrogen peroxide

Alcohol
Alcohol anhydrous
Alcohol C-1
Alcohol C-10
Alcohol C-13

Ethyl alcohol
Ethyl alcohol
Methyl alcohol
n-Decyl alcohol
Tridecanol

Alcohol C-2
Alcohol C-3

Ethyl alcohol
Propyl alcohol, iso- or n-
isomers
Butyl alcohol, iso-, n-, sec-
or tert- isomers

Alcohol C-5
Alcohol C-6
Alcohol C-8

n-Amyl alcohol
Hexanol
2-Ethyl hexanol or iso-Octyl
alcohol
Acetaldehyde

Aldehyde

Aldehyde-collidine
Aldehydine
Alkylbenzene
Alkyl (C7-C9) nitrate
Allene-methyl acetylene mixture

2-Methyl-5-ethylpyridine
2-Methyl-5-ethylpyridine
Dodecylbenzene
2-Ethyl hexyl nitrate
Methyl acetylene-Propadiene
mixture

Allyl trichloride
Aminobenzene
1-Aminobutane
2-Aminobutane
2-Aminoisobutane

1,2,3-Trichloropropane
Aniline
n-Butylamine
sec-Butylamine
tert-Butylamine





To Find**Look Up****An**

Anesthesia ether
Anesthetic ether
Aniline oil
Anprolene
Ant oil, artificial

Aqua ammonia
Aqua fortis
Aqua fortis
Arachis oil
Artificial oil of ants

Asphalt bitumen
Asphalt cement
Asphaltum
Asymmetrical Dichloroethane
Azabenzene

Azacyclohelane
Azine
Azotic acid
Azotic acid

Babulum oil
Banana oil
Battery acid
BBP
Benenamine

Benzenamine
Benzene carbinol
Benzene chloride
Benzene, chloro-
Benzene, chloromethyl-

Benzene concentrate

Benzenediamine, ar-methyl-

Acrylonitrile

Ethyl ether
Ethyl ether
Aniline
Ethylene oxide
Furfural

Ammonia solutions
Nitric acid (56 to 68%)
Nitric acid (95%)
Peanut oil
Furfural

Asphalt
Asphalt
Asphalt
1,1-Dichloroethane
Pyridine

Hexamethyleneimine
Pyridine
Nitric acid (56 to 68%)
Nitric acid (95%)

B

Neatsfoot oil
iso-Amyl acetate
Sulfuric acid
Butyl benzyl phthalate
Aniline

Aniline
Benzyl alcohol
Chlorobenzene
Chlorobenzene
Benzyl chloride

Benzene, Toluene, Xylene
mixtures
Toluenediamine



To Find**Look Up**

1,2-Benzenedicarboxylic acid
anhydride

Phthalic anhydride

Benzene, 1,2-dichloro-
Benzene, 1,3-diisocyanatomethyl-
Benzene, dimethyl-
Benzene, hexahydride
Benzene, hexahydro-

o-Dichlorobenzene
Toluene diisocyanate
Xylene, o-, m- or p- isomers
Cyclohexane
Cyclohexane

Benzene, hydroxy-
Benzene, methyl-
Benzene, 1-methylethyl-
Benzene, nitro-
Benzin

Phenol
Toluene
Cumene
Nitrobenzene
Gasoline, motor

Benzinoform
Benzol
Benzole
Benzyl n-butyl phthalate
Bicarbutretted hydrogen

Carbon tetrachloride
Benzene
Benzene
Butyl benzyl phthalate
Ethylene

Biethylene
Bimethyl
Biphenyl-diphenyl ether mixture

Butadiene
Ethane
Diphenyl-Diphenyl ether
mixture
2,2'-Dichloroethyl ether
Asphalt

Bis(2-chloroethyl)ether
Bitumen

Bivinyll
Blue oil
Bottled gas
Brazil wax
Brimstone

Butadiene
Aniline
Liquefied petroleum gas
Carnauba wax
Sulfur, molten

Bromofume
Bromomethane
BTX mixtures

Ethylene dibromide
Methyl bromide
Benzene, Toluene, Xylene
mixtures
Butadiene

1,3-Butadiene

alpha, gamma-Butadiene

Butadiene



To Find	Look Up
Butaldehyde	n-Butyraldehyde
Butanal	n-Butyraldehyde
n-Butanal	n-Butyraldehyde
1-Butanamine	n-Butylamine
2-Butanamine	sec-Butylamine
1-Butanamine, N-butyl-	Dibutylamine
Butane	n-Butane
Butane-1,3-diol	1,3-Butylene glycol
1,3-Butanediol	1,3-Butylene glycol
Butanic acid	n-Butyric acid
Butanoic acid	n-Butyric acid
Butanol	n-Butyl alcohol
1-Butanol	n-Butyl alcohol
2-Butanol	sec-Butyl alcohol
2-Butanol acetate	sec-Butyl acetate
n-Butanol	n-Butyl alcohol
Butanols	Butyl alcohol, n-, sec- or tert- isomers
sec-Butanol	sec-Butyl alcohol
tert-Butanol	tert-Butyl alcohol
2-Butanone	Methyl ethyl ketone
2-Butenal	Crotonaldehyde
trans-2-Butenal	Crotonaldehyde
Butene	Butylene
cis-Butenedioic anhydride	Maleic anhydride
Butene resins	Polybutene
1-Butoxy butane	n-Butyl ether
Butoxydiethylene glycol	Diethylene glycol butyl ether
2-Butoxy ethanol	Ethylene glycol butyl ether
2-(2-Butoxyethoxy)ethanol	Diethylene glycol butyl ether
Butyl acetate	iso-Butyl acetate
Butyl acetate	n-Butyl acetate
normal-Butyl acetate	n-Butyl acetate



To Find**Look Up**

Butyl alcohol
Butyl aldehyde
iso-Butyl aldehyde
n-Butyl aldehyde
Butylamine

n-Butyl alcohol
n-Butyraldehyde
iso-Butyraldehyde
n-Butyraldehyde
Butylamine, iso-, n-, sec- or
tert- isomers

Butylamine
N-Butyl-1-butanamine
n-Butylcarbinol
Butyl Carbitol

n-Butylamine
Dibutylamine
n-Amyl alcohol
Diethylene glycol butyl
ether
Ethylene glycol butyl ether

Butyl Cellosolve

Diethylene glycol butyl
ether

Butyl diglycol

Diethylene glycol butyl
ether

Butyl dioxitol

Butylene
Butylene
1,3-Butylene glycol

1-Butene
alpha-Butylene
beta-Butyleneglycol

Butylene hydrate
1,2-Butylene oxide, stabilized
alpha-Butylene oxide
Butyl ethanoate
Butyl ether

sec-Butyl alcohol
1,2-Butylene oxide
1,2-Butylene oxide
n-Butyl acetate
n-Butyl ether

Butyl 2-methacrylate
n-Butyl methacrylate
n-Butyl alpha-methacrylate
tert-Butyl methyl ether
Butyl 2-methyl-2-propenoate

Butyl methacrylate
Butyl methacrylate
Butyl methacrylate
Methyl tert-butyl ether
Butyl methacrylate

Butyl oxitol
n-Butyl-2-propenoate
Butyraldehyde
Butyric acid
Butyric alcohol

Ethylene glycol butyl ether
n-Butyl acrylate
n-Butyraldehyde
n-Butyric acid
n-Butyl alcohol

Butyric aldehyde

n-Butyraldehyde



To Find

Look Up

C

Camphor tar
Capric alcohol
epsilon-Caprolactam
Carbinol
Carbitol solvent

Carbolic acid
Carbon bisulfide
Carbon bisulphide
Carbon disulphide
Carbon tet

Cellosolve Acetate

Cellosolve Solvent
Chamber acid
Chinese bean oil

Chlorallylene
Chlorate of soda
2-Chlorethanol
Chlorex
Chlorinated hydrochloric ether

Chloroacetic acid, liquid
alpha-Chloroallyl chloride
gamma-Chloroallyl chloride
Chlorobenzol
1-Chloro-2,3-epoxypropane

3-Chloro-1,2-epoxypropane
Chloroethane
2-Chloroethanol
Chloroethene
2-Chloroethyl alcohol

Chloroethylene
Chloroethyl ether

Naphthalene
n-Decyl alcohol
Caprolactam solution
Methyl alcohol
Diethylene glycol ethyl ether

Phenol
Carbon disulfide
Carbon disulfide
Carbon disulfide
Carbon tetrachloride

Ethylene glycol ethyl ether acetate
Ethylene glycol ethyl ether
Sulfuric acid
Soybean oil

Allyl chloride
Sodium chlorate solution
Ethylene chlorohydrin
2,2'-Dichloroethyl ether
1,1-Dichloroethane

Chloroacetic acid
1,3-Dichloropropene
1,3-Dichloropropene
Chlorobenzene
Epichlorohydrin

Epichlorohydrin
Ethyl chloride
Ethylene chlorohydrin
Vinyl chloride
Ethylene chlorohydrin

Vinyl chloride
2,2'-Dichloroethyl ether



To Find**Look Up**

bis(2-Chloroethyl)ether
bis-beta-Chloroethyl ether
Chlorohydric acid

2,2'-Dichloroethyl ether
2,2'-Dichloroethyl ether
Hydrochloric acid

bis(2-Chloroisopropyl)ether
Chloromethane
(Chloromethyl)benzene
Chloromethyloxirane
1-Chloro-2-nitrobenzene

2,2'-Dichloroisopropyl ether
Methyl chloride
Benzyl chloride
Epichlorohydrin
o-Chloronitrobenzene

2-Chloro-1-nitrobenzene
Chloronitrobenzenes
Chlorophenols, liquid
1-Chloro-2-propene
3-Chloropropene

o-Chloronitrobenzene
o-Chloronitrobenzene
2,4-Dichlorophenol
Allyl chloride
Allyl chloride

3-Chloro-1-propene
3-Chloropropylene
alpha-Chloropropylene
2-Chloropropylene oxide
gamma-Chloropropylene oxide

Allyl chloride
Allyl chloride
Allyl chloride
Epichlorohydrin
Epichlorohydrin

Chlorosulfuric acid
Chlorothene
alpha-Chlorotoluene
omega-Chlorotoluene
Chlorox

Chlorosulfonic acid
1,1,1-Trichloroethane
Benzyl chloride
Benzyl chloride
Sodium hypochlorite
solution

Chlorsulfonic acid
Chlorsulfuric acid
Chlorylen
Cidex
Cinnamene

Chlorosulfonic acid
Chlorosulfonic acid
Trichloroethylene
Glutaraldehyde solution
Styrene monomer

Cinnamol
Coal naphtha
Coal oil
Coal oil
Coal tar creosote

Styrene monomer
Benzene
Crude oil
Kerosene
Creosote, coal tar



To Find	Look Up
Coal tar distillate	Coal tar
Coal tar light oil	Benzene, Toluene, Xylene mixtures
Coal tar naphtha	Benzene
Codoil	Rosin oil
Coke oven light oil	Benzene, Toluene, Xylene mixtures
Colamine	Ethanolamine
Cologne spirit	Ethyl alcohol
Colonial spirits	Methyl alcohol
Columbian spirits	Methyl alcohol
Creosote from coal tar	Creosote, coal tar
Creosote oil	Creosote, coal tar
Cresol (2-, 3-, 4-)	Cresols
Cresylic acid	Cresols
Cresylol	Cresols
o-Cresyl phosphate	Tricresyl phosphate
Crotenaldehyde	Crotonaldehyde
Crotonaldehyde, stabilized	Crotonaldehyde
Crotonic aldehyde	Crotonaldehyde
Crude coal tar	Coal tar
crude Epichlorohydrin	Chlorohydrins (crude)
Crude solvent coal tar naphtha	Coal tar naphtha solvent
Crystalite	Methyl methacrylate
Cumol	Cumene
Cyanoethane	Propionitrile
2-Cyanoethanol	Ethylene cyanohydrin
Cyanoethylene	Acrylonitrile
Cyanomethane	Acetonitrile
2-Cyanopropene	Methacrylonitrile
Cychlohexanamine	Cyclohexylamine
Cyclohexatriene	Benzene
Cyclohexyl alcohol	Cyclohexanol
Cyclohexyl ketone	Cyclohexanone
Cyclopentadiene	Dicyclopentadiene



To Find

1,3-Cyclopentadiene
1,3-Cyclopentadiene dimer
Cymol

Look Up

Dicyclopentadiene
Dicyclopentadiene
p-Cymene

D

DCEE
D.D. turpentine
DEA
Dead oil
DEAE

2,2'-Dichloroethyl ether
Turpentine
Diethanolamine
Creosote, coal tar
Diethylethanolamine

Deanol
1-Decanol
decylbenzenesulfonic acid; Un-,
Do-, Tri-, Tetra-, Penta- or
Hexa-

Dimethylethanolamine
n-Decyl alcohol
Alkylbenzenesulfonic acid

DEG
DEN
Denatured alcohol
Detergent alkylate #2
D-Glucitol

Diethylene glycol
Diethylamine
Ethyl alcohol
Dodecylbenzene
Sorbitol

Diacetone
2,4-Diaminotoluene
2,2'-Diaminodiethylamine
1,2-Diaminoethane
1,11-Diamino-3,6,9-
triazundecane

Diacetone alcohol
Toluenediamine
Diethylenetriamine
Ethylenediamine
Tetraethylenepentamine

Diammonium sulfide solution
DIBK
1,2-Dibromoethane
sym-Dibromoethane
Di-n-butylamine

Ammonium sulfide solution
Diisobutyl ketone
Ethylene dibromide
Ethylene dibromide
Dibutylamine

n-Dibutylamine
Di-(n-butyl)amine
Dibutyl ether
Di-n-butyl ether
n-Dibutyl ether

Dibutylamine
Dibutylamine
n-Butyl ether
n-Butyl ether
n-Butyl ether



To Find	Look Up
Dibutyl ethers	n-Butyl ether
Dibutyl oxide	n-Butyl ether
1,2-Dichlorobenzene	o-Dichlorobenzene
o-Dichlorobenzol	o-Dichlorobenzene
2,2'-Dichlorodiethyl ether	2,2'-Dichloroethyl ether
1,2-Dichloroethane	Ethylene dichloride
sym-Dichloroethane	Ethylene dichloride
1,1-Dichloroethene	Vinylidene chloride
Dichloroether	2,2'-Dichloroethyl ether
1,1-Dichloroethylene	Vinylidene chloride
asym-Dichloroethylene	Vinylidene chloride
Dichloroethyl ether	2,2'-Dichloroethyl ether
beta, beta'-Dichloroethyl ether	2,2'-Dichloroethyl ether
sym-Dichloroethyl ether	2,2'-Dichloroethyl ether
Dichloroethyl oxide	2,2'-Dichloroethyl ether
Dichloroisopropyl ether	2,2'-Dichloroisopropyl ether
Dichlorophenol	2,4-Dichlorophenol
Dichloropropane	1,2-Dichloropropane
Dichloropropene	1,3-Dichloropropene
1,3-Dichloropropylene	1,3-Dichloropropene
alpha, gamma-Dichloropropylene	1,3-Dichloropropene
Dicy; 3a, 4, 7, 7a-	Dicyclopentadiene
1,4-Dicyanobutane	Adiponitrile
Dicyclo-1,4-pentadiene	Dicyclopentadiene
Diesel fuel	Diesel oil
Diethyl	n-Butane
Diethylaminoethanol	Diethylethanolamine
2-Diethylaminoethanol	Diethylethanolamine
2-N-Diethylaminoethanol	Diethylethanolamine
2-Diethylaminoethyl alcohol	Diethylethanolamine
beta-Diethylaminoethyl alcohol	Diethylethanolamine
Diethylbenzene (1,2-, 1,3- or 1,4-)	Diethylbenzene
Diethylbenzene; m- or o- isomers	Diethylbenzene
Diethylene dioxide	1,4-Dioxane
1,4-Diethylenedioxide	1,4-Dioxane



To Find	Look Up
Diethylene ether	1,4-Dioxane
Diethylene imidoxide	Morpholine
Diethylene oxide	1,4-Dioxane
Diethylene oxide	Tetrahydrofuran
Diethylene oximide	Morpholine
Diethylenimide oxide	Morpholine
N,N-Diethylethanamine	Triethylamine
N,N-Diethylethanolamine	Diethylethanolamine
Diethyl ether	Ethyl ether
Di-(2-ethylhexyl)phthalate	Diocetyl phthalate
Diethyl-(2-hydroxyethyl)amine	Diethylethanolamine
Diethylolamine	Diethanolamine
Diethyl oxide	Ethyl ether
Difluorochloromethane	Chlorodifluoromethane
Difluorodichloromethane	Dichlorodifluoromethane
Difluoromonochloromethane	Chlorodifluoromethane
1,3-Diformylpropane	Glutaraldehyde solution
Diglycol	Diethylene glycol
Diglycol monobutyl ether	Diethylene glycol butyl ether
1,3-Dihydroxybutane	1,3-Butylene glycol
2,2'-Dihydroxydiethylamine	Diethanolamine
Dihydroxydiethyl ether	Diethylene glycol
2,2'-Dihydroxydipropylamine	Diisopropanolamine
2,2-Dihydroxydipropyl ether	Dipropylene glycol
1,2-Dihydroxyethane	Ethylene glycol
Di-beta-hydroxyethoxyethane	Triethylene glycol
Di-(2-hydroxyethyl)amine	Diethanolamine
2,2'-Dihydroxyethyl ether	Diethylene glycol
2,2'-Dihydroxyisopropyl ether	Dipropylene glycol
Diisobutene	Diisobutylene
Diisobutylene, isomeric comp's	Diisobutylene
2,4-Diisocyanatotoluene	Toluene diisocyanate
4,4-Diisocyanodiphenylmethane	Diphenylmethane diisocyanate



To Find	Look Up
sym-Diisopropylacetone	Diisobutyl ketone
sym-5-Diisopropylacetone	Diisobutyl ketone
Diisopropyl ether	iso-Propyl ether
Diisopropyl oxide	iso-Propyl ether
Dimethyl	Ethane
Dimethylamine, anhydrous	Dimethylamine
2-(Dimethylamino)ethanol	Dimethylethanolamine
beta-Dimethylaminoethyl alcohol	Dimethylethanolamine
Dimethyl benzene	Xylene, o-, m- or p- isomers
1,2-Dimethyl benzene	o-Xylene
1,3-Dimethyl benzene	m-Xylene
1,4-Dimethyl benzene	p-Xylene
1,3-Dimethylbutyl acetate	Methyl amyl acetate
Dimethyl carbinol	iso-Propyl alcohol
Dimethylene oxide	Ethylene oxide
Dimethyl ethylamine	tert-Butylamine
1,1-Dimethylethylamine	tert-Butylamine
N,N-Dimethylformamide	Dimethylformamide
2,6-Dimethyl-4-heptanol	Diisobutyl carbinol
2,6-Dimethyl-4-heptanone	Diisobutyl ketone
Dimethyl-1-hexanol	iso-Octyl alcohol
N,N-Dimethyl-N-(2-hydroxyethyl)amine	Dimethylethanolamine
Dimethyl ketone	Acetone
Dimethylmethane	Propane
Dioxan	1,4-Dioxane
Dioxane	1,4-Dioxane
p-Dioxane	1,4-Dioxane
1,3-Dioxophalan	Phthalic anhydride
DIPA	Diisopropanolamine
DIPA	Diisopropylamine
Diphenyl-diphenyl oxide mixture	Diphenyl-Diphenyl ether mixture



To Find	Look Up
4,4'-Diphenylmethane diisocyanate	Diphenylmethane diisocyanate
Diphenylmethane-4,4'-diisocyanate	Diphenylmethane diisocyanate
Diphenyl oxide-diphenyl mixture	Diphenyl-Diphenyl ether mixture
Dipropylamine	Di-n-propylamine
Dipropylmethane	Heptane
Dithiocarbonic anhydride	Carbon disulfide
Divinyl	Butadiene
DMA	Dimethylmethyl amine
DMF	Dimethylformamide
DMFA	Dimethylformamide
n-Dodecylbenzene	Dodecylbenzene
Dodecylbenzenesulfonic acid	Alkylbenzenesulfonic acid
alpha-Dodecylene	Dodecene
Dolcymene	p-Cymene
DOP	Diocetyl phthalate
Dowanol DB	Diethylene glycol butyl ether
Dowanol DE	Diethylene glycol ethyl ether
Dowanol DM	Diethylene glycol methyl ether
Dowanol EB	Ethylene glycol butyl ether
Dowanol EE	Ethylene glycol ethyl ether
Dowanol EM	Ethylene glycol methyl ether
Dowtherm A	Diphenyl-Diphenyl ether mixture
Dowtherm E	o-Dichlorobenzene
DPA	Di-n-propylamine
Dripolene	Benzene, Toluene, Xylene mixtures
Drycleaners naphtha	Naphtha: Stoddard solvent



To Find
Drycleaners safety solvent
Dutch liquid

Dutch oil

Earthnut oil
EB
EDB
EDC
Edible tallow

EE Solvent
Ektasolve DB Solvent

Ektasolve DE Solvent

Ektasolve DM Solvent

Ektasolve EB Solvent
Elayl
Embafume
Engravers acid
Engravers acid

Engravers oil
Engravers oil
EO
1,2-Epoxybutane
Epoxyethane

1,2-Epoxyethane
1,2-Epoxypropane
Erythrene
Essence of mirbane
Ethanal

Ethane carboxylic acid
1,2-Ethanediamine
Ethane, 1,2-dibromo-

Look Up
Naphtha: Stoddard solvent
Ethylene dichloride

Ethylene dichloride

E

Peanut oil
Ethylbenzene
Ethylene dibromide
Ethylene dichloride
Tallow

Ethylene glycol ethyl ether
Diethylene glycol butyl ether
Diethylene glycol ethyl ether
Diethylene glycol methyl ether

Ethylene glycol butyl ether
Ethylene
Methyl bromide
Nitric acid (56 to 68%)
Nitric acid (95%)

Nitric acid (56 to 68%)
Nitric acid (95%)
Ethylene oxide
1,2-Butylene oxide
Ethylene oxide

Ethylene oxide
Propylene oxide
Butadiene
Nitrobenzene
Acetaldehyde

Propionic acid
Ethylenediamine
Ethylene dibromide



To Find	Look Up
Ethane, 1,1-dichloro-	1,1-Dichloroethane
Ethane, 1,2-dichloro-	Ethylene dichloride
1,2-Ethanediol	Ethylene glycol
1,2-Ethanediol diacetate	Ethylene glycol diacetate
Ethanenitrile	Acetonitrile
Ethane, 1,1'-oxybis-	Ethyl ether
Ethane, 1,1'-oxybis[2-chloro-	2,2'-Dichloroethyl ether
Ethane, pentachloride	Pentachloroethane
Ethane, pentachloro-	Pentachloroethane
Ethane, 1,1,2,2-tetrachloro-	1,1,2,2-Tetrachloroethane
Ethane, 1,1,1-trichloro-	1,1,1-Trichloroethane
Ethane trichloride	1,1,2-Trichloroethane
Ethane, 1,1,2-trichloro-	1,1,2-Trichloroethane
Ethanoic acid	Acetic acid
Ethanoic anhydride	Acetic anhydride
Ethanol	Ethyl alcohol
Ethanol, 2-butoxy-	Ethylene glycol butyl ether
Ethanol, 2-ethoxy-	Ethylene glycol ethyl ether
Ethanol, 2-ethoxy-, acetate	Ethylene glycol ethyl ether acetate
Ethanol, 2-methoxy-	Ethylene glycol methyl ether
Ethene	Ethylene
Ethene, chloro-	Vinyl chloride
Ethene, 1,1-dichloro-	Vinylidene chloride
Ethene, tetrachloro-	Perchloroethylene
Ethene, trichloro-	Trichloroethylene
Ethenylbenzene	Styrene monomer
Ether	Ethyl ether
Ether, bis(2-chloro-1-methylethyl)	2,2'-Dichloroisopropyl ether
Ether cyanatus	Propionitrile
Ether, hydrochloric	Ethyl chloride
Ethynyl trichloride	Trichloroethylene
Ethoxyethane	Ethyl ether



To Find	Look Up
2-Ethoxyethanol	Ethylene glycol ethyl ether
Ethoxyethene	Vinyl ethyl ether
2-Ethoxyethylacetate	Ethylene glycol ethyl ether acetate
Ethylacetic acid	n-Butyric acid
Ethyl aldehyde	Acetaldehyde
Ethylamine, anhydrous	Ethylamine
Ethylamine, aqueous solutions	Ethylamine solution
Ethylbenzol	Ethylbenzene
2-Ethylbutanol	Ethyl butanol
2-Ethyl-1-butanol	Ethyl butanol
2-Ethyl butyl alcohol	Ethyl butanol
Ethyl carbinol	n-Propyl alcohol
Ethyl cyanide	Propionitrile
Ethyl dimethylmethane	iso-Pentane
Ethylene acetate	Ethylene glycol diacetate
Ethylene alcohol	Ethylene glycol
Ethylene bromide	Ethylene dibromide
Ethylene carboxylic acid	Acrylic acid
Ethylene chlorhydrin	Ethylene chlorohydrin
Ethylene chloride	Ethylene dichloride
Ethylene diacetate	Ethylene glycol diacetate
Ethylenediamine, anhydrous	Ethylenediamine
Ethylene dihydrate	Ethylene glycol
2,2'-Ethylene dioxybis(ethanol)	Triethylene glycol
2,2'-Ethylene dioxydiethanol	Triethylene glycol
Ethylene glycol monoacrylate	2-Hydroxyethyl acrylate
Ethylene glycol dihydroxy-diethyl ether	Triethylene glycol
Ethylene glycol monoethyl ether	Ethylene glycol ethyl ether
Ethylene monochloride	Vinyl chloride
Ethylene tetrachloride	Perchloroethylene
Ethylene trichloride	Trichloroethylene
N-Ethylethanamine	Diethylamine



To Find

Ethyl ethanoate
Ethylethylene
Ethylformic acid
2-Ethyl hexanal
2-Ethyl-2-hexanal

2-Ethyl-1-hexanol
2-Ethylhexyl alcohol
bis(2-Ethylhexyl)phthalate
2-Ethylhexyl, 2-propenoate
Ethyl hydride

Ethyl hydroxide
5-Ethylidene bicyclo(2,2,1)-hept-2-ene
Ethylidene chloride
Ethylidene dichloride

1,1-Ethylidene dichloride
Ethylidene norbornylene
Ethylidene norcamphene
Ethyl 2-methacrylate
Ethyl alpha-methacrylate

6-Ethyl-2-methyl benenamine
Ethyl methyl carbinol
Ethyl methyl ketone
Ethyl 2-methyl-2-propenoate
3-Ethyl-6-methyl pyridine

5-Ethyl-2-methyl pyridine
Ethyl nitrile
Ethylolamine
Ethyl oxide
5-Ethyl-2-picoline

Ethyl propenoate
Ethyl 2-propenoate
2-Ethyl-3-propyl acryaldehyde
Ethyl sulfate
Ethyl-o-toluidine

Look Up

Ethyl acetate
Butylene
Propionic acid
2-Ethyl-3-propylacrolein
2-Ethyl-3-propylacrolein

2-Ethyl hexanol
2-Ethyl hexanol
Dioctyl phthalate
2-Ethylhexyl acrylate
Ethane

Ethyl alcohol
Ethylidene norbornene

1,1-Dichloroethane
1,1-Dichloroethane

1,1-Dichloroethane
Ethylidene norbornene
Ethylidene norbornene
Ethyl methacrylate
Ethyl methacrylate

2-Methyl-6-ethylaniline
sec-Butyl alcohol
Methyl ethyl ketone
Ethyl methacrylate
2-Methyl-5-ethylpyridine

2-Methyl-5-ethylpyridine
Acetonitrile
Ethanamine
Ethyl ether
2-Methyl-5-ethylpyridine

Ethyl acrylate
Ethyl acrylate
2-Ethyl-3-propylacrolein
Diethyl sulfate
2-Methyl-6-ethylaniline



To Find	Look Up
Ethyl vinyl ether	Vinyl ethyl ether
Ethoxy diglycol	Diethylene glycol ethyl ether
2-(2-Ethoxyethoxy)ethanol	Diethylene glycol ethyl ether
2-[2-(2-Ethoxyethoxy)-ethoxy]ethanol	Ethoxy triglycol
Ethoxytriethylene glycol	Ethoxy triglycol
EVE	Vinyl ethyl ether
F	
F 12	Dichlorodifluoromethane
Fermentation alcohol	Ethyl alcohol
Fermentation butyl alcohol	iso-Butyl alcohol
Fertilizer acid	Sulfuric acid
Fluorocarbon 22	Chlorodifluoromethane
Formalin	Formaldehyde solutions
Formalith	Formaldehyde solutions
Formic acid, methyl ester	Methyl formate
Formic aldehyde solution	Formaldehyde solutions
Formol	Formaldehyde solutions
Formylic acid	Formic acid
Formyl trichloride	Chloroform
Freon 12	Dichlorodifluoromethane
Freon 22	Chlorodifluoromethane
Fuel oil no. 1	Kerosene
Fuel oil no. 1-D	Diesel oil
Fuel oil no. 2-D	Diesel oil
Fuel oil no. 6	Bunker C
Fuming sulfuric acid	Oleum
Fural	Furfural
2-Furaldehyde	Furfural
2-Furancarbinol	Furfuryl alcohol
2-Furancarboxal	Furfural
2-Furancarboxaldehyde	Furfural
2,5-Furandione	Maleic anhydride



To Find**Look Up**

2-Furanmethanol
Furan, tetrahydro-
Furfuralcohol
Furfuraldehyde
Furfuran carboxylic aldehyde

Furfuryl alcohol
Tetrahydrofuran
Furfuryl alcohol
Furfural
Furfural

Furfurole
Furole
Furylcarbinol
2-Furylcarbinol
alpha-Furylcarbinol

Furfural
Furfural
Furfuryl alcohol
Furfuryl alcohol
Furfuryl alcohol

2-Furylmethanol
Fyde

Furfuryl alcohol
Formaldehyde solutions

G

Genetron
Glacial acetic acid
Glutaral
Glutaric dialdehyde
Glutarol

Freon
Acetic acid
Glutaraldehyde solution
Glutaraldehyde solution
Glutaraldehyde solution

Glycerol
Glycol
Glycol alcohol
Glycol bis(hydroxyethyl)ether
Glycol chlorohydrin

Glycerine
Ethylene glycol
Ethylene glycol
Triethylene glycol
Ethylene chlorohydrin

Glycol cyanohydrin
Glycol diacetate
Glycol dibromide
Glycol dichloride
Glycol ethylene ether

Ethylene cyanohydrin
Ethylene glycol diacetate
Ethylene dibromide
Ethylene dichloride
1,4-Dioxane

Glycol monoethyl ether
Glycol monoethyl ether acetate

Ethylene glycol ethyl ether
Ethylene glycol ethyl ether
acetate

Glycol monomethyl ether

Ethylene glycol methyl
ether

Glycyl alcohol

Glycerine



To Find

Grain alcohol
Groundnut oil
L-Gulitol
Gum camphor
Gum spirits

Gum turpentine

Look Up

Ethyl alcohol
Peanut oil
Sorbitol
Camphor oil
Turpentine

Turpentine

H

Halon 122
Hard wax
HEA
Heavy industrial fuel oil
Heavy oil

n-Heptane
n-Heptylethylene
Heptyl hydride
Hexahydroaniline
Hexahydroazepine

Hexahydrobenzene
Hexahydrophenol
Hexamethylene
Hexanaphthene
Hexane

1,2,3,4,5,6-Hexanehexol
Hexanes
1-Hexanol
n-Hexanol
Hexanols

Hexone
sec-Hexyl acetate
Hexyl alcohol
n-Hexyl alcohol
sec-Hexyl alcohol

Hexyl hydride
High-strength hydrogen peroxide

Dichlorodifluoromethane
Paraffin wax
2-Hydroxyethyl acrylate
Bunker C
Creosote, coal tar

Heptane
1-Nonene
Heptane
Cyclohexylamine
Hexamethyleneimine

Cyclohexane
Cyclohexanol
Cyclohexane
Cyclohexane
n-Hexane

Sorbitol
Hexane, iso- or n- isomers
Hexanol
Hexanol
Hexanol

Methyl isobutyl ketone
Methyl amyl acetate
Hexanol
Hexanol
Ethyl butanol

n-Hexane
Hydrogen peroxide



To Find**Look Up**

High temperature coal tar
Hight solvent naphtha
Hioxyl

Coal tar
Coal tar naphtha solvent
Hydrogen peroxide

H₃N
Homopiperidine
Hoof oil
Household ammonia
Hydracrylic acid, beta-lactone

Ammonia, anhydrous
Hexamethyleneimine
Neatsfoot oil
Ammonia solutions
beta-Propiolactone

Hydracrylonitrile
Hydrochloric ether
Hydrocyanic ether
Hydrogencarboxylic acid
Hydrogen chloride

Ethylene cyanohydrin
Ethyl chloride
Propionitrile
Formic acid
Hydrochloric acid

Hydrogen dioxide
Hydrogen nitrate
Hydrogen nitrate
Hydroperoxide
2-Hydroxyethylamine

Hydrogen peroxide
Nitric acid (56 to 68%)
Nitric acid (95%)
Hydrogen peroxide
Ethanolamine

beta-Hydroxyethylamine
Hydroxybenzene
1-Hydroxybutane
2-Hydroxybutane
1-Hydroxy-2-cyanoethane

Ethanolamine
Phenol
n-Butyl alcohol
sec-Butyl alcohol
Ethylene cyanohydrin

Hydroxycyclohexane
bis[2-(2-Hydroxyethoxy)-
ethyl]ether
beta-Hydroxyethyl acrylate
bis(Hydroxyethyl)amine

Cyclohexanol
Tetraethylene glycol
2-Hydroxyethyl acrylate
Diethanolamine

bis(2-Hydroxyethyl)amine
bis(2-Hydroxyethyl)ether
Hydroxyethylethylenediamine
N-B-Hydroxyethylethylene-
diamine

Diethanolamine
Diethylene glycol
Aminoethylethanolamine
Aminoethylethanolamine



To Find	Look Up
N-Hydroxyethyl-1,2-ethylenediamine	Aminoethylethanolamine
2-Hydroxyethyl 2-propenoate	2-Hydroxyethyl acrylate
1-Hydroxyhexane	Hexanol
alpha-Hydroxyisobutronitrile	Acetone cyanohydrin
alpha-Hydroxyisobutyronitrile	Acetone cyanohydrin
Hydroxymethyl benzene	Cresols
2-Hydroxymethylfuran-	Furfuryl alcohol
4-Hydroxy-4-methyl-2-pentone	Diacetone alcohol
4-Hydroxy-4-methyl pentanone-2	Diacetone alcohol
1-Hydroxymethylpropane	iso-Butyl alcohol
2-Hydroxy-2-methylpropanenitrile	Acetone cyanohydrin
2-Hydroxynitrobenzene	o-Nitrophenol
3-Hydroxypropanenitrile	Ethylene cyanohydrin
3-Hydroxypropionitrile	Ethylene cyanohydrin
beta-Hydroxypropionitrile	Ethylene cyanohydrin
2-Hydroxypropylamine	iso-Propanolamine
3-Hydroxypropylamine	Propanolamine
Hydroxytoluene	Cresols
alpha-Hydroxytoluene	Benzyl alcohol
2-Hydroxytriethylamine	Diethylethanolamine
Hypochlorite, solutions	Sodium hypochlorite solution

I

IBA	iso-Butyl alcohol
Illuminating oil	Kerosene
2,2'-Iminobisethanol	Diethanolamine
2,2'-Iminodiethanol	Diethanolamine
1,1'-Iminodi-2-propanol	Diisopropanolamine
Impure camphor	Camphor oil
Inedible tallow	Tallow
IPA	iso-Propyl alcohol
iso-	Omit prefix and look up compound



To Find

Isoacetophenone
Isoamyl acetate
Isoamyl ethanoate
Isoamyl hydride
1,3-Isobenzofuandione

Isobutanal
Isobutanol
Isobutenyl methyl ketone
Isobutyl acetate
Isobutyl acrylate

Isobutyl alcohol
Isobutylaldehyde
Isobutylamine
mono-Isobutylamine
Isobutyl methyl carbinol

Isobutyl methyl ketone
Isobutyl methyl methanol
Isobutyl-2-propenoate
Isobutyraldehyde
Isobutyric aldehyde

Isodecaldehyde, mixed isomers
Isodecyl acrylate
Isodecyl propenoate
Isonitropropane
Isooctanol

Isooctyl alcohol
Isopentane
Isopentyl acetate
Isopropanol
Isopropanolamine

Isopropene cyanide
Isopropenylbenzene
2-Isopropoxypropane
Isopropyl acetate
Isopropylacetone

Look Up

Isophorone
iso-Amyl acetate
iso-Amyl acetate
iso-Pentane
Phthalic anhydride

iso-Butyraldehyde
iso-Butyl alcohol
Mesityl oxide
iso-Butyl acetate
iso-Butyl acrylate

iso-Butyl alcohol
iso-Butyraldehyde
iso-Butylamine
iso-Butylamine
Methylamyl alcohol

Methyl isobutyl ketone
Methylamyl alcohol
iso-Butyl acrylate
iso-Butyraldehyde
iso-Butyraldehyde

iso-Decaldehyde
iso-Decyl acrylate
iso-Decyl acrylate
2-Nitropropane
iso-Octyl alcohol

iso-Octyl alcohol
iso-Pentane
iso-Amyl acetate
iso-Propyl alcohol
iso-Propanolamine

Methacrylonitrile
alpha-Methylstyrene
iso-Propyl ether
iso-Propyl acetate
Methyl isobutyl ketone



To Find	Look Up
Isopropyl alcohol	iso-Propyl alcohol
Isopropylamine	iso-Propylamine
Isopropyl benzene	Cumene
Isopropylcarbinol	iso-Butyl alcohol
Isopropyl ester of acetic acid	iso-Propyl acetate
Isopropyl ether	iso-Propyl ether
Isopropylideneacetone	Mesityl oxide
4-Isopropyl-1-methyl benzene	p-Cymene
Isopropyltoluene	p-Cymene
4-Isopropyl toluene	p-Cymene
p-Isopropyltoluene	p-Cymene
Isotridecanol	Tridecanol
Isotridecyl alcohol	Tridecanol
Isotron	Freon
Isovaleral	iso-Valeraldehyde
Isovaleraldehyde	iso-Valeraldehyde
Isovaleric aldehyde	iso-Valeraldehyde
Isovalerone	Diisobutyl ketone
J	
Javelle water	Sodium hypochlorite solution
Judean pitch	Asphalt
K	
Katchung oil	Peanut oil
Kerosine	Kerosene
Ketohexamethylene	Cyclohexanone
2-Ketohexamethylenimine	Caprolactam solution
Ketone propane	Acetone
beta-keto-Propane	Acetone
L	
Laurylbenzene	Dodecylbenzene
Lead tetraethyl	Motor fuel anti-knock compounds



To Find**Look Up**

Lead tetramethyl

Motor fuel anti-knock compounds

LH2

Hydrogen (liquefied)

Light camphor oil

Camphor oil

Light naphtha

Naphtha: VM & P

Light oil

Benzene, Toluene, Xylene mixtures

Ligroin (in U.S.A.)

Mineral spirits, or naphthas

Liquid ammonia

Ammonia, anhydrous

Liquid bleach

Sodium hypochlorite solution

Liquid camphor

Camphor oil

Liquid hydrogen

Hydrogen (liquefied)

Liquid oxygen

Oxygen (liquefied)

Liquid pitch oil

Creosote, coal tar

Liquid rosin

Tall oil

LNG

Liquefied natural gas

LOX

Oxygen (liquefied)

LPG

Liquefied petroleum gas

Lye

Caustic potash solution or
Caustic soda solution

M

MAAc

Methyl amyl acetate

MAN

Methacrylonitrile

MAOH

Methylamyl alcohol

MAPP Gas

Methyl acetylene-Propadiene mixture

Marsh gas

Methane

MCA

Chloroacetic acid

MCB

Chlorobenzene

MDI

Diphenylmethane diisocyanate

MEA, 70%

Ethylamine solution

MEK

Methyl ethyl ketone



To Find	Look Up
MEP	2-Methyl-5-ethylpyridine
Metaphosphoric acid	Phosphoric acid
Metaxylene	m-Xylene
Methacetic acid	Propionic acid
Methacide	Toluene
Methacrylate monomer	Methyl methacrylate
alpha-Methacrylic acid	Methacrylic acid
Methacrylic acid, butyl ester	Butyl methacrylate
Methacrylic acid, ethyl ester	Ethyl methacrylate
Methacrylic acid, methyl ester	Methyl methacrylate
Methanal solution	Formaldehyde solutions
Methanamine, N-methyl-	Dimethylamine
Methanamine, N-methyl-	Dimethylamine solution, 40%
Methanamine, N-methyl-	Dimethylamine solution, 50%
Methane, bromo-	Methyl bromide
Methane carboxylic acid	Acetic acid
Methane, chloro-	Methyl chloride
Methane, dichlorodifluoro-	Dichlorodifluoromethane
Methane, refrigerated liquid or Natural gas, refrigerated liquid	Liquefied natural gas
Methane, tetrachloro-	Carbon tetrachloride
Methane, trichloro	Chloroform
Methanoic acid	Formic acid
Methanol	Methyl alcohol
Methenyl trichloride	Chloroform
2-Methoxyethanol	Ethylene glycol methyl ether
2-(2-Methoxyethoxy)ethanol	Diethylene glycol methyl ether
2-[2-(2-Methoxyethoxy)-ethoxy]ethanol	Methoxy triglycol
Methyl acetaldehyde	Propionaldehyde
Methylacetic acid	Propionic acid



To Find

Methylacetic anhydride

Methyl acetylene-allene mixture

beta-Methylacrolein

2-Methylacrylic acid

2-Methyl acetonitrile

Methylbenzene

Methylbenzol

alpha-Methylbiviny

cis-Pentadiene-1,3

trans-Pentadiene-1,3

beta-Methylbiviny

1-Methylbutadiene

2-Methyl-1,3-butadiene

3-Methyl-1,3-butadiene

3-Methylbutanal

2-Methylbutane

3-Methyl-1-butanol acetate

Methyl iso-butenyl ketone

Methyl iso-butyl carbinol acetate

Methyl iso-butyl carbonyl acetate

2-Methylbutyl ethanoate

3-Methyl butyraldehyde

Methyl carbinol

Methyl Carbitol

Methyl Cellosolve

Methyl chloroform

Methyl cyanide

Methylene bichloride

Methylene bis(4-phenyl
isocyanate)

Look Up

Propionic anhydride

Methyl acetylene-Propadiene
mixture

Crotonaldehyde

Methacrylic acid

Acetone cyanohydrin

Toluene

Toluene

1,3-Pentadiene

1,3-Pentadiene

1,3-Pentadiene

Isoprene

1,3-Pentadiene

Isoprene

Isoprene

iso-Valeraldehyde

iso-Pentane

iso-Amyl acetate

Mesityl oxide

Methyl amyl acetate

Methyl amyl acetate

iso-Amyl acetate

iso-Valeraldehyde

Ethyl alcohol

Diethylene glycol methyl
ether

Ethylene glycol methyl
ether

1,1,1-Trichloroethane

Acetonitrile

Dichloromethane

Diphenylmethane
diisocyanate



To Find**Look Up**

Methylene bis-phenylisocyanate

Methylene chloride

Methylene dichloride

Methylene oxide

Methylethene

Methylethyl aniline

(1-Methylethyl)benzene

Methyl ethyl carbinol

Methylethylene

Methylethylmethane

N-(1-Methylethyl)-2-propanamine

6-Methyl-1-heptanol

Methyl hydride

Methyl hydroxide

Methylisoamyl acetate

Methyl isobutenyl ketone

Methyl iso-butyl carbinol

Methylisopropylbenzene

1-Methyl-4-isopropylbenzene

Methyl methacrylate monomer,
inh.

N-Methylmethanamine

N-Methyl methanamine, 40%

N-Methyl methanamine, 50%

Methylmethane

Methyl methanoate

Methyl alpha-methacrylate

Methyl-2-methyl propenoate

2-Methyl nitrobenzene

Methyloxirane

Methyl oxitol

Diphenylmethane
diisocyanate

Dichloromethane

Dichloromethane

Formaldehyde solutions

Propylene

2-Methyl-6-ethylaniline

Cumene

sec-Butyl alcohol

Propylene

n-Butane

Diisopropylamine

iso-Octyl alcohol

Methane

Methyl alcohol

Methyl amyl acetate

Mesityl oxide

Methylamyl alcohol

p-Cymene

p-Cymene

Methyl methacrylate

Dimethylamine

Dimethylamine solution,
40%

Dimethylamine solution,
50%

Ethane

Methyl formate

Methyl methacrylate

Methyl methacrylate

o-Nitrotoluene

Propylene oxide

Ethylene glycol methyl
ether



To Find	Look Up
2-Methyl pentane	iso-Hexane
2-Methyl-2,4-pentanediol	Hexylene glycol
4-Methyl-2-pentanol	Methylamyl alcohol
4-Methyl-2-pentanol acetate	Methyl amyl acetate
4-Methyl-2-pentanone	Methyl isobutyl ketone
4-Methyl-3-penten-2-one	Mesityl oxide
4-Methyl-2-pentyl acetate	Methyl amyl acetate
2-Methyl-2-pentanol-4-one	Diacetone alcohol
Methylphenol (2-, 3- or 4-)	Cresols
1-Methyl-1-phenylethylene	alpha-Methylstyrene
2-Methylpropanal	iso-Butyraldehyde
2-Methyl-2-propanamine	tert-Butylamine
2-Methyl-1-propanol	iso-Butyl alcohol
2-Methyl-2-propanol	tert-Butyl alcohol
2-Methylpropenic acid	Methacrylic acid
Methyl propenoate	Methyl acrylate
Methyl 2-propenoate	Methyl acrylate
2-Methylpropenoic acid	Methacrylic acid
2-Methylpropenoic acid	Methyl methacrylate
1-Methylpropylacetate	sec-Butyl acetate
2-Methylpropyl acetate	iso-Butyl acetate
2-Methyl-1-propyl acetate	iso-Butyl acetate
2-Methyl-1-propyl acrylate	iso-Butyl acrylate
1-Methyl propylamine	sec-Butylamine
2-Methylpropylamine	iso-Butylamine
N-(2-Methyl propyl)amine	Diisobutylamine
N,N-bis(2-Methylpropyl)amine	Diisobutylamine
Methyl propyl benzene	p-Cymene
beta-Methylpropyl ethanoate	iso-Butyl acetate
Methylstyrene	Vinyltoluene
para-Methylstyrene	Vinyltoluene
Methyltrimethylene glycol	1,3-Butylene glycol
MIBC	Methylamyl alcohol
MIBK	Methyl isobutyl ketone



To Find**Look Up****MIC****MIK****Mineral oil****Mineral pitch****Mineral spirits****MIPA****Mixed octyl nitrates****Monobromomethane****Mono-n-butylamine****Monochloroacetic acid****Monochlorobenzene****Monochlorodifluoromethane****Monochloroethane****Monochloroethene****Monochloroethylene****Monoethanolamine****Monoethylamine****Monoethylamine solution, 70%****Monoethylene glycol****Monohydroxybenzene****Monoisopropanolamine****Monoisopropylamine****Monomethyl amine****Mononitrobenzene****Monopropylamine****Morbicid****Motor spirit****MTBE****Muriatic acid****Muriatic ether****Myricycl cerotate****Naphtha****Naphtha****Methylamyl alcohol****Methyl isobutyl ketone****Crude oil****Asphalt****Naphtha: Stoddard solvent****iso-Propanolamine****2-Ethyl hexyl nitrate****Methyl bromide****n-Butylamine****Chloroacetic acid****Chlorobenzene****Chlorodifluoromethane****Ethyl chloride****Vinyl chloride****Vinyl chloride****Ethanolamine****Ethylamine****Ethylamine solution****Ethylene glycol****Phenol****iso-Propanolamine****iso-Propylamine****Methylamine solution****Nitrobenzene****Propylamine****Formaldehyde solutions****Gasoline, motor****Methyl tert-butyl ether****Hydrochloric acid****Ethyl chloride****Carnauba wax****N****Coal tar naphtha solvent****Mineral spirits**

To Find

Naphthaline
Naphtha, petroleum
Naphthene

Natural gas
NBA
Necatorina
Neolid
2,2',2''-Nitrilotriethanol

Nitrobenzol
o-Nitrochlorobenzene
2-Nitrophenol
2-Nitropropane
Nitropropanes

sec-Nitropropane
2-Nitrotoluene
o-Nitrotoluol
1-Nonane
n-Nonane

sec-Nonyl alcohol
Nonylcarbinol
1-Nonylene
Normal heptane
Normal hexane

Normal pentane
Norvalamine
2-NP

Octanol
Octanol
iso-Octanol
Octoil
Octyl acrylate

Octyl alcohol
Octyl nitrates

Look Up

Naphthalene
Naphtha: VM & P
Naphthalene

Methane
n-Butyl alcohol
Carbon tetrachloride
Caster oil
Triethanolamine

Nitrobenzene
o-Chloronitrobenzene
o-Nitrophenol
2-Nitropropane
2-Nitropropanes

2-Nitropropane
o-Nitrotoluene
o-Nitrotoluene
Nonane
Nonane

Diisobutyl carbinol
n-Decyl alcohol
1-Nonene
Heptane
n-Hexane

Pentane
n-Butylamine
2-Nitropropane

O

2-Ethyl hexanol
iso-Octyl alcohol
iso-Octyl alcohol
Diocetyl phthalate
2-Ethylhexyl acrylate

2-Ethyl hexanol
2-Ethyl hexyl nitrate



To Find

Oil of mirbane
Oil of Palma Christi
Oil of turpentine

Oil of vitriol
Olefiant gas
Olefin C-13
ONP
Orthodichlorobenzene

Orthonitrotoluene
Orthophosphoric acid
Orthoxylene
3-Oxa-1,5-pentanediol
2-Oxetanone

Oxirane
Oxirane, (chloromethyl)-
2-Oxohexamethylenimine
Oxoctyl alcohol
Oxotridecyl alcohol

Oxybenzene
1,1'-Oxybis[butane]
1,1'-Oxybis[2-chloroethane]
1,1'-Oxybisethane
2,2'-Oxybisethanol

2,2'Oxybis[propane]
2,2'-Oxydiethanol
1,1'-Oxydi-2-propanol
Oxytoluenes

Painters naphtha
PAN
PAPI

Paracetaldehyde

Paraffin

Look Up

Nitrobenzene
Caster oil
Turpentine

Sulfuric acid
Ethylene
1-Tridecene
o-Nitrophenol
o-Dichlorobenzene

o-Nitrotoluene
Phosphoric acid
o-Xylene
Diethylene glycol
beta-Propiolactone

Ethylene oxide
Epichlorohydrin
Caprolactam solution
iso-Octyl alcohol
Tridecanol

Phenol
n-Butyl ether
2,2'-Dichloroethyl ether
Ethyl ether
Diethylene glycol

iso-Propyl ether
Diethylene glycol
Dipropylene glycol
Cresols

P

Naphtha: VM & P
Phthalic anhydride
Polymethylene polyphenyl
isocyanate
Paraldehyde

Paraffin wax



To Find**Look Up**

Paraffin jelly
Paraffin scale
Paraxylene
Pear oil

Petrolatum
Paraffin wax
p-Xylene
iso-Amyl acetate

Pentanal
Pentanedial
1,5-Pentanedial
n-Pentane
1-Pentanol

n-Valeraldehyde
Glutaraldehyde solution
Glutaraldehyde solution
Pentane
n-Amyl alcohol

Pentalin
Pentyl alcohol
Pentylcarbinol
sec-Pentylcarbinol
Perchlorethylene

Pentachloroethane
n-Amyl alcohol
Hexanol
Ethyl butanol
Perchloroethylene

Perchloromethane
Peroxide
Petroleum oil
Petrohol
Petrol

Carbon tetrachloride
Hydrogen peroxide
Diesel oil
iso-Propyl alcohol
Gasoline, motor

Petrolatum jelly
Petroleum
Petroleum asphalt
Petroleum crude oil
Petroleum gases, liquefied

Petrolatum
Crude oil
Asphalt
Crude oil
Liquefied petroleum gas

Petroleum jelly
Petroleum pitch
Petroleum solvent
Petroleum solvent
Petroleum solvent

Petrolatum
Asphalt
Naphthas
Naphtha: Stoddard solvent
Naphtha: VM & P

Petroleum spirits
Petroleum wax
Phene
Phenic acid
Phenol, 2,4-dichloro-

Mineral spirits
Paraffin wax
Benzene
Phenol
2,4-Dichlorophenol



To Find	Look Up
Phenylamine	Aniline
Phenyl carbinol	Benzyl alcohol
Phenyl chloride	Chlorobenzene
1-Phenyldodecane	Dodecylbenzene
Phenylethane	Ethylbenzene
Phenyl ether-biphenyl mixture	Diphenyl-Diphenyl ether mixture
Phenylethylene	Styrene monomer
Phenyl hydride	Benzene
Phenyl hydroxide	Phenol
Phenylic acid	Phenol
Phenylmethane	Toluene
Phenyl methyl alcohol	Benzyl alcohol
2-Phenyl propane	Cumene
Phenylpropylene	alpha-Methylstyrene
meta-Phosphoric acid	Phosphoric acid
ortho-Phosphoric acid	Phosphoric acid
Phosphoric acid, tris(methyl-phenyl)ester	Tricresyl phosphate
Phthalandione	Phthalic anhydride
Phthalic acid anhydride	Phthalic anhydride
Phthalic acid, benzyl butyl ether	Butyl benzyl phthalate
Phthalic acid, bis(2-ethylhexyl)ester	Dioctyl phthalate
Pimelic ketone	Cyclohexanone
Piperylene	1,3-Pentadiene
Polybutylene	Polybutene
Polyisobutene	Polybutene
Polyisobutylene	Polybutene
Polyisobutylene; plastics, resins & waxes	Polybutene
Potassium hydroxide	Caustic potash solution
Potassium hydroxide solution	Caustic potash solution
Propadiene-methyl acetylene mixture	Methyl acetylene-Propadiene mixture



To Find**Look Up**

Propanal

Propionaldehyde

1-Propanamine

Propylamine

2-Propanamine

iso-Propylamine

1-Propanamine, 2-methyl-

Diisobutylamine

1-Propanamine, N-propyl-

Di-n-propylamine

Propanecarboxylic acid

n-Butyric acid

Propane-Butane mixtures

Liquefied petroleum gas

Propane, 1-chloro-2,3-epoxy

Epichlorohydrin

Propane, 1,2-dichloro-

1,2-Dichloropropane

Propanenitrile

Propionitrile

Propanenitrile, 2-hydroxy-2-methyl

Acetone cyanohydrin

Propane, nitro-

2-Nitropropane

Propane, 2,2'-oxybis[2-chloro

2,2'-Dichloroisopropyl ether

1,2,3-Propanetriol

Glycerine

Propanoic acid

Propionic acid

Propanoic acid anhydride

Propionic anhydride

Propanoic anhydride

Propionic anhydride

Propanol

n-Propyl alcohol

1-Propanol

n-Propyl alcohol

2-Propanol

iso-Propyl alcohol

3-Propanolamine

Propanolamine

1-Propanol, 3-amino-

Propanolamine

Propanolide

beta-Propiolactone

n-Propanol

n-Propyl alcohol

Propanone

Acetone

2-Propanone

Acetone

Propellant 12

Dichlorodifluoromethane

Propellant 22

Chlorodifluoromethane

Propenamide

Acrylamide solution

2-Propenamide

Acrylamide solution

Propene

Propylene

1-Propene, 1,3-dichloro-

1,3-Dichloropropene

Propenenitrile

Acrylonitrile



To Find	Look Up
2-Propenenitrile	Acrylonitrile
2-Propenenitrile, 2-methyl-	Methacrylonitrile
Propene oxide	Propylene oxide
2-Propenic acid	Acrylic acid
Propenoic acid, 2-methylene	Methacrylic acid
Propenoic acid	Acrylic acid
2-Propenoic acid	Acrylic acid
2-Propenoic acid, butyl ester	n-Butyl acrylate
2-Propenoic acid, ethyl ester	Ethyl acrylate
2-Propenoic acid methyl ester	Methyl acrylate
2-Propenoic acid, 2-methyl-, ethyl ester	Ethyl methacrylate
2-Propenoic acid, 2-methyl-, methyl ester	Methyl methacrylate
Propenol	Allyl alcohol
1-Propenol-3	Allyl alcohol
1-Propen-3-ol	Allyl alcohol
2-Propenol	Allyl alcohol
2-Propen-1-ol	Allyl alcohol
Propenyl alcohol	Allyl alcohol
Propionic aldehyde	Propionaldehyde
Propionic nitrile	Propionitrile
beta-Propionolactone	beta-Propiolactone
Propionyl oxide	Propionic anhydride
Propylacetate	n-Propyl acetate
2-Propyl acetate	iso-Propyl acetate
sec-Propyl acetate	iso-Propyl acetate
Propyl alcohol	n-Propyl alcohol
Propyl alcohol normal	n-Propyl alcohol
sec-Propyl alcohol	iso-Propyl alcohol
Propyl aldehyde	Propionaldehyde
n-Propylamine	Propylamine
mono-n-Propylamine	Propylamine
Propyl carbinol	n-Butyl alcohol



To Find

n-Propyl carbinol
Propylene aldehyde
Propylene chloride
Propylene dichloride
Propylene tetramer

Propylformic acid
Propyl hydride
Propylic alcohol
Propylic aldehyde
iso-Propylideneacetone

Propyne-allene mixture

Protium
Pseudohexyl alcohol
Pyroacetic ether

Pyrofax
Pyromucic aldehyde
Pyroxylic spirit
Pyrrolylene

Range oil
Red fuming nitric acid
Refined solvent naphtha
Refrigerant 12
Refrigerant 22

Refrigerant gases

Residual fuel oil no. 6
Resin oil

Retinol
Ricinus oil
Rock oil
Rosinol
Rubbing alcohol

Look Up

n-Butyl alcohol
Crotonaldehyde
1,2-Dichloropropane
1,2-Dichloropropane
Dodecene

n-Butyric acid
Propane
n-Propyl alcohol
Propionaldehyde
Mesityl oxide

Methyl acetylene-Propadiene
mixture
Hydrogen (liquefied)
Ethyl butanol
Acetone

Liquefied petroleum gas
Furfural
Methyl alcohol
Butadiene

R

Kerosene
Nitric acid (95%)
Naphtha: VM & P
Dichlorodifluoromethane
Chlorodifluoromethane

Freon, or
Chlorodifluoromethane, or
Dichlorodifluoromethane
Bunker C
Rosin oil

Rosin oil
Caster oil
Crude oil
Rosin oil
iso-Propyl alcohol



To Find**Look Up****S**

Santicizer 160
SBA
Secondary light oil

Seneca oil

Soda chloric acid, sodium salt
Soda lye
Sodium bichromate
Sodium bichromate solution
Sodium bisulfide

Sodium hydrogen sulfide

Sodium hydroxide
Sodium hydroxide solution
Sodium hypochlorite

Sodium mercaptan

Sodium sulfhydrate

Solar nitrogen solution

Solvent ether
Solvent naphtha

Solvent naphtha
Sorbicolan
Sorbit
Sorbo
Sorbol

Sorbostyl
Soyabean oil
Soy oil
Spirit of Hartshorn

Butyl benzyl phthalate
sec-Butyl alcohol
Benzene, Toluene, Xylene
mixtures
Crude oil

Sodium chlorate solution
Caustic soda solution
Sodium dichromate solution
Sodium dichromate solution
Sodium hydrosulfide
solution

Sodium hydrosulfide
solution
Caustic soda solution
Caustic soda solution
Sodium hypochlorite
solution
Sodium hydrosulfide
solution

Sodium hydrosulfide
solution
Urea-Ammonium nitrate
solution
Ethyl ether
Naphthas

Naphtha: VM & P
Sorbitol
Sorbitol
Sorbitol
Sorbitol

Sorbitol
Soybean oil
Soybean oil
Ammonia solutions



To Find**Look Up**

Spirits of turpentine

Turpentine

Spotting solvent

Naphtha: Stoddard solvent

Steam distilled turpentine

Turpentine

Stoddard solvent

Naphtha: Stoddard solvent

Styrene

Styrene monomer

Styrol

Styrene monomer

Styrolene

Styrene monomer

Sulfate turpentine

Turpentine

Sulfate wood turpentine

Turpentine

Sulfur

Sulfur, molten

Sulfur dioxide, liquefied

Sulfur dioxide

Sulfuric acid, diethyl ester

Diethyl sulfate

Sulfuric acid, fuming

Oleum

Sulfuric chlorohydrin

Chlorosulfonic acid

Sulfuric ether

Ethyl ether

Sulfurous anhydride

Sulfur dioxide

Sulfurous oxide

Sulfur dioxide

Sulphur

Sulfur, molten

Superoxol

Hydrogen peroxide

Sweet oil

Olive oil

T

Talleol

Tall oil

Tallol

Tall oil

Tallow oil

Tallow

Tangantangan oil

Caster oil

Tar

Coal tar

Tar acids

Cresols

Tar camphor

Naphthalene

Tar, liquid

Coal tar

Tar oil

Creosote, coal tar

Tars liquid

Asphalt

TBA

tert-Butyl alcohol

beta-T

1,1,2-Trichloroethane

1,1,1-TCE

1,1,1-Trichloroethane



To Find	Look Up
1,1,2-TCE	1,1,2-Trichloroethane
TCP	Tricresyl phosphate
TDI	Toluene diisocyanate
TEA	Triethanolamine
TEG	Tetraethylene glycol
TEG	Triethylene glycol
TEL	Motor fuel anti-knock compounds
Telone	1,3-Dichloropropene
TEN	Triethylamine
TETA	Triethylenetetramine
Tetrachlorethene	Perchloroethylene
Tetrachlorethylene	Perchloroethylene
Tetrachloroethane	1,1,2,2-Tetrachloroethane
sym-Tetrachloroethane	1,1,2,2-Tetrachloroethane
Tetrachloroethylene	Perchloroethylene
Tetrachloromethane	Carbon tetrachloride
Tetraethyl lead compounds	Motor fuel anti-knock compounds
Tetrahydro-4,7-methanoindene	Dicyclopentadiene
1,2,3,4-Tetrahydronaphthalene	Tetrahydronaphthalene
Tetrahydro-1,4-oxazine	Morpholine
Tetrahydro-2H-1,4-oxazine	Morpholine
Tetrahydro-p-oxazine	Morpholine
Tetralin	Tetrahydronaphthalene
Tetraline	Tetrahydronaphthalene
Tetramethylene cyanide	Adiponitrile
Tetramethylene oxide	Tetrahydrofuran
Tetramethyl lead compounds	Motor fuel anti-knock compounds
Tetramp	Tetrahydronaphthalene
Tetranap	Tetrahydronaphthalene
Tetrapropylene	Dodecene
THF	Tetrahydrofuran



To Find**Look Up**

TML

Motor fuel anti-knock
compounds

TOCP

Tricresyl phosphate

2,4-Tolamine

Toluenediamine

2,4-Toluenediamine

Toluenediamine

4-m-Toluenediamine

Toluenediamine

m-Toluenediamine

Toluenediamine

2,4-Toluene diisocyanate

Toluene diisocyanate

Toluene-2,4-diisocyanate

Toluene diisocyanate

Toluene, orthonitro-

o-Nitrotoluene

2,4-Tolulene diisocyanate

Toluene diisocyanate

Toluol (o-, m-, p-)

Cresols

Toluol

Toluene

Tolyethylene

Vinyltoluene

Tolylenediamine

Toluenediamine

2,4-Tolylenediamine

Toluenediamine

m-Tolylenediamine

Toluenediamine

2,4-Tolylene diisocyanate

Toluene diisocyanate

m-Tolylene diisocyanate

Toluene diisocyanate

Tolylphosphate

Tricresyl phosphate

Treacle

Molasses

Tri

Trichloroethylene

Trichlorobenzenes, liquid

1,2,4-Trichlorobenzene

unsym-Trichlorobenzene

1,2,4-Trichlorobenzene

1,2,4-Trichlorobenzol

1,2,4-Trichlorobenzene

Trichloroethene

Trichloroethylene

Trichlorohydrin

1,2,3-Trichloropropane

Trichloromethane

Chloroform

Trichloropropane

1,2,3-Trichloropropane

beta-Trichlorethane

1,1,2-Trichloroethane

Tricresol

Cresols

1-Tridecanol

Tridecanol

Tridecyl alcohol

Tridecanol

Trien

Triethylenetetramine



To Find	Look Up
1,3,5-Triethylbenzene	Triethylbenzene
sym-Triethylbenzene	Triethylbenzene
Triethylene glycol ethyl ether	Ethoxy triglycol
Triethylene glycol methyl ether	Methoxy triglycol
Triethylamine	Triethanolamine
Triglycol	Triethylene glycol
Triglycol ethyl ether	Ethoxy triglycol
Triglycol monoethyl ether	Ethoxy triglycol
Tri(hydroxyethyl)amine	Triethanolamine
Tri(2-hydroxyethyl)amine	Triethanolamine
Trihydroxypropane	Glycerine
1,2,3-Trihydroxypropane	Glycerine
Trihydroxytriethylamine	Triethanolamine
Trimethylaminomethane	tert-Butylamine
Trimethyl carbinol	tert-Butyl alcohol
3,5,5-Trimethyl-2-cyclohexene-1-one	Isophorone
Trimethylheptanols	iso-Decaldehyde
2,4,4-Trimethyl pentene-1	Diisobutylene
2,4,4-Trimethyl pentene-2	Diisobutylene
Trimethyl pentene	Diisobutylene
Trimethyltrimethylene glycol	Hexylene glycol
alpha, alpha, alpha'-Trimethyl-trimethylene glycol	Hexylene glycol
2,4,6-Trimethyl-1,3,5-trioxane	Paraldehyde
Tri-o-cresyl phosphate	Tricresyl phosphate
Tri-o-tolyl phosphate	Tricresyl phosphate
1,3,5-Trioxane, 2,4,6-trimethyl-	Paraldehyde
3,6,9-Trioxaundecanol, 11-diol	Tetraethylene glycol
Tris(hydroxyethyl)amine	Triethanolamine
Tritolyl phosphate	Tricresyl phosphate
Trolamine	Triethanolamine
Turkey-red oil (sulfated castor oil)	Castor oil
Turpentine substitute	Mineral spirits



To Find	Look Up
Turps	Turpentine
U	
UAN-Nitrogen solution	Urea-Ammonium nitrate solution
UAN solution	Urea-Ammonium nitrate solution
Ucon	Freon
Ucon 12	Dichlorodifluoromethane
Undecylethylene	1-Tridecene
V	
Valeral	n-Valeraldehyde
Valeraldehyde	Valeraldehyde, iso- or n-isomers
Valeric aldehyde	n-Valeraldehyde
Valerone	Diisobutyl ketone
VAM	Vinyl acetate
Varnish makers' & painters' naphtha	Naphtha: VM & P
Vaseline	Petrolatum
VC	Vinyl chloride
VCL	Vinyl chloride
VCM	Vinyl chloride
Vinamar	Vinyl ethyl ether
Vinegar acid	Acetic acid
Vinegar naphtha	Ethyl acetate
Vinyl acetate monomer	Vinyl acetate
Vinyl A monomer	Vinyl acetate
Vinylbenzene	Styrene monomer
Vinyl carbinol	Allyl alcohol
Vinyl chloride monomer	Vinyl chloride
Vinyl C monomer	Vinyl chloride
Vinyl cyanide	Acrylonitrile
Vinyl ethylene	Butadiene



To Find	Look Up
Vinyl trichloride	1,1,2-Trichloroethane
Vinyl formic acid	Acrylic acid
Vy Ac	Vinyl acetate
W	
Wash oil	Creosote, coal tar
Whale sperm oil	Sperm oil
White camphor oil	Camphor oil
White fuming nitric acid	Nitric acid (95%)
White phosphoric acid	Phosphoric acid
White phosphorus	-Phosphorus (white)
White spirits	Naphtha: Stoddard solvent
White tar	Naphthalene
Wood alcohol	Methyl alcohol
Wood spirit	Methyl alcohol
Wood turpentine	Turpentine
WP	Phosphorus (white)
X	
meta-Xylene	m-Xylene
ortho-Xylene	o-Xylene
para-Xylene	p-Xylene
Xylol	Xylene
Y	
Yellow petrolatum	Petrolatum
Yellow phosphorus	Phosphorus (white)
Z	
Zinc dihexyldithiophosphate	Zinc dialkyldithiophosphate
Zinc dihexylphosphorodithioate	Zinc dialkyldithiophosphate



APPENDIXES

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APPENDIX A

COMPATIBILITY INFORMATION

In this seventh edition, chemical compatibility is covered by a general discussion and summary of 46 CFR 150 Subpart A followed by 46 CFR 150 in essentially its entirety. If necessary, current information may be obtained by calling 202-267-1577 or writing to Commandant (G-MTH-1), Washington, D.C. 20593-0001.

General Discussion.

a. Introduction—The accidental mixing of one chemical product with another inside a cargo tank or pipe may result in a vigorous chemical reaction. Binary combinations that generate significant heat or produce gas can be very hazardous to personnel and property. The purpose of the Compatibility Guide is to indicate, in chart form, combinations believed to be dangerous. Based on information provided by the National Academy of Sciences, the Guide represents the latest data available to the Coast Guard on chemical compatibility. Extensive use was made of direct experimental evidence obtained under contract to the NAS and Coast Guard.

b. Definition of a Hazardous Reaction—As a first approximation, a binary mixture is considered hazardous when the products are mixed under specified conditions and the temperature rise exceeds 25°C or a gas is evolved. In rare cases the reaction of two components (even though non-hazardous, from temperature or pressure considerations) may produce a product which is significantly more flammable or toxic than the original materials. Although no examples of such a reaction are known at this time, they would be considered hazardous.

c. Chart Format—In reviewing the binary test results and previous charts, it was evident that there were different degrees of reactivity among the various products. Many of them are relatively non-reactive (aromatic hydrocarbons, paraffins) while others form hazardous combinations with many groups (inorganic acids).

The compatibility chart (refer to Figure 1 in 46 CFR 150) is separated into two sections, group 1 through group 22 are Reactive groups, and group 30 through group 43 are Cargo groups. Left unassigned and available for future expansion are groups 23 through 29 and those past 43. Reactive groups contain products which are chemically the most reactive; dangerous combinations may result between members of different Reactive groups and between members of Reactive and Cargo



groups. Products assigned to Cargo groups, however, are much less reactive and dangerous combinations can be formed only with members of certain Reactive groups. Cargo groups do not react hazardously with one another. Because of these differences in reactivity, a significant part of the usual two-dimensional chart has been eliminated.

d. Using the Guide—The following procedure explains how the Guide should be used to find compatibility information:

(1) Determine the group numbers of the two chemicals by referring to the alphabetical listing of products and their corresponding groups (Table 1 of 46 CFR 150). Many chemicals are listed under their parent names and, unless otherwise indicated, isomers or mixtures of isomers for a particular product are assigned to the same group. For example, to find the group number for Isobutyl alcohol, look under the parent name Butyl alcohol. Similarly, the group number for para-Xylene is found under the entry Xylene. If a chemical cannot be found in this listing, contact the Coast Guard for a group determination.

(2) If both group numbers do not fall between 30 and 43 inclusive, locate on the chart one of the numbers on the left (Cargo groups) and the other across the top (Reactive groups). Note that if one of the group numbers is between 30 and 43 it must be located on the left side. Proceed across the page until the appropriate Reactive group column is intersected. The box formed by the intersection will indicate one of the following:

(a) **blank**—The two products are considered compatible.

(b) **"X"**—The two products are not considered compatible.

(c) **a letter other than an "X"**—Differences (deviations) in reactivity are present among the group members—refer to the listing following the chart to find whether the products in question are included in the deviations. Unless the combination is specifically covered on this page, it may be considered compatible.

Examples:

Combination	Groups	Compatible?
Butyraldehyde/Acetic acid	19/4	yes
Allyl alcohol/Toluene diisocyanate	^a 15/12	no
Decene/Ethylbenzene	30/32	yes
Ethanolamine/Acetone	8/18	yes
Ammonia/Dimethylformamide	6/10	no



e. Exceptions to the Guide—The hazard ratings in the chart are based largely upon direct experimental data using in most cases one of the most reactive members of the group. Combinations of other group members may display considerably less reactivity. For this reason, an experimental procedure (refer to Appendix III, 46 CFR 150) has been developed which allows a shipper to test two particular products he believes non-hazardous although an "X" appears in the chart for their corresponding groups. A data sheet is also supplied and should be completed and returned to the Coast Guard for evaluation. If the combination is not found to be dangerously reactive, an exception will be issued.

46 CFR PART 150—COMPATIBILITY OF CARGOES

Subpart A—Compatibility of Cargoes

Sec.

150.105 OMB control numbers assigned pursuant to the Paperwork Reduction Act.

150.110 Applicability.

150.115 Definitions.

150.120 Definition of incompatible cargoes.

150.130 Loading a cargo on vessels carrying cargoes with which it is incompatible.

150.140 Cargoes not listed in Table I or II.

150.150 Exceptions to the compatibility chart.

150.160 Carrying a cargo as an exception to the compatibility chart.

150.170 Right of appeal.

FIGURE I—COMPATIBILITY CHART

TABLE I—ALPHABETICAL LIST OF CARGOES

TABLE II—GROUPING OF CARGOES

APPENDIX I—EXCEPTIONS TO THE CHART

APPENDIX II—EXPLANATION OF FIGURE 1

APPENDIX III—TESTING PROCEDURES FOR DETERMINING EXCEPTIONS TO THE CHART

APPENDIX IV—DATA SHEET

Subpart A—Compatibility of Cargoes

§150.105 OMB control numbers assigned pursuant to the Paperwork Reduction Act.

(a) *Purpose.* This section collects and displays the control numbers assigned to information collection and recordkeeping requirements in this subchapter by the Office of Management and Budget (OMB) pursuant to the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.).



The Coast Guard intends that this section comply with the requirements of 44 U.S.C. 3507(f) which requires that agencies display a current control number assigned by the Director of the OMB for each approved agency information collection requirement.

(b) *Display.*

46 CFR part or section where identified or described	Current OMB control No.
150.01-15	2115-0016
153.5	2115-0016
153.905	2115-0089
153.910	2115-0089
153.968	2115-0089
Part 154	2115-0113
154.12	2115-0016

§150.110 Applicability.

This subpart prescribes rules for identifying incompatible hazardous materials and rules for carrying these materials in bulk as cargo in permanently attached tanks or in tanks that are loaded or discharged while aboard the vessel. The rules apply to all vessels subject to 46 U.S.C. 391a.

§150.115 Definitions.

As used in this subpart: "Hazardous material" means:

(a) A flammable liquid as defined in § 30.10-22 or a combustible liquid as defined in § 30.10-15 of this chapter;

(b) A material listed in Table 151.05, Table 1 of Part 153, or Table 4 of Part 154 of this chapter; or

(c) A liquid, liquefied gas, or compressed gas listed in 49 CFR 172.101.

"Person in charge" means the master of a self-propelled vessel, or the person in charge of a barge.

§150.120 Definition of incompatible cargoes.

Except as described in § 150.150, a cargo of hazardous material is incompatible with another cargo listed in Table I if the chemical groups of the two cargoes have an "X" where their columns intersect in



Figure 1 and are not shown as exceptions in Appendix I. (See also § 150.140.)

§150.130 Loading a cargo on vessels carrying cargoes with which it is incompatible.

Except as described in § 150.160, the person in charge of a vessel shall ensure that the containment system for a cargo that is a hazardous material meets the following requirements:

(a) The containment system must separate the hazardous material or its residue from any cargo in table I with which it is incompatible by two barriers such as formed by a:

- (1) Cofferdam;
- (2) Empty tank;
- (3) Void space;
- (4) Cargo handling space;
- (5) Tank containing a compatible cargo; or
- (6) Piping tunnel.

(b) In this subpart, isolation across a cruciform joint is equivalent to isolation by two barriers.

(c) The containment system for the hazardous material must not have a piping or venting system that connects to a containment system carrying a cargo with which the hazardous material is incompatible. Any such piping or venting system must have been separated from the containment system carrying the incompatible cargo by:

(1) Removing a valve or spool piece and blanking off the exposed pipe ends, or

(2) Installing two spectacle flanges in series with a means of detecting leakage into the pipe between the spectacle flanges.

§150.140 Cargoes not listed in Table I or II.

A cargo of hazardous material not listed in Table I or II must be handled as if incompatible with all other cargoes until the Commandant (G-MTH) (tel. no. (202) 267-1577) assigns the hazardous material to a compatibility group. (Table I lists cargoes alphabetically while Table II lists cargoes by compatibility group).



§150.150 Exceptions to the compatibility chart.

The Commandant (G-MTH) authorizes, on a case by case basis, exceptions to the rules in this subpart under the following conditions:

(a) When two cargoes shown to be incompatible in Figure 1 meet the standards for a compatible pair in Appendix III, or

(b) When two cargoes shown to be compatible in Figure 1 meet the standards for an incompatible pair in Appendix III.

Appendix I contains cargoes which have been found to be exceptions to Figure 1, the Compatibility Chart.

§150.160 Carrying a cargo as an exception to the compatibility chart.

The Operator of a vessel having on board a cargo carried as an exception under §150.150 but not listed in Appendix I, Exceptions to the Chart, shall make sure that:

(a) The Commandant (G-MTH) has authorized by letter or message the cargo pair as an exception to the compatibility chart; and

(b) A copy of the letter or message is on the vessel.

§150.170 Right of appeal.

Any person directly affected by a decision or action taken under this part, by or on behalf of the Coast Guard, may appeal therefrom in accordance with subpart 1.03 of this chapter.



Figure 1—Compatibility Chart

CARGO GROUPS																					
REACTIVE GROUPS																					
1. NON-OXIDIZING MINERAL ACIDS	2. SULFURIC ACID	3. NITRIC ACID	4. ORGANIC ACIDS	5. CAUSTICS	6. AMMONIA	7. ALIPHATIC AMINES	8. ALKANOLAMINES	9. AROMATIC AMINES	10. AMIDES	11. ORGANIC ANHYDRIDES	12. ISOCYANATES	13. VINYL ACETATE	14. ACRYLATES	15. SUBSTITUTED ALLYLS	16. ALKYLENE OXIDES	17. EPICHLOROHYDRIN	18. KETONES	19. ALDEHYDES	20. ALCOHOLS, GLYCOLS	21. PHENOLS, CRESOLS	22. CAPROLACTAM SOLUTION
1. NON-OXIDIZING MINERAL ACIDS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2. SULFURIC ACID		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3. NITRIC ACID			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4. ORGANIC ACIDS				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5. CAUSTICS					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6. AMMONIA						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7. ALIPHATIC AMINES							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8. ALKANOLAMINES								X	X	X	X	X	X	X	X	X	X	X	X	X	X
9. AROMATIC AMINES									X	X	X	X	X	X	X	X	X	X	X	X	X
10. AMIDES										X	X	X	X	X	X	X	X	X	X	X	X
11. ORGANIC ANHYDRIDES											X	X	X	X	X	X	X	X	X	X	X
12. ISOCYANATES												X	X	X	X	X	X	X	X	X	X
13. VINYL ACETATE													X	X	X	X	X	X	X	X	X
14. ACRYLATES														X	X	X	X	X	X	X	X
15. SUBSTITUTED ALLYLS															X	X	X	X	X	X	X
16. ALKYLENE OXIDES																X	X	X	X	X	X
17. EPICHLOROHYDRIN																	X	X	X	X	X
18. KETONES																		X	X	X	X
19. ALDEHYDES																			X	X	X
20. ALCOHOLS, GLYCOLS																				X	X
21. PHENOLS, CRESOLS																					X
22. CAPROLACTAM SOLUTION																					
23. OLEFINS																					
24. PARAFFINS																					
25. AROMATIC HYDROCARBON MIXTURES																					
26. ALIPHATIC HYDROCARBON MIXTURES																					
27. ETHERS																					
28. VINYL HALIDES																					
29. HALOGENATED HYDROCARBONS																					
30. CARBON DIBLENDE																					
31. NITRILES																					
32. SULFONATE																					
33. GLYCOL ETHERS																					
34. ETHERS																					
35. NITROCOMPOUNDS																					
36. ISOCYANATES																					
37. VINYL ETHERS																					
38. ISOCYANATES																					
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BILLING CODE 4910-14-C

X: Incompatible Groups

Table I—Alphabetical List of Cargoes

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Acetaldehyde.....	19	AAD	
Acetic acid.....	² 4	AAC	
Acetic anhydride.....	11	ACA	
Acetone.....	² 18	ACT	
Acetone cyanohydrin.....	¹ , ² 0	ACY	
Acetonitrile.....	37	ATN	
Acetophenone.....	18	ACP	
Acetyl tributyl citrate.....	34		
Acrolein.....	² 19	ARL	
Acrylamide solution.....	10	AAM	
Acrylic acid.....	² 4	ACR	
Acrylonitrile.....	² 15	ACN	
Acrylonitrile-Styrene copolymer dispersion in Polyether polyol	20	ALE	
Adiponitrile.....	37	ADN	
Alcohols (C13 and above).....	20	ALY	TDN/TTN/PDC
Alcoholic beverages.....	20		
Alcohol polyethoxylates.....	20		APK/APL
Alcohol polyethoxylates, secondary.....	20		AEA/AEB
Alkyl acrylate-Vinyl pyridine copolymer in Toluene.....	32	AAP	
Alkyl(C9 - C17) benzenes.....	32	AKB	DBZ/UDB/DDB/TRB/TDB
Alkylbenzenesulfonic acid.....	¹ , ² 0	ABS	
Alkylbenzenesulfonic acid, sodium salt solutions.....	33	ABT	
Alkyl phthalates.....	34		
Allyl alcohol.....	² 15	ALA	
Allyl chloride.....	15	ALC	
Aluminium chloride, Hydrochloric acid solution.....	0	AHS	
Aluminum sulfate solution.....	² 43	ASX	ALM
2-(2-Aminoethoxy)ethanol.....	8	AEX	
Aminoethyldiethanolamine, Aminoethylethanolamine solution.....	8		
Aminoethylethanolamine.....	8	AEE	
N-Aminoethylpiperazine.....	7	AEP	
2-Amino-2-hydroxymethyl-1,3- propanediol solution.....	43	AHL	
2-Amino-2-methyl-1-propanol.....	8	APR	
Ammonia, anhydrous.....	6	AMA	
Ammonium bisulfite solution.....	² 43	ABX	ASU
Ammonium hydrogen phosphate solution.....	0		
Ammonium hydroxide (28% or less Ammonia).....	6	AMH	



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Ammonium nitrate solution.....	10	ANR	AMN
Ammonium nitrate, Urea solution (containing Ammonia).....	6	UAS	
Ammonium nitrate, Urea solution (not containing Ammonia).....	43	ANU	
Ammonium polyphosphate solution	43		ANS/APP
Ammonium sulfate solution.....	43	AME	AMS
Ammonium sulfide solution	5	ASS	ASF
Ammonium thiocyanate, Ammonium thiosulfate solution ..	0	ACS	
Ammonium thiosulfate solution	43	ATV	ATF
Amyl acetate.....	34	AEC	IAT/AML/AAS/AYA
Amyl alcohol.....	20	AAI	IAA/AAN/ASE/APM
Amylene.....	30	AMZ	PTX/PTE
Amyl methyl ketone.....	18	AMK	
Amyl tallate.....	34		
Aniline.....	9	ANL	
Anthracene oil (Coal tar fraction), see Coal tar.....	33	AHO	COR
Asphalt.....	33	ASP	ACU
Asphalt blending stocks, roofers flux.....	33	ARF	
Asphalt blending stocks, straight run residue	33	ASR	
Aviation alkylates.....	33	AVA	GAV
Behenyl alcohol.....	20		
Benzene.....	32	BNZ	
Benzene hydrocarbon mixtures (having 10% Benzene or more) ..	32	BHB	
Benzenesulfonyl chloride.....	1, 20	BSC	
Benzene, Toluene, Xylene mixtures	32	BTX	
Benzene tricarboxylic acid, trioctyl ester	34		
Benzylacetate.....	34	BZE	
Benzyl alcohol.....	21	BAL	
Benzyl chloride	36	BCL	
Brake fluid base mixtures	20	BFX	
Butadiene	30	BDI	
Butadiene, Butylene mixtures (cont. Acetylenes)	30	BBM	
Butane	31	BMX	IBT/BUT
Butene	30		IBL/BTN
Butene oligomer	30	BOL	
Butyl acetate.....	34	BAX	IBA/BCN/BTA/BYA
Butyl acrylate	14	BAR	BAI/BTC



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Butyl alcohol	² 20		IAL/BAN/BAS/BAT
Butylamine	7	BTY	IAM/BAM/BTL/BUA
Butylbenzene	32	BBE	
Butyl benzyl phthalate	34	BPH	
n-Butyl butyrate	34	BUB	
Butylene	30	BTN	IBL
Butylene glycol	² 20	BUG	
Butylene oxide	16	BTO	
Butyl ether	41	BTE	
Butyl formate	34		BFI/BFN
iso-Butyl isobutyrate	34	BIB	
Butyl heptyl ketone	18	BHK	
Butyl methacrylate	14	BMH	BMI/BMN
Butyl methacrylate, Decyl methacrylate, Cetyl-Eicosyl methacrylate mixture	14	DER	
Butyl phenol, Formaldehyde resin in Xylene	32		
Butyl toluene	32	BUE	
Butyraldehyde	19	BAE	BAD/BTR/BFA
Butyric acid	4	BRA	IBR
gamma-Butyrolactone	^{1, 2} 0	BLA	
Calcium bromide solution	43		CBM
Calcium bromide, Zinc bromide solution <i>see</i> Drilling brine (containing Zinc salts)	43		DZB
Calcium chloride solution	43	CCS	CLC
Calcium hypochlorite solutions	5		CHZ/CHU/CHY
Calcium naphthenate in Mineral oil	34	CNM	
Calcium nitrate, Magnesium nitrate, Potassium chloride solution	34		
Calcium sulfonate, Calcium carbonate, Hydrocarbon solvent mixture	33		
Camphor oil	18	CPO	
Caprolactam solution	22	CLS	
Carbolic oil	21	CBO	
Carbon black base	33		
Carbon disulfide	38	CBB	
Carbon tetrachloride	36	CBT	
Cashew nut shell oil (untreated)	4	OCN	
Caustic potash solution	² 5	CPS	
Caustic soda solution	² 5	CSS	
Cetyl-Eicosyl methacrylate mixture	14	CEM	



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Chlorinated paraffins (C10 - C13)...	36	CLH	
Chlorinated paraffins (C14 - C17)...	36		
Chlorine	10	CLX	
Chloroacetic acid solution.....	4	CHM	CHL/MCA
Chlorobenzene.....	36	CRB	
Chlorodifluoromethane.....	36	MCF	
Chloroform	36	CRF	
Chlorohydrins.....	17	CHD	
4-Chloro-2-methylphenoxyacetic acid, Dimethylamine salt solution.....	9	CDM	
Chloronitrobenzene <i>see</i> o- Nitrochlorobenzene.....			CNO CLA/CLP
Chloropropionic acid	4	CPM	
Chlorosulfonic acid.....	10	CSA	
Chlorotoluene.....	36	CHI	CTM/CTO/CRN
Choline chloride solutions.....	20	CCO	
Coal tar	33	COR	OCT
Coal tar pitch.....	33	CTP	
Coconut oil, fatty acid.....	34	CFA	
Corn syrup.....	43	CSY	
Cottonseed oil, fatty acid	34	CFY	
Creosote	21	CCT	CCW/CWD CRL/CSL/CSO
Cresols.....	21	CRS	
Cresylate spent caustic.....	5	CSC	
Cresylic acid.....	21	CRY	
Cresylic acid, sodium salt solution .	5		CSC
Crotonaldehyde	19	CTA	
Cumene	32	CUM	
Cycloaliphatic resins.....	31		
1,5,9-Cyclododecatriene	30	CYT	
Cycloheptane.....	31	CYE	
Cyclohexane	31	CHX	
Cyclohexane oxidation product acid water.....	4		
Cyclohexanol.....	20	CHN	
Cyclohexanone	18	CCH	
Cyclohexanone, Cyclohexanol mixtures.....	18	CYX	
Cyclohexyl acetate.....	34	CYC	
Cyclohexylamine.....	7	CHA	
1,3-Cyclopentadiene dimer.....	30	CPD	
Cyclopentadiene polymers	30		CPD
Cyclopentadiene, Styrene, Benzene mixtures.....	30	CSB	
Cyclopentane	31	CYP	
Cyclopentene.....	30	CPE	



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Cymene	32	CMP	
Decahydronaphthalene	33	DHN	
Decaldehyde	19		IDA/DAL
Decane	31	DDC	PFN
Decanoic acid	4	DCO	
Decene	30	DCE	
Decyl acrylate	14	DAT	IAI/DAR
Decyl alcohol	² 20	DAX	ISA/DAN
Decylbenzene	32	DBZ	AKB
Dextrose solution	43	DTS	
Diacetone alcohol	² 20	DAA	
Dialkyl(C10 - C14) benzenes	32	DAB	
Dialkyl(C7 - C13) phthalates	34	DAH	DHP/DIE/DOP/DIF/DTP/ DUP
Diammonium salt of Zinc EDTA solution	43	DSZ	
Dibutylamine	7	DBA	
Dibutyl phthalate	34	DPA	
Dichlorobenzene	36	DBX	DBM/DBO/DBP
Dichlorodifluoromethane	36	DCF	
1,1-Dichloroethane	36	DCH	
2,2'-Dichloroethyl ether	41	DEE	
2,2'-Dichloroisopropyl ether	36	DCI	
Dichloromethane	36	DCM	
2,4-Dichlorophenol	21	DCP	
2,4-Dichlorophenoxyacetic acid, Diethanolamine salt solution	43	DDE	
2,4-Dichlorophenoxyacetic acid, Dimethylamine salt solution	^{1, 2} 0	DAD	DDA/DSX
2,4-Dichlorophenoxyacetic acid, Triisopropanolamine salt solution	² 43	DTI	
Dichloropropane	36	DPX	DPB/DPP/DPC/DPL
1,3-Dichloropropene	15	DPS	DPU/DPF
Dichloropropene, Dichloropropane mixtures	15	DMX	
2,2-Dichloropropionic acid	4	DCN	
Dicyclopentadiene	30	DPT	
Didecyl dimethyl ammonium chloride, Ethanol mixture solution	43	DDX	
Diethanolamine	8	DEA	
Diethanolamine salt of 2,4-Dichlorophenoxyacetic acid solution	43	DDE	
Diethylamine	7	DEN	
Diethylaminoethanol	8		DAE



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
2,6-Diethylaniline	9	DMN	
Diethylbenzene	32	DEB	
Diethylene glycol	40	DEG	
Diethylene glycol butyl ether	40	DME	
Diethylene glycol butyl ether acetate	34	DEM	
Diethylene glycol dibutyl ether	40	DIG	
Diethylene glycol ethyl ether	40	DGE	
Diethylene glycol ethyl ether acetate	34	DGA	
Diethylene glycol methyl ether	40	DGM	
Diethylene glycol methyl ether acetate	34	DGR	
Diethylene glycol phenyl ether	40	DGP	
Diethylene glycol phthalate	34	DGL	
Diethylenetriamine	27	DET	
Diethylethanamine	8	DAE	
Diethyl ether	41		EET
Di-(2-ethylhexyl)adipate	34	DEH	
Di-(2-ethylhexyl)phosphoric acid ...	1	DEP	
Di-(2-ethylhexyl)phthalate	34	DIE	DIO/DOP/DAH
Diethyl phthalate	34	DPH	
Diethyl sulfate	34	DSU	
Diglycidyl ether of Bisphenol A	41	BDE	BPA
Diglycidyl ether of Bisphenol F	41	DGF	
Diheptyl phthalate	34	DHP	
Di-n-hexyl adipate	34	DHA	
Diisobutylamine	7	DBU	
Diisobutyl carbinol	20	DBC	
Diisobutylene	30	DBL	
Diisobutyl ketone	18	DIK	
Diisobutyl phthalate	34	DIT	
Diisodecyl phthalate	34	DID	
Diisononyl adipate	34	DNY	
Diisononyl phthalate	34	DIN	
Diisooctyl phthalate	34	DIO	
Diisopropanolamine	8	DIP	
Diisopropylamine	7	DIA	
Diisopropylbenzene	32	DIX	
Diisopropyl naphthalene	32	DII	
N,N-Dimethylacetamide	10	DAC	
N,N-Dimethylacetamide solution ...	10	DLS	
Dimethyl adipate	34	DLA	
Dimethylamine	7	DMA	
Dimethylamine solution	7		DMG/DMY/DMC



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Dimethylamine salt of 4-Chloro-2-methylphenoxyacetic acid solution	9	CDM	
Dimethylamine salt of 2,4-Dichlorophenoxyacetic acid solution	¹ 20	DAD	DDA/DSX
2,6-Dimethylaniline	9	DMM	
Dimethylcyclcsiloxane hydrolyzate	34		
N,N-Dimethylcyclohexylamine	7	DXN	
Dimethylethanolamine	8	DMB	
Dimethylformamide	10	DMF	
Dimethyl furan	41		
Dimethyl glutarate	34	DGT	
Dimethyl hydrogen phosphite	² 34	DPI	
Dimethyl naphthalene sulfonic acid, sodium salt solution	² 34	DNS	
Dimethyloctanoic acid	4	DMO	
Dimethyl phthalate	34	DTL	
Dimethylpolysiloxane	34	DMP	
2,2-Dimethylpropane-1,3-diol	20	DDI	
Dimethyl succinate	34	DSE	
Dinitrotoluene	42	DNM	DTT/DNL/DNU
Dinonyl phthalate	34	DIF	DAH
Dioctyl phthalate	34	DOP	DAH
1,4-Dioxane	41	DOX	
Dipentene	30	DPN	
Diphenyl	32	DIL	
Diphenyl, Diphenyl ether mixture ..	33	DDO	DTH
Diphenyl ether	41	DPE	
Diphenyl ether, Diphenyl phenyl ether mixture	41	DOB	
Diphenylmethane diisocyanate	12	DPM	
Diphenylol propane-Epichlorohydrin resins	¹ 0	DPR	
Di-n-Propylamine	7	DNA	
Dipropylene glycol	40	DPG	
Dipropylene glycol dibenzoate	34	DGY	
Dipropylene glycol methyl ether ...	40	DPY	
Distillates, flashed feed stocks	33	DFF	
Distillates, straight run	33	DSR	
Ditridecyl phthalate	34	DTP	DAH
Diundecyl phthalate	34	DUP	DAH
Dodecane	31	DOC	PFN
Dodecanol	20	DDN	LAL
Dodecene	30	DOZ	DDC/DOD



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
2-Dodecenylsuccinic acid, dipotassium salt solution	34		
Dodecylamine, Tetradecylamine mixture	² 7	DTA	
Dodecyl alcohol	20		DDN/LAL
Dodecylbenzene	32	DDB	AKB
Dodecylbenzenesulfonic acid	² 0	DSA	
Dodecyl diphenyl ether disulfonate solution	43	DOS	
Dodecyl methacrylate	14	DDM	
Dodecyl-Pentadecyl methacrylate mixtures	14	DDP	
Dodecyl phenol	21	DOL	
Drilling brine (containing Calcium, Potassium or Sodium salts)	43		DRB
Drilling brine (containing Zinc salts)	43	DZB	
Drilling mud (low toxicity) (<i>if flammable or combustible</i>)	33		DRM
Drilling mud (low toxicity) (<i>if non-flammable or non-combustible</i>)	43		DRM
Epichlorohydrin	17	EPC	
Epoxy resin	18		
Ethane	31	ETH	
Ethanolamine	8	MEA	
2-Ethoxyethanol	20	EEO	
2-Ethoxyethyl acetate	34	EEA	
Ethoxylated alcohols, C11-C15	20		EOD/ENP/EOP/EOT/ETD
Ethoxy triglycol	40	ETG	
Ethyl acetate	34	ETA	
Ethyl acetoacetate	34	EAA	
Ethyl acrylate	14	EAC	
Ethyl alcohol	² 20	EAL	
Ethylamine	² 7	EAM	
Ethylamine solution	7	EAN	
Ethyl amyl ketone	18	EAK	ELK
Ethylbenzene	32	ETB	
Ethyl butanol	20	EBT	
N-Ethyl-n-butylamine	7	EBA	
Ethyl butyrate	34	EBR	
Ethyl chloride	36	ECL	
Ethyl chlorothioformate	² 0	ECT	
N-Ethylcyclohexylamine	7	ECC	
Ethylene	30	ETL	
Ethylene chlorohydrin	20	ECH	
Ethylene cyanohydrin	20	ETC	
Ethylenediamine	² 7	EDA	EMX



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Ethylenediaminetetracetic acid, tetrasodium salt solution	43	EDS	
Ethylene dibromide.....	36	EDB	
Ethylene dichloride.....	² 36	EDC	
Ethylene glycol	² 20	EGL	
Ethylene glycol acetate	34	EGO	
Ethylene glycol butyl ether	40	EGM	
Ethylene glycol tert-butyl ether	40		
Ethylene glycol butyl ether acetate.....	34	EMA	
Ethylene glycol diacetate	34	EGY	
Ethylene glycol dibutyl ether	40	EGB	
Ethylene glycol ethyl ether.....	40	EGE	
Ethylene glycol ethyl ether acetate	34	EGA	
Ethylene glycol isopropyl ether	40	EGI	
Ethylene glycol methyl ether	40	EME	
Ethylene glycol methyl ether acetate.....	34	EGT	
Ethylene glycol phenyl ether.....	40	EPE	
Ethylene glycol phenyl ether, Diethylene glycol phenyl ether mixture	40	EDX	
Ethylene glycol propyl ether	40	EGP	
Ethylene oxide.....	¹ 0	EOX	
Ethylene oxide, Propylene oxide mixture	16	EPM	
Ethylene-Vinyl acetate copolymer emulsion	43		
Ethyl ether.....	41	EET	
Ethyl-3-ethoxypropionate.....	34	EEP	
2-Ethylhexaldehyde	19	EHA	
2-Ethylhexanoic acid	4	EHO	
2-Ethylhexanol	20	EHX	
2-Ethylhexyl acrylate.....	14	EAI	
2-Ethylhexylamine	7	EHM	
Ethyl hexyl phthalate	34	EHE	
Ethyl hexyl tallate.....	34	EHT	
Ethylidene norbornene	² 30	ENB	
Ethyl methacrylate.....	14	ETM	
2-Ethyl-6-methyl-N-(1'-methyl-2-methoxyethyl)aniline	9	EEM	
o-Ethyl phenol.....	21	EPL	
Ethyl propionate	34	EPR	
2-Ethyl-3-propylacrolein.....	² 19	EPA	
Ethyl toluene	32	ETE	
Fatty acids (saturated, C13 and above).....	34		



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Fatty acid amides	33		
Ferric chloride solution	1	FCS	FCL
Ferric hydroxyethylethylene- diaminetriacetic acid, trisodium salt solution	² 43	FHX	STA
Ferric nitrate, Nitric acid solution..	3	FNN	
Fish solubles (<i>water based fish meal extracts</i>)	43	FSO	
Formaldehyde, Methanol mixtures.	² 19	MTM	
Formaldehyde solution	² 19	FMS	
Formamide	10	FAM	
Formic acid	² 4	FMA	
Fructose solution	43		
Fumaric adduct of Rosin, water dispersion	43	FAR	
Furfural	19	FFA	
Furfuryl alcohol	² 20	FAL	
Gas oil, cracked	33	GOC	
Gasoline blending stock, alkylates..	33	GAK	
Gasoline blending stock, reformates	33	GRF	
Gasolines:			
Automotive (<i>not over 4.23 grams lead per gal.</i>)	33	GAT	
Aviation (<i>not over 4.86 grams lead per gal.</i>)	33	GAV	AVA
Casinghead (<i>natural</i>)	33	GCS	
Polymer	33	GPL	
Straight run	33	GSR	
Glutaraldehyde solution	19	GTA	
Glycerine	² 20	GCR	
Glycerol polyalkoxylate	34		
Glyceryl triacetate	34		
Glycidyl ester of tridecylacetic acid	34	GLT	
Glycidyl ester of Versatic acid	34		GLT
Glycol diacetate	34		
Glycols, Resins, and Solvents mixture	33		
Glyoxal solutions	19	GOS	
Heptane	31	HMX	HPI/HPT
n-Heptanoic acid	4	HEP	
Heptanol	20	HTX	HTN
Heptene	30	HPX	HTE
Heptyl acetate	34	HPE	
Herbicide (C15-H22-NO2-Cl)	33		MCO
Hexamethylenediamine solution	7	HMC	HMD



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Hexamethylenetetramine	7	HMT	
Hexamethylenetetramine solutions .	7	HTS	
Hexamethylenimine	7	HMI	
Hexane.....	² 31	HXS	IHA/HXA
Hexanoic acid	4	HXO	
Hexanol	20	HXN	
Hexene.....	30	HEX	HXE/HXT
Hexyl acetate	34	HAE	HSA
Hexylene glycol	20	HXG	
Hydrochloric acid	1	HCL	
Hydrochloric acid, spent	1	HCS	
Hydrofluorosilicic acid	1	HFS	
Hydrogen peroxide solutions	¹ 0		HPN/HPS/HPO
2-Hydroxyethyl acrylate.....	^{1, 2} 0	HAI	
N-			
(Hydroxyethyl)ethylenediamine-			
triacetic acid, trisodium salt			
solution	43	HET	
2-Hydroxy-4-(methylthio)butanoic			
acid	4	HBA	
Isophorone	² 18	IPH	
Isophorone diamine.....	7	IPi	
Isophorone diisocyanate	12	IPD	
Isoprene.....	30	IPR	
Isopropylbenzene	32	CUM	
Jet fuels:			
JP-1	33	JPO	
JP-3	33	JPT	
JP-4	33	JPF	
JP-5	33	JPV	
JP-8	33	JPE	
Kaolin clay slurry	43		
Kerosene	33	KRS	
Ketone residue.....	18		
Kraft black liquor.....	5		KPL
Kraft pulping liquors (<i>Black,</i>			
<i>Green, or White</i>).....	5	KPL	
Lactonitrile solution.....	37	LNI	
Latex, liquid synthetic	43	LLS	LTX
Lauric acid.....	34	LRA	
Lignin liquor.....	43		
Magnesium chloride solution	^{1, 2} 0		
Magnesium nonyl phenol sulfide	33		
Magnesium sulfonate.....	34	MSE	MAS
Maleic anhydride.....	11	MLA	
Maleic anhydride copolymer	33		



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Mercaptobenzothiazol, sodium salt solution	5		SMB
Mesityl oxide	² 18	MSO	
Metam sodium solution	7	MSS	SMD
Methacrylic acid	4	MAD	
Methacrylonitrile	15	MET	
Methane	31	MTH	
3-Methoxy-1-butanol	20		
3-Methoxybutyl acetate	34	MOA	
1-Methoxy-2-propyl acetate	34	MPO	
Methoxy triglycol	40	MTG	
Methyl acetate	34	MTT	
Methyl acetoacetate	34	MAE	
Methyl acetylene, Propadiene mixture	30	MAP	
Methyl acrylate	14	MAM	
Methyl alcohol	² 20	MAL	
Methylamine	7	MTA	
Methylamine solutions	7	MSZ	
Methyl amyl acetate	34	MAC	
Methyl amyl alcohol	20	MAA	
Methyl amyl ketone	18	MAK	
Methyl bromide	36	MTB	
Methyl butenol	20	MBL	
Methyl butyl ketone	18	MBK	
Methyl tert-butyl ether	² 41	MBE	
Methylbutynol	20	MBY	
3-Methyl butyraldehyde	19		
Methyl butyrate	34	MBU	
Methyl chloride	36	MTC	
Methylcyclohexane	31	MCY	
Methylcyclopentadiene dimer	30	MCK	
Methyl diethanolamine	8	MDE	MAB
4,4'-Methylene dianiline (43% or less), Polymethylene polyphenylamine, o-Dichlorobenzene mixtures	9	MDB	
2-Methyl-6-ethylaniline	9	MEN	
Methyl ethyl ketone	² 18	MEK	
2-Methyl-5-ethylpyridine	9	MEP	
Methyl formal	41	MTF	
Methyl formate	34	MFM	
Methyl heptyl ketone	18	MHK	
2-Methyl-2-hydroxy-3-butyne	20	MHB	
Methyl isoamyl ketone	18		MAK
Methyl isobutyl carbinol	20	MIC	
Methyl isobutyl ketone	² 18	MIK	



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Methyl methacrylate.....	14	MMM	
3-Methyl-3-methoxybutanol	20		
3-Methyl-3-methoxybutyl acetate ...	34		
Methyl naphthalene	32	MNA	
Methylolureas	19	MUS	
2-Methyl pentane.....	31		IHA
2-Methyl-1-pentene	30	MPN	
4-Methyl-1-pentene	30	MTN	
Methylpyridine	9		MPR/MPE/MPF
N-Methyl-2-pyrrolidone	9	MPY	
Methyl salicylate	34	MES	
alpha-Methylstyrene.....	30	MSR	
Metolachlor	34	MCO	
Mineral spirits.....	33	MNS	
Molasses	20		
Molasses residue	0		
Monochlorodifluoromethane.....	36	MCF	
Morpholine	² 7	MPL	
Motor fuel antiknock compounds containing lead alkyls.....	¹ 0	MFA	
Myrcene	30	MRE	
Naphtha:			
Coal tar solvent	33	NCT	
Cracking fraction.....	² 33		
Petroleum	33	PTN	
Solvent	33	NSV	
Stoddard solvent.....	33	NSS	
Varnish Makers' and Painters'	33	NVM	
Naphthalene.....	32	NTM	
Naphthalene sulfonic acid- formaldehyde copolymer, sodium salt solution.....	0	NFS	
Naphthalene sulfonic acid, sodium salt solution	34	NSA	
Naphthenic acid	4	NTI	
Naphthenic acid, sodium salt solution	43	NTS	
Neodecanoic acid	4	NEA	
Nitrating acid.....	¹ 0	NIA	
Nitric acid (70% or less)	3	NCD	
Nitric acid (greater than 70%).....	¹ 0		NAC
Nitrobenzene.....	42	NTB	
o-Nitrochlorobenzene	42	CNO	CNP
Nitroethane	42	NTE	
o-Nitrophenol	¹ ² 0	NTP	NIP/NPH
Nitropropane	42	NPM	NPN/NPP
Nitropropane, Nitroethane mixture	42	NNM	



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Nitrotoluene.....	42	NIT	NIE/NTT/NTR
Nonane.....	31	NAX	NAN
Nonanoic acid.....	4	NNA	NAI/NIN
Nonene.....	30	NON	NNE
Nonyl alcohol.....	² 20	NNS	NNI/NNN
Nonyl methacrylate.....	14	NMA	
Nonyl phenol.....	21	NNP	
Nonyl phenol (ethoxylated).....	40		NPE
Nonyl phenol poly(4- 12)ethoxylates.....	40	NPE	
Nonyl phenol sulfide solution.....	33		NPS
Noxious Liquid Substance, n.o.s. (NLS's).....	0		
1-Octadecene.....	30		
Octadecenoamide.....	10	ODD	
Octane.....	31	OAX	IOO/OAN
Octanoic acid.....	4	OAY	OAA
Octene.....	30	OTX	OTE
Octyl alcohol (Octanol).....	² 20	OCX	IOA/OTA
Octyl aldehyde.....	19	OAL	IOC/OLX
Octyl decyl adipate.....	34	ODA	
Octyl epoxystallate.....	34	OET	
Octyl nitrate.....	² 34	ONE	
Octyl phenol.....	21		
Oil, edible:			
Babassu.....	34	OBG	
Castor.....	34	OCA	
Coconut.....	² 34	OCC	
Corn.....	34	OCO	
Cottonseed.....	34	OCS	
Fish.....	² 34	OFS	
Lard.....	34	OLD	
Olive.....	34	OOL	
Palm.....	² 34	OPM	
Palm kernel.....	34	OPO	
Peanut.....	34	OPN	
Rapeseed.....	34	ORP	
Rice bran.....	34	ORB	
Safflower.....	34	OSF	
Soya bean.....	34	OSB	
Sunflower seed.....	34	OSN	
Tucum.....	34	OTC	
Vegetable.....	34	OVG	
Oil, fuel:			
No. 1.....	33	OON	
No. 1-D.....	33	OOD	
No. 2.....	33	OTW	



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
No. 2-D	33	OTD	
No. 4	33	OFR	
No. 5	33	OFV	
No. 6	33	OSX	
Oil, misc:			
Absorption	33	OAS	
Aliphatic	33		
Aromatic	33		
Clarified	33	OCF	
Coal	33		
Coconut oil, fatty acid methyl ester	34	OCM	
Cotton seed oil, fatty acid	34	CFY	
Crude	33	OIL	
Diesel	33	ODS	
Heartcut distillate	33		
Linseed	33	OLS	
Lubricating	33	OLB	
Mineral	33	OMN	
Mineral seal	33	OMS	
Motor	33	OMT	
Neatsfoot	33	ONF	
Oiticica	34	OOI	
Palm oil, fatty acid methyl ester.	34	OPE	
Palm oil, methyl ester, <i>see</i> Palm oil, fatty acid methyl ester	34	OPE	
Penetrating	33	OPT	
Pine	33	OPI	
Range	33	ORG	
Residual	33		
Resin	33	ORS	
Resinous petroleum	33		
Road	33	ORD	
Rosin	33	ORN	
Seal	34		
Soapstock	34	OIS	
Soybean (epoxidized)	40		EVO
Sperm	33	OSP	
Spindle	33	OSD	
Spray	33	OSY	
Tall	34	OTL	
Tall, fatty acid	² 34	TOF	
Tanner's	33	OTN	
Transformer	33	OTF	
Tung	34	OTG	
Turbine	33	OTB	
White (mineral)	33		



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Olefin mixtures	30		OFX/OFY
alpha-Olefins (C6 - C18) mixtures ..	30	OAM	
alpha-Olefins (C13 and above)	30		
Oleic acid	34	OLA	
Oleum	1. 20	OLM	
Oxyalkylated alkyl phenol			
formaldehyde	33		
Palm kernel oil, fatty acid	34	PNO	
Palm kernel oil, fatty acid methyl ester	34	PNF	
Palm stearin	34	PMS	
n-Paraffins (C10 - C20)	31	PFN	DCC/DOC/TRD
Paraldehyde	19	PDH	
Pentachloroethane	36	PCE	
Pentadecanol	20	PDC	
1,3-Pentadiene	30	PDE	PDN
Pentaethylenhexamine,			
Tetraethylenepentamine mixture.	7	PEP	
Pentane	31	PTY	IPT/PTA
Pentene	30	PTX	PTE
Pentene, Miscellaneous			
hydrocarbon mixture	230		
3-Pentenitrile	37	PNT	
Pentyl aldehyde	19		
Perchloroethylene	36	PER	
Petrolatum	33	PTL	
Phenol	21	PHN	
1-Phenyl-1-xylyl ethane	32	PXE	
Phosphoric acid	1	PAC	
Phosphorus	10		PPW/PPR/PPB
Phthalic anhydride	11	PAN	
Pinene	30	PIN	
Pine oil	33	OPI	
Polyalkenyl succinic anhydride			
amine	33		
Polyalkylene glycols, Polyalkylene glycol monoalkyl ethers			
mixtures	40	PPX	
Polyalkyl(C18 - C22) acrylate in			
Xylene	14	PIX	
Polyalkylene oxide polyol	20	PAO	
Polybutadiene, hydroxyl			
terminated	20		
Polybutene	30	PLB	
Polydimethylsiloxane	34		
Polyethylene glycol	40		



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Polyethylene glycol dimethyl ether.....	40		
Polyethylene glycol monoalkyl ether.....	40	PEE	
Polyethylene polyamines.....	² 7	PEB	
Polyferric sulfate solution.....	34	PSS	
Polyglycerol.....	20		GCR
Polymethylene polyphenyl isocyanate.....	12	PPI	
Polymethylsiloxane.....	34		
Poly(20)oxyethylene sorbitan monooleate.....	34	PSM	
Polypropylene.....	30	PLP	
Polypropylene glycol.....	40	PGC	
Polypropylene glycol methyl ether.....	40	PGM	
Polysiloxane.....	34		
Potassium hydroxide solution.....	² 5		CPS
Potassium oleate.....	34	POE	
Propane.....	31	PRP	
Propanolamine.....	8	PAX	MPA/PLA
Propionaldehyde.....	19	PAD	
Propionic acid.....	4	PNA	
Propionic anhydride.....	11	PAH	
Propionitrile.....	37	PCN	
n-Propoxypropanol.....	40	PXP	
Propyl acetate.....	34		IAC/PAT
Propyl alcohol.....	² 20		IPA/PAL
Propylamine.....	7		IPP/PRA/IPO
Propylbenzene.....	32	PBZ	
iso-Propylcyclohexane.....	31	IPX	
Propylene.....	30	PPL	
Propylene-butylene copolymer.....	30	PBP	
Propylene dimer.....	30	PDR	
Propylene glycol.....	² 20	PPG	
Propylene glycol monoalkyl ether.....	40	PGE	PME/PGY
Propylene glycol ethyl ether.....	40	PGY	PGE
Propylene glycol methyl ether.....	40	PME	PGE
Propylene oxide.....	16	POX	
Propylene tetramer.....	30	PTT	
Propylene trimer.....	30	PTR	
Propyl ether.....	41		IPE/PRE
Pseudocumene.....	32		TME/TRE
Pyridine.....	9	PRD	
Pyridine bases.....	9	PRB	
Rosin oil.....	33	ORN	
Rosin soap (disproportionated) solution.....	43	RSP	



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Rum.....	20		
Salicylaldehyde.....	19	SAL	
Sewage sludge.....	43		
Sodium acetate solution.....	34	SAN	
Sodium alkyl sulfonate solution.....	43	SSU	
Sodium aluminate solution.....	5	SAU	
Sodium benzoate solution.....	34	SBN	
Sodium borohydride, Sodium hydroxide solution.....	5	SBX	SBH/SBI
Sodium carbonate solutions.....	5	SCE	
Sodium chlorate solution.....	¹ 20	SDD	SDC
Sodium cyanide solution.....	5	SCS	SCN
Sodium dichromate solution.....	¹ 20	SDL	SCR
Sodium dimethyl naphthalene sulfonate solution.....	² 34		DNS
Sodium hydrogen sulfide, Sodium carbonate solution.....	² 0	SSS	
Sodium hydrogen sulfite solution...	43	SHX	
Sodium hydrosulfide solution.....	² 5	SHR	
Sodium hydrosulfide, Ammonium sulfide solution.....	² 5	SSA	
Sodium hydroxide solution.....	² 5		CSS
Sodium hypochlorite solution.....	5	SHP	SHC
Sodium 2-mercaptobenzothiazol solution.....	5	SMB	
Sodium naphthalene sulfonate solution.....	34	SNS	
Sodium nitrite solution.....	5	SNI	SNT
Sodium polyacrylate solution.....	² 43		
Sodium salt of Ferric hydro- xyethylethylenediaminetriacetic acid solution.....	43	STA	FHX
Sodium silicate solution.....	² 43	SSN	SSC
Sodium sulfide, Hydrosulfide solution.....	¹ ² 0		SSH/SSI/SSJ
Sodium thiocyanate solution.....	¹ ² 0	STS	SCY
Sorbitol solutions.....	20		SBT
Stearic acid.....	34	SRA	
Styrene.....	30	STY	STX
Sulfolane.....	39	SFL	
Sulfur.....	¹ 0	SXX	
Sulfuric acid.....	² 2	SFA	
Sulfuric acid, spent.....	2	SAC	
Tall oil.....	34	OTL	
Tall oil soap (disproportionated) solution.....	43	TOS	
Tallow.....	² 34	TLO	



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Tallow fatty acid.....	² 34	TFD	
Tallow fatty alcohol	20	TFA	
Tallow nitrile.....	37		
1,1,1,2-Tetrachloroethane	36	TEC	
Tetradecanol.....	20	TTN	
Tetradecene	30	TTD	
Tetradecylbenzene	32	TDB	AKB
Tetraethylene glycol.....	40	TTG	
Tetraethylenepentamine.....	7	TTP	
Tetrahydrofuran.....	41	THF	
Tetrahydronaphthalene.....	32	THN	
1,2,3,5-Tetramethylbenzene	32	TTB	
Tetrasodium salt of EDTA solution.....	43		EDS
Titanium tetrachloride	2	TTT	
Toluene	32	TOL	
Toluenediamine	9	TDA	
Toluene diisocyanate	12	TDI	
o-Toluidine.....	9	TLI	
Triarylphosphate	34		
Tributyl phosphate.....	34	TBP	
1,2,4-Trichlorobenzene	36	TCB	
1,1,1-Trichloroethane.....	² 36	TCE	
1,1,2-Trichloroethane.....	36	TCM	
Trichloroethylene.....	² 36	TCL	
1,2,3-Trichloropropane	36	TCN	
1,1,2-Trichloro-1,2,2- trifluoroethane	36	TTF	
Tricresyl phosphate.....	34		TCO/TCP PFN
Tridecane	31	TRD	
Tridecanol.....	20	TDN	
Tridecene	30	TDC	
Tridecylbenzene	32	TRB	AKB
Triethanolamine.....	² 8	TEA	
Triethylamine	7	TEN	
Triethylbenzene.....	32	TEB	
Triethylene glycol.....	40	TEG	
Triethylene glycol butyl ether	40		
Triethylene glycol butyl ether mixture	40		
Triethylene glycol di-(2- ethylbutyrate).....	34	TGD	
Triethylene glycol ether mixture....	40		
Triethylene glycol ethyl ether	40	TGE	
Triethylenetetramine.....	² 7	TET	
Triethyl phosphate.....	34	TPS	
Triethyl phosphite.....	² 34	TPI	



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Triisobutylene.....	30	TIB	
Triisooctyl trimellitate.....	34		
Triisopropanolamine.....	8	TIP	
Triisopropanolamine salt of 2,4-Dichlorophenoxyacetic acid solution.....	43		DTI
Trimethylacetic acid.....	4	TAA	
Trimethylbenzene.....	32	TRE	TME/TMB/TMD
Trimethylhexamethylenediamine (2,2,4- and 2,4,4-).....	7	THA	
Trimethylhexamethylene diisocyanate (2,2,4- and 2,4,4-)....	12	THI	
Trimethylol propane polyethoxylate.....	20	TPR	
2,2,4-Trimethyl pentanediol-1,3-diisobutyrate.....	34		
2,2,4-Trimethyl-1,3-pentanediol-1-isobutyrate.....	34	TMP	
2,2,4-Trimethyl-3-pentanol-1-isobutyrate.....	34		
Trimethyl phosphite.....	² 34	TPP	
Tripropylene.....	30		
Tripropylene glycol.....	40	TGC	
Tripropylene glycol methyl ether ..	40	TGM	
Trisodium nitrilotriacetate.....	34		
Trixylenyl phosphate.....	34	TRP	
Turpentine.....	30	TPT	
Undecanoic acid.....	4	UDA	
Undecanol.....	20		UND
Undecene.....	30	UDC	
Undecyl alcohol.....	20	UND	
Undecylbenzene.....	32	UDB	AKB
Urea, Ammonium mono- and di-hydrogen phosphate, Potassium chloride solution.....	0	UPX	
Urea, Ammonium nitrate solution (containing Ammonia).....	6	UAS	
Urea, Ammonium nitrate solution (not containing Ammonia).....	43	ANU	
Urea, Ammonium phosphate solution.....	43	UAP	
Valeraldehyde.....	19		IVA/VAL/VAK
Vanillin black liquor.....	5	VBL	
Vegetable protein solution.....	43		
Vinyl acetate.....	13	VAM	
Vinyl acetate-Fumarate copolymer	34		
Vinyl chloride.....	35	VCM	



Table I—Alphabetical List of Cargoes—Continued

Chemical name	Group No.	CHRIS code	Related CHRIS codes
Vinyl ethyl ether.....	13	VEE	
Vinylidene chloride.....	35	VCI	
Vinyl neodecanate.....	13	VND	
Vinyltoluene	13	VNT	
Waxes:		WAX	
Carnauba	34	WCA	
Paraffin.....	31	WPF	
White spirit (low (15-20%) aromatic)	33	WSL	WSP
Xylene.....	32	XLX	XLM/XLO/XLP
Xylenols	21	XYL	
Zinc bromide, Calcium bromide solution <i>see</i> Drilling brine (containing Zinc salts).....	43		DZB

¹ Because of very high reactivity or unusual conditions of carriage or potential compatibility problems, this product is not assigned to a specific group in the Compatibility Chart. For additional compatibility information, contact Commandant (G-MTH), U.S. Coast Guard, 2100 Second Street, SW., Washington, D.C. 20593-0001. Telephone (202) 267-1577.

²See Appendix I—Exceptions to the Chart.



Table II—Grouping of Cargoes

0. Unassigned Cargoes

Acetone cyanohydrin ^{1,2}
 Alkylbenzenesulfonic acid ^{1,2}
 Aluminium chloride, Hydrochloric acid solution ¹
 Ammonium hydrogen phosphate solution ¹
 Ammonium nitrate solution ¹
 Ammonium thiocyanate, Ammonium thiosulfate solution ¹
 Benzenesulfonyl chloride ^{1,2}
 gamma-Butyrolactone ^{1,2}
 Chlorine ¹
 Chlorosulfonic acid ¹
 2,4-Dichlorophenoxyacetic acid, Dimethylamine salt solution ^{1,2}
 Dimethylamine salt of 2,4-Dichlorophenoxyacetic acid solution ^{1,2}
 Diphenylol propane-Epichlorohydrin resins ¹
 Dodecylbenzenesulfonic acid ^{1,2}
 Ethyl chlorothioformate ^{1,2}
 Ethylene oxide ¹
 2-Hydroxyethyl acrylate ^{1,2}
 Magnesium chloride solution ^{1,2}
 Molasses residue ¹
 Motor fuel antiknock compounds containing Lead alkyls ¹
 Naphthalene sulfonic acid-formaldehyde copolymer, sodium salt solution ¹
 Nitrating acid ¹
 Nitric acid (greater than 70%) ¹
 o-Nitrophenol ^{1,2}
 Noxious Liquid Substance, n.o.s. (NLS's) ¹
 Oleum ^{1,2}
 Phosphorus ¹
 Sodium chlorate solution ^{1,2}
 Sodium dichromate solution ^{1,2}
 Sodium hydrogen sulfide, Sodium carbonate solution ^{1,2}
 Sodium sulfide, Hydrosulfide solution ^{1,2}
 Sodium thiocyanate solution ^{1,2}
 Sulfur ¹

Urea, Ammonium mono- and di-hydrogen phosphate, Potassium chloride solution

1. Non-Oxidizing Mineral Acids

Di-(2-ethylhexyl)phosphoric acid
 Ferric chloride solution
 Hydrochloric acid
 Hydrochloric acid, spent
 Hydrofluorosilicic acid
 Phosphoric acid

2. Sulfuric Acids

Sulfuric acid ²
 Sulfuric acid, spent
 Titanium tetrachloride

3. Nitric Acid

Ferric nitrate, Nitric acid solution
 Nitric acid (70% or less)

4. Organic Acids

Acetic acid ²
 Acrylic acid ²
 Butyric acid
 Cashew nut shell oil (untreated)
 Chloroacetic acid solution
 Chloropropionic acid
 Cyclohexane oxidation product acid water
 Decanoic acid
 2,2-Dichloropropionic acid
 2,2-Dimethyloctanoic acid
 2-Ethylhexanoic acid
 Formic acid ²
 n-Heptanoic acid
 Hexanoic acid
 2-Hydroxy-4-(methylthio)butanoic acid
 Methacrylic acid
 Naphthenic acid
 Neodecanoic acid
 Nonanoic acid
 Octanoic acid
 Propionic acid
 Trimethylacetic acid
 Undecanoic acid

5. Caustics

Ammonium sulfide solution
 Calcium hypochlorite solutions
 Caustic potash solution ²
 Caustic soda solution ²
 Cresylate spent caustic



Cresylic acid, sodium salt solution
 Kraft black liquor
 Kraft pulping liquors
 Mercaptobenzothiazol, sodium salt solution
 Potassium hydroxide solution ²
 Sodium aluminate solution
 Sodium borohydride, Sodium hydroxide solution
 Sodium carbonate solutions
 Sodium cyanide solution
 Sodium hydrosulfide solution ²
 Sodium hydrosulfide, Ammonium sulfide solution ²
 Sodium hydroxide solution ²
 Sodium hypochlorite solution
 Sodium 2-mercaptobenzothiazol solution
 Sodium nitrite solution
 Vanillin black liquor

6. Ammonia

Ammonia, anhydrous
 Ammonium hydroxide (28% or less Ammonia)
 Ammonium nitrate, Urea solution (containing Ammonia)
 Urea, Ammonium nitrate solution (containing Ammonia)

7. Aliphatic Amines

N-Aminoethylpiperazine
 Butylamine
 Cyclohexylamine
 Dibutylamine
 Diethylamine ²
 Diethylenetriamine
 Diisobutylamine
 Diisopropylamine
 Dimethylamine
 Dimethylamine solution
 N,N-Dimethylcyclohexylamine
 Di-n-propylamine
 Dodecylamine, Tetradecylamine mixture ²
 Ethylamine ²
 Ethylamine solution
 N-Ethyl-n-butylamine
 N-Ethyl cyclohexylamine
 Ethylenediamine ²
 2-Ethyl hexylamine
 Hexamethylenediamine solution
 Hexamethylenetetramine

Hexamethylenetetramine solutions
 Hexamethylenimine
 Isophorone diamine
 Metam sodium solution
 Methylamine
 Methylamine solutions
 Morpholine ²
 Pentaethylenhexamine,
 Tetraethylenepentamine mixture
 Polyethylene polyamines ²
 Propylamine
 Tetraethylenepentamine
 Triethylamine
 Triethylenetetramine ²
 Trimethylhexamethylene diamine (2,2,4- and 2,4,4-)

8. Alkanolamines

2-(2-Aminoethoxy)ethanol
 Aminoethyldiethanolamine,
 Aminoethylethanolamine solution
 Aminoethylethanolamine
 2-Amino-2-methyl-1-propanol
 Diethanolamine
 Diethylaminoethanol
 Diethylethanolamine
 Diisopropanolamine
 Dimethylethanolamine
 Ethanolamine
 Propanolamine
 Triethanolamine ²
 Triisopropanolamine

9. Aromatic Amines

Aniline
 4-Chloro-2-methylphenoxyacetic acid, Dimethylamine salt solution
 2,6-Diethylaniline
 Dimethylamine salt of 4-Chloro-2-methylphenoxyacetic acid solution
 2,6-Dimethylaniline
 2-Ethyl-6-methyl-N-(1'-methyl-2-methoxyethyl)aniline
 4,4'-Methylene dianiline (43% or less), Polymethylene polyphenylamine, o-Dichlorobenzene mixtures
 2-Methyl-6-ethyl aniline
 2-Methyl-5-ethyl pyridine
 Methyl pyridine
 3-Methylpyridine
 N-Methyl pyrrolidone
 Pyridine



- Pyridine bases
Toluenediamine
p-Toluidine
- 10. Amides**
Acrylamide solution
N,N-Dimethylacetamide
N,N-Dimethylacetamide solution
Dimethylformamide
Formamide
Octadecenoamide
- 11. Organic Anhydrides**
Acetic anhydride
Maleic anhydride
Phthalic anhydride
Propionic anhydride
Isocyanates
Diphenylmethane diisocyanate
Isophorone diisocyanate
Polymethylene polyphenyl isocyanate
Toluene diisocyanate
Trimethylhexamethylene diisocyanate (2,2,4- and 2,4,4-)
- 13. Vinyl Acetate**
Vinyl acetate
Vinyl ethyl ether
Vinyl neodecanate
Vinyl toluene
- 14. Acrylates**
Butyl acrylate
Butyl methacrylate
Butyl methacrylate, Decyl methacrylate, Cetyl-Eicosyl methacrylate mixture
Cetyl-Eicosyl methacrylate mixture
Decyl acrylate
Dodecyl methacrylate
Dodecyl-Pentadecyl methacrylate mixture
Ethyl acrylate
2-Ethylhexyl acrylate
Ethyl methacrylate
Methyl acrylate
Methyl methacrylate
Nonyl methacrylate
Polyalkyl(C18 - C22) acrylate in Xylene
- 15. Substituted Alkyls**
Acrylonitrile ²
Allyl alcohol ²
Allyl chloride
- 1,3-Dichloropropene
Dichloropropene, Dichloropropane mixtures
Methacrylonitrile
- 16. Alkylene Oxides**
Butylene oxide
Ethylene oxide, Propylene oxide mixtures
Propylene oxide
- 17. Epichlorohydrin**
Chlorohydrins
Epichlorohydrin
- 18. Ketones**
Acetone ²
Acetophenone
Amyl methyl ketone
Butyl heptyl ketone
Camphor oil
Cyclohexanone
Cyclohexanone, Cyclohexanol mixtures ²
Diisobutyl ketone
Ethyl amyl ketone
Epoxy resin
Ketone residue
Isophorone ²
Mesityl oxide ²
Methyl amyl ketone
Methyl butyl ketone
Methyl butyl ketone
Methyl diethanolamine
Methyl ethyl ketone ²
Methyl heptyl ketone
Methyl isoamyl ketone
Methyl isobutyl ketone ²
- 19. Aldehydes**
Acetaldehyde
Acrolein ²
Butyraldehyde
Crotonaldehyde ²
Decaldehyde
Ethylhexaldehyde
2-Ethyl-3-propylacrolein ²
Formaldehyde, Methanol mixtures ²
Formaldehyde solution ²
Furfural
Glutaraldehyde solution
Glyoxal solutions
3-Methyl butyraldehyde
Methylolureas
Octyl aldehyde



Paraldehyde
Pentyl aldehyde
Propionaldehyde
Salicylaldehyde
Valeraldehyde

20. Alcohols, Glycols

Acrylonitrile-Styrene copolymer
dispersion in Polyether polyol
Alcoholic beverages
Alcohol polyethoxylates
Alcohol polyethoxylates, secondary
Alcohols (C13 and above)
Amyl alcohol
Behenyl alcohol
Brake fluid base mixtures
Butyl alcohol ²
Butylene glycol ²
Choline chloride solutions
Cyclohexanol
Decyl alcohol ²
Diacetone alcohol ²
Diisobutyl carbinol
2,2-Dimethylpropane-1,3-diol
Dodecanol
Dodecyl alcohol
Ethoxylated alcohols, C11-C15
2-Ethoxyethanol
Ethyl alcohol ²
Ethyl butanol
Ethylene chlorohydrin
Ethylene cyanohydrin
Ethylene glycol ²
2-Ethylhexanol
Furfuryl alcohol ²
Glycerine ²
Heptanol
Hexanol
Hexylene glycol
3-Methoxy-1-butanol
Methyl alcohol ²
Methyl amyl alcohol
Methyl butanol
Methylbutynol
2-Methyl-2-hydroxy-3-butyne
Methyl isobutyl carbinol
3-Methyl-3-methoxybutanol
Molasses
Nonyl alcohol ²
Octyl alcohol ²
Pentadecanol
Polyalkylene oxide polyol

Polybutadiene, hydroxyl terminated
Polyglycerol
Propyl alcohol ²
Propylene glycol ²
Rum
Sorbitol solutions
Tallow fatty alcohol
Tetradecanol
Tridecanol
Trimethylol propane polyethoxylate
Undecanol
Undecyl alcohol

21. Phenols, Cresols

Benzyl alcohol
Carbolic oil
Creosote ²
Cresols
Cresylic acid
2,4-Dichlorophenol
Dodecyl phenol
o-Ethylphenol
Nonyl phenol
Octyl phenol
Phenol
Xylenols

22. Caprolactam Solutions

Caprolactam solution

23 - 29. Unassigned

30. Olefins

Amylene
Butadiene
Butadiene, Butylene mixtures (cont.
Acetylenes)
Butene
Butene oligomer
Butylene
1,5,9-Cyclododecatriene
1,3-Cyclopentadiene dimer
Cyclopentadiene polymers
Cyclopentadiene, Styrene, Benzene
mixture
Cyclopentene
Decene
Dicyclopentadiene
Diisobutylene
Dipentene
Dodecene
Ethylene
Ethylidene norbornene ²
1-Heptene
Hexene



Isoprene
 Methyl acetylene, Propadiene mixture
 Methylcyclopentadiene dimer
 2-Methyl-1-pentene
 4-Methyl-1-pentene
 alpha-Methyl styrene
 Myrcene
 Nonene
 1-Octadecene
 Octene
 Olefin mixtures
 alpha-Olefins (C6 - C18) mixtures
 alpha-Olefins (C13 and above)
 1,3-Pentadiene
 Pentene
 Pentene, Miscellaneous hydrocarbon mixture ²
 Pinene
 Polybutene
 Polypropylene
 Propylene
 Propylene-butylene copolymer
 Propylene dimer
 Propylene tetramer
 Propylene trimer
 Styrene
 Tetradecene
 Tridecene
 Triisobutylene
 Tripropylene
 Turpentine
 Undecene

31. Paraffins

Butane
 Cycloaliphatic resins
 Cycloheptane
 Cyclohexane
 Cyclopentane
 Decane
 Dodecane
 Ethane
 Heptane
 Hexane ²
 Methane
 Methylcyclohexane
 2-Methyl pentane
 Nonane
 Octane
 n-Paraffins (C10 - C20)
 Pentane

Propane
 iso-Propylcyclohexane
 Tridecane

Waxes:

Paraffin

32. Aromatic Hydrocarbons

Alkyl acrylate-Vinyl pyridine copolymer in Toluene
 Alkyl(C9 - C17) benzenes
 Benzene
 Benzene hydrocarbon mixtures (having 10% Benzene or more)
 Benzene, Toluene, Xylene mixtures
 Butylbenzene
 Butyl phenol, Formaldehyde resin in Xylene
 Butyl toluene
 Cumene
 Cymene
 Decylbenzene
 Dialkyl(C10 - C14) benzenes
 Diethylbenzene
 Diisopropylbenzene
 Diisopropyl naphthalene
 Diphenyl
 Dodecylbenzene
 Ethylbenzene
 Ethyl toluene
 Isopropylbenzene
 Methyl naphthalene
 Naphthalene
 1-Phenyl-1-xylyl ethane
 Propylbenzene
 Pseudocumene
 Tetradecylbenzene
 Tetrahydronaphthalene
 1,2,3,5-Tetramethylbenzene
 Toluene
 Tridecylbenzene
 Triethylbenzene
 Trimethylbenzene
 Undecylbenzene
 Xylene

33. Miscellaneous Hydrocarbon Mixtures

Alkylbenzenesulfonic acid, sodium salt solutions
 Asphalt blending stocks, roofers flux
 Asphalt blending stocks, straight run residue
 Aviation alkylates



Calcium sulfonate, Calcium carbonate, Hydrocarbon solvent mixture

Carbon black base

Coal tar

Coal tar pitch

Decahydronaphthalene

Diphenyl, Diphenyl ether

Distillates, flashed feed stocks

Distillates, straight run

Drilling mud (low toxicity) (*if flammable or combustible*)

Fatty acid amides

Gas oil, cracked

Gasoline blending stock, alkylates

Gasoline blending stock, reformates

Gasolines:

Automotive (*not over 4.23 grams lead per gal.*)

Aviation (*not over 4.86 grams lead per gal.*)

Casinghead (*natural*)

Polymer

Straight run

Glycols, Resins, and Solvents mixture

Herbicide (C15-H22-NO2-Cl)

Jet Fuels:

JP-1

JP-3

JP-4

JP-5

JP-8

Kerosene

Magnesium nonyl phenol sulfide

Maleic anhydride copolymer

Mineral spirits

Naphtha:

Coal tar solvent

Cracking fraction ²

Petroleum

Solvent

Stoddard solvent

Varnish Makers' and Painters'

Nonyl phenolsulfide solution

Oil, fuel:

No. 1

No. 1-D

No. 2

No. 2-D

No. 4

No. 5

No. 6

Oil, misc:

Absorption

Aliphatic

Aromatic

Clarified

Coal

Crude

Diesel

Heartcut distillate

Linseed

Lubricating

Mineral

Mineral seal

Motor

Neatsfoot

Penetrating

Pine

Range

Resin

Resinous petroleum

Rosin

Sperm

Spindle

Spray

Tanner's

Turbine

White (mineral)

Residual

Road

Transformer

Oxyalkylated alkyl phenol formaldehyde

Petrolatum

Pine oil

Polyalkenyl succinic anhydride amine

White spirit (low (15-20%) aromatic)

34. Esters

Acetyl tributyl citrate

Alkyl phthalates

Amyl acetate

Amyl tallate

Benzene tricarboxylic acid trioctyl ester

Benzyl acetate

Butyl acetate

Butyl benzyl phthalate

n-Butyl butyrate

Butyl formate



iso-Butyl isobutyrate
 Calcium naphthenate in Mineral oil
 Calcium nitrate, Magnesium nitrate,
 Potassium chloride solution
 Coconut oil, fatty acid
 Cottonseed oil, fatty acid
 Cyclohexyl acetate
 Dialkyl(C7 - C13) phthalates
 Dibutyl phthalate
 Diethylene glycol butyl ether acetate
 Diethylene glycol ethyl ether acetate
 Diethylene glycol methyl ether
 acetate
 Diethylene glycol phthalate
 Di-(2-ethylhexyl)adipate
 Di-(2-ethylhexyl)phthalate
 Diethyl phthalate
 Diethyl sulfate
 Diheptyl phthalate
 Di-n-hexyl adipate
 Diisobutyl phthalate
 Diisodecyl phthalate
 Diisononyl adipate
 Diisononyl phthalate
 Diisooctyl phthalate
 Dimethyl adipate
 Dimethylcyclsiloxane hydrolyzate
 Dimethyl glutarate
 Dimethyl hydrogen phosphite ²
 Dimethyl naphthalene sulfonic acid,
 sodium salt solution ²
 Dimethyl phthalate
 Dimethyl polysiloxane
 Dimethyl succinate
 Dinonyl phthalate
 Dioctyl phthalate
 Dipropylene glycol dibenzoate
 Ditridecyl phthalate
 2-Dodecenylsuccinic acid,
 dipotassium salt solution
 Diundecyl phthalate
 2-Ethoxyethyl acetate
 Ethyl acetate
 Ethyl acetoacetate
 Ethyl butyrate
 Ethylene glycol acetate
 Ethylene glycol butyl ether acetate
 Ethylene glycol diacetate
 Ethylene glycol ethyl ether acetate
 Ethylene glycol methyl ether acetate
 Ethyl-3-ethoxypropionate

Ethyl hexyl phthalate
 Ethyl hexyl tallate
 Ethyl propionate
 Ethyl propionate
 Fatty acids (saturated, C13 and
 above)
 Glycerol polyalkoxylate
 Glyceryl triacetate
 Glycidyl ester of tridecylacetic acid
 Glycidyl ester of Versatic acid
 Glycol diacetate
 Heptyl acetate
 Hexyl acetate
 Lauric acid
 Magnesium sulfonate
 3-Methoxybutyl acetate
 1-Methoxy-2-propyl acetate
 Methyl acetate
 Methyl acetoacetate
 Methyl amyl acetate
 Methyl butyrate
 Methyl formate
 3-Methyl-3-methoxybutyl acetate
 Methyl salicylate
 Metolachlor
 Naphthalene sulfonic acid, sodium
 salt solution (40% or less)
 Octyl decyl adipate
 Octyl epoxytallate
 Octyl nitrate ²
 Oil, edible:
 Babassu
 Castor
 Coconut ²
 Corn
 Cotton seed
 Fish ²
 Lard
 Olive
 Palm ²
 Palm kernel
 Peanut
 Rapeseed
 Rice bran
 Safflower
 Soya bean
 Sunflower
 Sunflower seed
 Tucum
 Vegetable



Oil, misc:

Coconut oil, fatty acid methyl ester
Cotton seed oil, fatty acid
Palm oil, fatty acid methyl ester
Palm oil, methyl ester
Soapstock
Tall
Tall, fatty acid ²
Tung
Oleic acid
Palm kernel oil, fatty acid
Palm kernel oil, fatty acid methyl ester
Palm stearin
Polydimethylsiloxane
Polyferric sulfate solution
Polymethylsiloxane
Poly(20)oxyethylene sorbitan monooleate
Polysiloxane
Potassium oleate
Propyl acetate
Sodium acetate solution
Sodium benzoate solution
Sodium dimethyl naphthalene sulfonate solution ²
Sodium naphthalene sulfonate solution
Stearic acid
Tall oil
Tallow ²
Tallow fatty acid ²
Triarylphosphate
Tributyl phosphate
Tricresyl phosphate
Triethylene glycol di-(2-ethylbutyrate)
Triethyl phosphate
Triethyl phosphite ²
Triisooctyl trimellitate ²
2,2,4-Trimethyl pentanediol-1,3-diisobutyrate
2,2,4-Trimethyl-1,3-pentanediol-1-isobutyrate
2,2,4-Trimethyl-3-pentanol-1-isobutyrate
Trimethyl phosphite ²
Trisodium nitrilotriacetate
Trixylenyl phosphate
Vinyl acetate-Fumarate copolymer

Waxes:

Carnauba

35. Vinyl Halides

Vinyl chloride

Vinylidene chloride

36. Halogenated Hydrocarbons

Benzyl chloride

Carbon tetrachloride

Chlorinated paraffins (C10 - C13)

Chlorinated paraffins (C14 - C17)

Chlorobenzene

Chlorodifluoromethane

Chloroform

Chlorotoluene

Dichlorobenzene

Dichlorodifluoromethane

1,1-Dichloroethane

2,2'-Dichloroisopropyl ether

Dichloromethane

Dichloropropane

Ethyl chloride

Ethylene dibromide

Ethylene dichloride ²

Methyl bromide

Methyl chloride

Monochlorodifluoromethane

Pentachloroethane

Perchloroethylene

1,1,2,2-Tetrachloroethane

1,2,4-Trichlorobenzene

1,1,1-Trichloroethane ²

1,1,2-Trichloroethane

Trichloroethylene ²

1,2,3-Trichloropropane

1,1,2-Trichloro-1,2,2-trifluoroethane

37. Nitriles

Acetonitrile

Adiponitrile

Lactonitrile solution

3-Pentenitrile

Propionitrile

Tallow nitrile

38. Carbon Disulfide

Carbon disulfide

39. Sulfolane

Sulfolane

40. Glycol Ethers

Diethylene glycol

Diethylene glycol butyl ether

Diethylene glycol dibutyl ether

Diethylene glycol ethyl ether



Diethylene glycol methyl ether
 Diethylene glycol phenyl ether
 Dipropylene glycol
 Dipropylene glycol methyl ether
 Ethoxy triglycol
 Ethylene glycol tert-butyl ether
 Ethylene glycol butyl ether
 Ethylene glycol dibutyl ether
 Ethylene glycol ethyl ether
 Ethylene glycol isopropyl ether
 Ethylene glycol methyl ether
 Ethylene glycol phenyl ether
 Ethylene glycol phenyl ether,
 Diethylene glycol phenyl ether
 mixture
 Ethylene glycol propyl ether
 Methoxy triglycol
 Nonyl phenol (ethoxylated)
 Nonyl phenol poly(4-12)ethoxylates
 Oil, misc:
 Soybean (epoxidized)
 Polyalkylene glycols, Polyalkylene
 glycol monoalkyl ethers mixtures
 Polyethylene glycols
 Polyethylene glycol dimethyl ether
 Polyethylene glycol monoalkyl ether
 Polypropylene glycol methyl ether
 Polypropylene glycols
 n-Propoxypropanol
 Propylene glycol monoalkyl ether
 Propylene glycol ethyl ether
 Propylene glycol methyl ether
 Tetraethylene glycol
 Triethylene glycol
 Triethylene glycol butyl ether
 Triethylene glycol butyl ether
 mixture
 Triethylene glycol ether mixture
 Triethylene glycol ethyl ether
 Tripropylene glycol
 Tripropylene glycol methyl ether

41. Ethers

Butyl ether
 2,2'-Dichloroethyl ether
 Diglycidyl ether of Bisphenol A
 Diglycidyl ether of Bisphenol F
 Dimethyl furan
 1,4-Dioxane
 Diphenyl ether
 Diphenyl ether, Diphenyl phenyl
 ether mixture

Ethyl ether
 Methyl-tert-butyl ether ²
 Methyl formal
 Propyl ether
 Tetrahydrofuran

42. Nitrocompounds

Dinitrotoluene
 Nitrobenzene
 o-Nitrochlorobenzene
 Nitroethane
 Nitropropane
 Nitropropane, Nitroethane mixture
 Nitrotoluene

43. Miscellaneous Water Solutions

Aluminum sulfate solution ²
 2-Amino-2-hydroxymethyl-1,3-
 propanediol solution
 Ammonium bisulfite solution ²
 Ammonium nitrate, Urea solution
 (not containing Ammonia)
 Ammonium polyphosphate solution
 Ammonium sulfate solution
 Ammonium thiosulfate solution
 Calcium bromide solution
 Calcium chloride solution
 Corn syrup
 Dextrose solution
 Diammonium salt of Zinc EDTA
 solution
 2,4-Dichlorophenoxyacetic acid,
 Diethanolamine salt solution
 2,4-Dichlorophenoxyacetic acid,
 Triisopropanolamine salt solution
 ²
 Didecyl dimethyl ammonium
 chloride, Ethanol mixture solution
 Diethanolamine salt of 2,4-
 Dichlorophenoxyacetic acid
 solution
 Dodecyl diphenyl ether disulfonate
 solution
 Drilling brine (containing Calcium,
 Potassium, or Sodium salts)
 Drilling brine (containing Zinc salts)
 Drilling mud (low toxicity) (*if non-
 flammable or non-combustible*)
 Ethylenediaminetetracetic acid,
 tetrasodium salt solution
 Ethylene-Vinyl acetate copolymer
 emulsion



Ferric hydroxyethylethylenediamine triacetic acid, trisodium salt solution ²
 Fish solubles (*water based fish meal extracts*)
 Fructose solution
 Fumaric adduct of Rosin, water dispersion
 N-(Hydroxyethyl)ethylene diamine triacetic acid, trisodium salt solution
 Kaolin clay slurry
 Latex, liquid synthetic
 Lignin liquor
 Naphthenic acid, sodium salt solution
 Rosin soap (disproportionated) solution
 Sewage sludge, treated
 Sodium alkyl sulfonate solution
 Sodium hydrogen sulfite solution
 Sodium polyacrylate solution ²
 Sodium salt of Ferric hydroxyethylethylenediamine triacetic acid solution
 Sodium silicate solution ²

Tall oil soap (disproportionated) solution
 Tetrasodium salt of EDTA solution
 Triisopropanolamine salt of 2,4-Dichlorophenoxyacetic acid solution
 Urea, Ammonium nitrate solution (not containing Ammonia)
 Urea, Ammonium phosphate solution
 Vegetable protein solution (hydrolysed)

Footnotes to Table II

¹ Because of very high reactivity or unusual conditions of carriage or potential compatibility problems, this product is not assigned to a specific group in the Compatibility Chart. For additional compatibility information, contact Commandant (G-MTH), U.S. Coast Guard, 2100 Second Street, SW., Washington, D.C. 20593-0001. Telephone (202) 267-1577.

² See Appendix I—Exceptions to the Chart.

Appendix I—Exceptions to the Chart

(a). The binary combinations listed below have been tested as prescribed in Appendix III and found not to be dangerously reactive. These combinations are exceptions to the Compatibility Chart (Figure 1) and may be stowed in adjacent tanks.

Member of reactive group	Compatible with
Acetone (18)	Diethylenetriamine (7)
Acetone cyanohydrin (0)	Acetic acid (4)
Acrylonitrile (15)	Triethanolamine (8)
1,3-Butylene glycol (20)	Morpholine (7)
1,4-Butylene glycol (20)	Ethylamine (7)
	Triethanolamine (8)
Caustic potash, 50% or less (5)	Ethyl alcohol (20)
	Ethylene glycol (20)
	Isopropyl alcohol (20)
	Methyl alcohol (20)
	iso-Octyl alcohol (20)



Member of reactive group	Compatible with
Caustic soda, 50% or less (5)	Butyl alcohol (20) tert-Butyl alcohol, Methanol mixtures Decyl alcohol (20) Diacetone alcohol (20) Diethylene glycol (40) Ethyl alcohol (20) Ethyl alcohol (40%, whiskey) (20) Ethylene glycol (20) Ethylene glycol, Diethylene glycol mixture (20) Ethyl hexanol (Octyl alcohol) (20) Methyl alcohol (20) Nonyl alcohol (20) Propyl alcohol (20) Propylene glycol (20) Sodium chlorate (0) iso-Tridecanol (20)
Dodecyl and Tetradecylamine mixture (7)	Tall oil, fatty acid (34)
Ethylenediamine (7)	Butyl alcohol (20) tert-Butyl alcohol (20) Butylene glycol (20) Creosote (21) Diethylene glycol (40) Ethyl alcohol (20) Ethylene glycol (20) Ethyl hexanol (20) Glycerine (20) Isononyl alcohol (20) Isophorone (18) Methyl butyl ketone (18) Methyl iso-butyl ketone (18) Methyl ethyl ketone (18) Propyl alcohol (20) Propylene glycol (20)
Oleum (0)	Hexane (31) Dichloromethane (38) Perchloroethylene (36)
1,2-Propylene glycol (20)	Diethylenetriamine (7) Polyethylene polyamines (7) Triethylenetetramine (7)
Sulfuric acid (2)	Coconut oil (34) Coconut oil acid (34) Palm oil (34) Tallow (34)
Sulfuric acid, 98% or less (2)	Choice white grease tallow (34)



(b). The binary combinations listed below have been determined to be dangerously reactive, based on either data obtained in the literature or on laboratory testing which has been carried out in accordance with procedures prescribed in Appendix III. These combinations are exceptions to the Compatibility Chart (Figure 1) and may not be stowed in adjacent tanks.

- Acetone cyanohydrin (0) is not compatible with Groups 1-12, 16, 17, and 22.
- Acrolein (19) is not compatible with Group 1, Non-Oxidizing Mineral Acids.
- Acrylic acid (4) is not compatible with Group 9, Aromatic Amines.
- Alkylbenzenesulfonic acid (0) is not compatible with Groups 1-3, 5-9, 15, 16, 18, 19, 30, 34, 37, and strong oxidizers.
- Allyl alcohol (15) is not compatible with Group 12, Isocyanates.
- Aluminum sulfate solution (43) is not compatible with Groups 5-11.
- Ammonium bisulfite solution (43) is not compatible with Groups 1, 3, 4, and 5.
- Benzenesulfonyl chloride (0) is not compatible with Groups 5-7 and 43.
- gamma-Butyrolactone (0) is not compatible with Groups 1-9.
- Crotonaldehyde (19) is not compatible with Group 1, Non-Oxidizing Mineral Acids.
- Cyclohexanone, Cyclohexanol mixture (18) is not compatible with Group 12, Isocyanates.
- 2,4-Dichlorophenoxyacetic acid, Dimethylamine salt solution (0) is not compatible with Groups 1-5, 11, 12, and 16.
- 2,4-Dichlorophenoxyacetic acid, Triisopropanolamine salt solution (43) is not compatible with Group 3, Nitric Acid.
- Dimethyl hydrogen phosphite (34) is not compatible with Groups 1 and 4.
- Dimethyl naphthalene sulfonic acid, sodium salt solution (34) is not compatible with Group 12, Formaldehyde, and strong oxidizing agents.
- Dodecylbenzenesulfonic acid (0) is not compatible with oxidizing agents and Groups 1, 2, 3, 5, 6, 7, 8, 9, 15, 16, 18, 19, 30, 34, and 37.



- Ethyl chlorothioformate (0) is not compatible with Groups 5, 6, 7, 8, and 9.
- Ethylenediamine (7) is not compatible with Ethylene dichloride (36).
- Ethylene dichloride (36) is not compatible with Ethylenediamine (7).
- Ethylidene norbornene (30) is not compatible with Groups 1-3 and 5-8.
- 2-Ethyl-3-propylacrolein (19) is not compatible with Group 1, Non-Oxidizing Mineral Acids.
- Ferric hydroxyethylethylenediamine triacetic acid, Sodium salt solution (43) is not compatible with Group 3, Nitric acid.
- Fish oil (34) is not compatible with Sulfuric acid (2).
- Formaldehyde (over 50%) in Methyl alcohol (over 30%) (19) is not compatible with Group 12, Isocyanates.
- Formic acid (4) is not compatible with Furfural alcohol (20).
- Furfuryl alcohol (20) is not compatible with Group 1, Non-Oxidizing Mineral Acids and Formic acid (4).
- 2-Hydroxyethyl acrylate is not compatible with Groups 2, 3, 5-8, and 12.
- Isophorone (18) is not compatible with Group 8, Alkanolamines.
- Magnesium chloride solution (0) is not compatible with Groups 2, 3, 5, 6, and 12.
- Mesityl oxide (18) is not compatible with Group 8, Alkanolamines.
- Methyl tert-butyl ether (41) is not compatible with Group 1, Non-oxidizing Mineral Acids.
- Naphtha, cracking fraction (33) is not compatible with strong acids, caustics or oxidizing agents.
- o-Nitrophenol (0) is not compatible with Groups 2, 3, and 5-10.
- Octyl nitrates (all isomers) (34) is not compatible with Group 1, Non-oxidizing Mineral Acids.
- Oleum (0) is not compatible with Sulfuric acid (2) and 1,1,1-Trichloroethane (36).
- Pentene, Miscellaneous hydrocarbon mixtures (30) are not compatible with strong acids or oxidizing agents.



- Sodium chlorate solution (50% or less) (0) is not compatible with Groups 1-3, 5, 7, 8, 10, 12, 13, 17, and 20.
- Sodium dichromate solution (70% or less) (0) is not compatible with Groups 1-3, 5, 7, 8, 10, 12, 13, 17, and 20.
- Sodium dimethyl naphthalene sulfonate solution (34) is not compatible with Group 12, Formaldehyde and strong oxidizing agents.
- Sodium hydrogen sulfide, Sodium carbonate solution (0) is not compatible with Groups 6 (Ammonia) and 7 (Aliphatic amines).
- Sodium hydrosulfide (5) is not compatible with Groups 6 (Ammonia) and 7 (Aliphatic amines).
- Sodium hydrosulfide, Ammonium sulfide solution (5) is not compatible with Groups 6 (Ammonia) and 7 (Aliphatic amines).
- Sodium polyacrylate solution (43) is not compatible with Group 3, Nitric Acid.
- Sodium salt of Ferric hydroxyethylethylenediamine triacetic acid solution (43) is not compatible with Group 3, Nitric acid.
- Sodium silicate solution (43) is not compatible with Group 3, Nitric Acid.
- Sodium sulfide, hydrosulfide solution (0) is not compatible with Groups 6 (Ammonia) and 7 (Aliphatic amines).
- Sodium thiocyanate (56% or less) (0) is not compatible with Groups 1-4.
- Sulfuric acid (2) is not compatible with Fish oil (34), or Oleum (0).
- Tallow fatty acid (34) is not compatible with Group 5, Caustics.
- 1,1,1-Trichloroethane (36) is not compatible with Oleum (0).
- Trichloroethylene (36) is not compatible with Group 5, Caustics.
- Triethyl phosphite (34) is not compatible with Groups 1 and 4.
- Trimethyl phosphite (34) is not compatible with Groups 1 and 4.

Appendix II—Explanation of Figure 1

Definition of a hazardous reaction—As a first approximation, a mixture of two cargoes is considered hazardous when, under specified condition, the temperature rise of the mixture exceeds 25°C or a gas is evolved. It is possible for the reaction of two cargoes to produce a product that is significantly more flammable or toxic than the original



cargoes even though the reaction is non-hazardous from temperature or pressure considerations, although no examples of such a reaction are known at this time.

Chart format—There are different degrees of reactivity among the various cargoes. Many of them are relatively non-reactive: For example, aromatic hydrocarbons or paraffins. Others will form hazardous combinations with many groups: For example, the inorganic acids.

The cargo groups in the compatibility chart are separated into two categories: 1 through 22 are “Reactive Groups” and 30 through 43 are “Cargo Groups”. Left unassigned and available for future expansion are groups 23 through 29 and those past 43. Reactive Groups contain products which are chemically the most reactive; dangerous combinations may result between members of different Reactive Groups and between members of Reactive Groups and Cargo Groups. Products assigned to Cargo Groups, however, are much less reactive; dangerous combinations involving these can be formed only with members of certain Reactive Groups. Cargo Groups do not react hazardously with one another.

Using the Compatibility Chart—The following procedure explains how the compatibility chart should be used to find compatibility information:

(1) Determine the group numbers of the two cargoes by referring to the alphabetical listing of cargoes and the corresponding groups (Table I). Many cargoes are listed under their parent names; unless otherwise indicated, isomers or mixtures of isomers of a particular cargo are assigned to the same group. For example, to find the group number for Isobutyl Alcohol, look under the parent name Butyl Alcohol. Similarly, the group number for para-Xylene is found under the entry Xylene. If a cargo cannot be found in this listing, contact the Coast Guard for a group determination (see § 150.140).

(2) If both group numbers are between 30 and 43 inclusive, the products are compatible and the chart need not be used.

(3) If both group numbers do not fall between 30 and 43 inclusive, locate one of the numbers on the left of the chart (Cargo Groups) and the other across the top (Reactive Groups). (Note that if a group number is between 30 and 43, it can only be found on the left side of the chart.) The box formed by the intersection of the column and row containing the two numbers will contain one of the following:

(a) **Blank**—The two cargoes are compatible.



(b) "X"—The two cargoes are not compatible.

(Note that reactivity may vary among the group members. Refer to Table I or Table II to find whether the products in question are referenced by a footnote which indicates that exceptions exist and are listed in Appendix I. Unless the combination is specifically mentioned in Appendix I, it is compatible.)

Examples

Combination	Groups	Compatible
Butyraldehyde/Acetic Acid	19/4	Yes
Allyl Alcohol/Toluene Diisocyanate	15/12	No
Decene/Ethyl Benzene	30/32	Yes
Ethanolamine/Acetone	8/18	Yes
Ammonia/Dimethylformamide	6/10	No

Appendix III—Testing Procedures for Determining Exceptions to the Chart

Experimental Procedure for Evaluating Binary Chemical Reactivity

General safety precautions—Chemical reactivity tests have, by their nature, serious potential for injuring the experimenter or destroying equipment. The experimenter should 1) have knowledge of the magnitude of the reactivity to be expected, 2) use adequate facilities and protective equipment to prevent injury from splatter of materials or release of fumes, and 3) start on a small scale so that unexpected reactions can be safely contained. All tests should be performed in a well-ventilated laboratory hood provided with shields.

Testing chemicals other than liquids—The procedure outlined below was developed for chemicals which are liquids at ambient temperatures. If one or both chemicals are normally shipped at elevated temperatures, the same procedure may be followed except the chemicals are tested at their respective shipping temperatures and the oil bath in Step 3 is maintained at a level 25°C above the higher temperature. This information is then indicated on the data sheet. If one of the chemicals is a gas at ambient temperatures, consult the Coast Guard for additional instructions before proceeding with the compatibility test.

Step 1

Objective—To determine if the test chemicals react violently and present a safety hazard in further tests.



Procedure—Place 0.5 ml of one (A) of the test chemicals in a 25×150 mm test tube. Clamp the test tube to a stand behind a safety shield (in a hood). Carefully add from a dropper 0.5 ml of the other substance (B). Shake to induce mixing. If no immediate reaction occurs, retain the mixture for at least 10 minutes to check for a delayed reaction.

Results—If a violent reaction occurs, such as sputtering, boiling of reactants or release of fumes, record the results on the Data Sheet (Appendix IV) and do not proceed to Step 2. If no reaction or a minor reaction occurs, proceed to Step 2.

Step 2

Objective—To determine the heat of reaction of two chemicals on mixing under specified conditions.

Procedure—These separate mixes of the proposed binary combination will be tested. These are 2 ml : 18 ml, 10 ml : 10 ml, and 18 ml : 2 ml, respectively, to result in a final mixture of about 20 ml in each case.

A reference-junctioned thermocouple is prepared by inserting two lengths of 20 gauge or finer iron-constantan or chromelalumel duplex thermocouple wire into glass capillary sheaths. The common wire of each probe is joined, while the other wire of each is connected to a strip-chart recorder. The thermocouple probe which produces a negative pen deflection upon warming is the reference junction and is placed in a test tube of water at ambient laboratory temperature. The other probe is placed near the bottom of a Dewar flask of about 300 ml capacity, such that the thermocouple will be below the surface of the test mixture. The Dewar flask is equipped with a magnetic stirrer having a stirring bar coated with an inert material such as a fluorinated hydrocarbon.

Start the temperature recorder and stirrer. Deliver the test chemicals to the Dewar Flask simultaneously from separate graduated syringes. If an exothermic reaction occurs, continue the test until the maximum temperature is reached and begins to subside. If no apparent reaction occurs, continue the test for at least 30 minutes to check for a delayed reaction. Stop agitation and observe the mixture at five-minute intervals to determine if the mixture is miscible, if gases are evolved, or if other visible changes occur. In the interest of safety, a mirror can be used for these observations. Repeat the above test for the other mixture combinations.

Results—Record the results in the appropriate places on the Data Sheet. If no reaction occurs or if the temperature rise is less than 25°C,



proceed to Step 3. If the observed temperature rise exceeds 25°C or gases are evolved, do not proceed to Step 3.

Step 3

Objective—To determine if exothermic reactions occur at temperatures up to 50°C

Procedure—If a non-hazardous reaction occurred in Step 2, the ratio of chemicals which resulted in the greatest temperature rise will be tested. Fresh chemicals will be used with a total volume for this test of about 10 ml (a ratio of 1 ml : 9 ml, 5 ml : 5 ml, or 9 ml : 1 ml). If no reaction was observed in Step 2, use a ratio of 5 ml : 5 ml. Using the thermocouple prepared for Step 2, insert the reference probe into a 25×150 mm test tube containing 10 ml of water. Place the other probe into an empty test tube. Start the temperature recorder and add the two chemicals of the combination, one at a time, to the empty test tube. Lower the two test tubes into an oil bath maintained at 50±2°C. Hold the samples in the oil bath until the maximum temperature differential is recorded, and in all cases at least 15 minutes. Observe the test mixture to determine if gases are evolved or if other visible changes occur. Follow prescribed safety precautions.

Results—Record the maximum differential temperature measured, the time required to reach this temperature, and any other observations in the proper space on the Data Sheet.

Send a copy of the Data Sheet for each binary chemical mixture tested to: Commandant (G-MTH), U.S. Coast Guard, Washington, DC 20593-0001.



Appendix IV—Data Sheet

CHEMICAL REACTIVITY TEST DATA

Chemicals: A _____ B _____

Synonyms: _____

Formula: _____

Description of Products:

Manufacturer

Sample Source

Composition (by weight %)

Inhibitors or Stabilizers

Deviations from Prescribed Method
(including special equipment)

A	B

Step Number 1

Products miscible? _____ Gases evolved? _____

Other Observations:

Step Number 2

A/B Ratio:

Initial Temperature

Maximum ΔT

Time to reach Max. Temp.

Products miscible?

Gases evolved?

Other Observations

2/18	10/10	18/2

Size of Dewar Flask (inside measurement)

Width _____ mm

Height _____ mm



Step Number 3

A/B Ratio:

Oil Bath Temperature

Maximum ΔT

Time to reach Max. Temp.

Gases evolved?

Other Observations

Date of Test: _____

Submitting Organization: _____

Test Data Approved By: _____

BILLING CODE 4810-14-C



APPENDIX B

MEDICAL KIT INFORMATION

Cyanide-like cargoes

The kit described below should be readily available for use by a doctor or other person specially trained in its use when the following cargoes handled:

Acetone cyanohydrin
Acetonitrile
Acrylonitrile
Adiponitrile
Ethylene cyanohydrin
Methacrylonitrile
Propionitrile
Toluene diisocyanate

Medical Kit

12 pearls of amyl nitrite
1 sterile syringe, 10 cc.
1 sterile syringe, 50 cc.
2 ampules of sodium nitrite (10 cc., 3% solution)
2 ampules of sodium thiosulfate (50 cc., 25% solution)

Inhalation - DO NOT DELAY!

Break an amyl nitrite pearl in a cloth and hold it lightly under the nose of the victim (but away from the person giving first aid) for about 15 seconds. Repeat five times at about 15 second intervals.

Follow further instructions found with the kit.



APPENDIX B

CARCINOGENS

The following is a list of carcinogens, either known or suspected, for which data are given in this Guide:

Acetaldehyde	Diethyl phthalate
Acrylamide	Epichlorohydrin
Acrylonitrile	Ethyl acrylate
Allyl chloride	Ethylene dibromide
Aniline	Ethylene dichloride
Benzene	Ethylene oxide
Benzene, Toluene, Xylene mixtures	Ethyl methacrylate (a teratogen)
Benzyl chloride	Formaldehyde
Butadiene	Methyl bromide
Carbon tetrachloride	Methyl chloride
Chlorodifluoromethane	2-Nitropropane
crude Chlorohydrins*	Perchloroethylene
Chloroform	beta-Propiolactone
Coal tar	Propylene oxide
Coal tar naphtha	Styrene
Cresols	1,1,2,2-Tetrachloroethane
Crotonaldehyde	1,1,2-Trichloroethane
1,4-Dioxane	2,4-Toluenediamine
Dichloromethane	Toluene diisocyanate
1,3-Dichloropropene	Trichloroethylene
	Vinyl chloride
	Vinylidene chloride

* By analogy to epichlorohydrin.

This list has been compiled from those published by the International Agency for Research on Cancer (IARC) Supplement 7, the National Toxicology Program (NTP) *Fifth Annual Report on Carcinogens*, 1989, and the American Conference of Governmental Industrial Hygienists (ACGIH) *Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment*, 1989-1990.



APPENDIX C

MARPOL 73/78

LIST OF OILS *

Asphalt solutions	Gas Oil
Blending Stocks	Cracked
Roofers Flux	Gasoline Blending Stocks
Straight Run Residue	Alkylates - fuel
Oils	Reformats
Clarified	Polymer -fuel
Crude Oil	Gasolines
Mixtures containing crude oil	Casinghead (natural)
Diesel Oil	Automotive
Fuel Oil No.4	Aviation
Fuel Oil No.5	Straight Run
Fuel Oil No.6	Fuel Oil No.1 (Kerosene)
Residual Fuel Oil	Fuel Oil No.1-D
Road Oil	Fuel Oil No.2
Transformer Oil	Fuel Oil No.2-D
Aromatic Oil (excluding vegetable oil)	Jet Fuels
Lubricating Oils and Blending Stocks	JP-1 (Kerosene)
Mineral Oil	JP-3
Motor Oil	JP-4
Penetrating Oil	JP-5 (Kerosene, Heavy)
Spindle Oil	Turbo Fuel
Turbine Oil	Kerosene
Distillates	Mineral Spirit
Straight Run	Naphtha
Flashed Feed Stocks	Solvent
	Petroleum
	Heartcut Distillate Oil

* The list of oils shall not necessarily be considered as comprehensive.



Composition of Common Petroleum Products – General Paraffin Formula C_nH_{2n+2}

Number of Carbon Atoms		C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇	C ₈	C ₉	C ₁₀	C ₁₁	C ₁₂	C ₁₃	C ₁₄	C ₁₅	C ₁₆	C ₁₇	C ₁₈	C ₁₉	C ₂₀	C ₂₁₊
Boiling Point of Normal	°C	-162	-89	-42	-0.5	+36	69	98	126	151	174	196	216	235	253	270	287	302	316	329	343	
Paraffin at one atmosphere	°F	-259	-127	-44	+31	97	156	209	258	303	345	384	421	456	488	519	548	575	601	625	649	

Liquified Natural Gas (LNG)*



Liquified Petroleum Gas (LPG)



Gasoline



VM&P Naphtha



Mineral Spirits



Kerosene, Diesel Fuel



Fuel Oil



Wax



Lubricating Oil



Asphalt Pitch



*Approximately 90% methane or higher

APPENDIX D

CONVERSION FACTORS

Metric Units Used In Part 153

Parameter	Metric (SI unit)	Abbreviation	Equivalent to English or common metric
Force	Newton	N	0.225 lbs.
Length	Meter	m	39.37 in.
	Centimeter	cm	.3937 in.
Pressure	Pascal	Pa	1.450×10^{-4} lbs/in ² .
	Kilo-Pascal (1,000 Pascals)	kPa	0.145 lbs/in ² .
	Kilo-Pascal	kPa	1.02×10^{-2} kg/cm ² .
	do	kPa	1×10^3 N/m ² .
Temperature	Degree Celsius	°C	5/9 (°F-32).
Viscosity	milli-Pascal second	mPa.sec	1.0 centipoise.
Volume	Cubic meter	m ³	264 gallons (gal).
	do	m ³	35.3 ft ³ .

“RULE OF THUMB”

Specific gravity of water:

fresh = 1.00

salt = 1.025 (approx.)

VISCOSITY

Centistokes $\times$ density (grams per ml.) = centipoises

Kinematic viscosity $\times$ density = absolute viscosity

DENSITY

Pound per gal. (U.S.) at 20°C = specific gravity at 20/20°C $\times$ 8.32162

Pound per gal. (U.S.) = 0.119 826 grams per ml.



APPENDIX D

CONVERSION FACTORS

Miscellaneous Conversion Factors

Given this,	multiply by this,	to get this.
atmosphere (atm)	760	mm Hg (at 0°C)
	29.92	in. Hg (at 0°C)
	33.899	ft H ₂ O (at 4°C)
	1.0333	kg/cm ²
	14.69	lb/in. ²
	1.0133	bar
	101.3	kPa
bar	0.987	atm
	750	mm Hg (at 0°C)
	14.5	lb/in. ²
	100	kPa
barrel (U.S. liq.) (bbl)	26.229	gal (Brit)
	31.5	gal (U.S.)
	119.237	l
	4.2109	ft ³
barrel, petroleum	42	gal (U.S.)
foot, H ₂ O (at 4°C)	0.0295	atm
	0.883	in. Hg (at 0°C)
	2.2419	cm Hg (at 0°C)
	0.4335	lb/in. ²
	304.79	kg/m ²
foot ³	0.02832	m ³
	28.316	l
	7.4805	gal (U.S.)
	6.2288	gal (Brit)
gallon, U.S. (gal)	0.8327	gal (Brit)
	128	oz (U.S. liq.)
	8	pt (U.S. liq.)
	4	qt (U.S. liq.)



APPENDIX D

CONVERSION FACTORS

Given this,	multiply by this,	to get this.
gallon, U.S. cont.	3.785	l
	0.1337	ft ³
	8.328	lb fresh H ₂ O (fresh water at 60°F)
	8.336	lb fresh H ₂ O (fresh water at 4°C)
	0.0317	bbl (U.S. liq.)
	0.0238	bbl (petroleum)
gallon, British	1.2009	gal (U.S.)
	4.546	l
	160	oz (Brit liq.)
	0.16054	ft ³
	10	lb H ₂ O (at 60°F)
gallon/minute (U.S.)	8.0208	ft ³ /hr
	0.06309	l/sec
gram (g)	0.001	kg
	0.0353	oz (avoir.)
	0.0022	lb
gram/liter (g/l)	1 000	ppm
	0.008345	lb/gal (U.S.)
	0.0624	lb/ft ³
kilogram/meter ² (kg/m ²)	0.07356	mm Hg (at 0°C)
	0.00142	lb/in. ²
	0.000097	atm
	0.20482	lb/ft ²
kilogram/meter ³ (kg/m ³)	0.06243	lb/ft ³
kilopascal (kPa)	0.1450377 4	lb/in. ²
liter (l)	0.035	ft ³



APPENDIX D

CONVERSION FACTORS

Given this,	multiply by this,	to get this.
liter cont.	0.001	m ³
	0.2642	gal (U.S.)
	0.21998	gal (Brit)
	1.0567	qt (U.S. liq.)
	0.8799	qt (Brit liq.)
liters/min (l/min)	0.035316	ft ³ /min
	0.264179	gal (U.S.)/min
meter ³ (m ³)	35.315	ft ³
	264.172	gal (U.S.)
	219.969	gal (Brit)
	1000	l
millimeter Hg	0.001316	atm
(at 0°C)	0.001333	bar
	1.3595	g/cm ²
	0.0193	lb/in. ²
	1	torr
ounce	28.35	g
(avoirdupois)(oz)		
ounce (U.S. liq.)	29.5737	cc
	0.0296	l
	0.032	qt
ounce (Brit liq.)	28.413	cc
pint (U.S. liq.)	473.176	cc
	0.473163	l
	0.5	qt
pound (lb)	453.5924	g
	0.45359	kg
	16	oz (avdp)



APPENDIX D

CONVERSION FACTORS

Given this,	multiply by this,	to get this.
pound/in. ² (lb/in. ²)	51.715	mm Hg (at 0°C)
	703.07	kg/m ²
	0.068046	atm
	0.06895	bar
	70.307	g/cm ²
	6.894757	kPa
pound/foot ³ (lb/ft ³)	0.01602	g/cc
	16.018	kg/m ³
quart (liquid)	946.353	cc
	0.94633	l
	0.25	gal (U.S.)
ton (short)	907.1847	kg
	2000	lb (avdp)
	0.89286	ton (long)
	0.9072	tonne (metric)
ton (long)	1016.047	kg
	2240	lb (avdp)
	1.12	ton (short)
	1.01605	tonne (metric)
tonne (metric)	1000	kg
	2204.62	lb (avdp)
	1.1023	ton (short)
	0.98421	ton (long)
torr	0.001316	atm
	1.0	mm Hg (at 0°C)



APPENDIX E

TEMPERATURE CONVERSION TABLE

$$(^{\circ}\text{C} \times \frac{9}{5}) + 32 = ^{\circ}\text{F} \quad (^{\circ}\text{F} - 32) \times \frac{5}{9} = ^{\circ}\text{C}$$

To convert			To convert			To convert		
To $^{\circ}\text{F}$	From	To $^{\circ}\text{C}$	To $^{\circ}\text{F}$	From	To $^{\circ}\text{C}$	To $^{\circ}\text{F}$	From	To $^{\circ}\text{C}$
-40.0	-40	-40.0	26.6	-3	-19.4	93.2	34	1.1
-38.2	-39	-39.4	28.4	-2	-18.9	95.0	35	1.7
-36.4	-38	-38.9	30.2	-1	-18.3	96.8	36	2.2
-34.6	-37	-38.3	32.0	0	-17.8	98.6	37	2.8
-32.8	-36	-37.8	33.8	1	-17.2	100.4	38	3.3
-31.0	-35	-37.2	35.6	2	-16.7	102.2	39	3.9
-29.2	-34	-36.7	37.4	3	-16.1	104.0	40	4.4
-27.4	-33	-36.1	39.2	4	-15.6	105.8	41	5.0
-25.6	-32	-35.6	41.0	5	-15.0	107.6	42	5.6
-23.8	-31	-35.0	42.8	6	-14.4	109.4	43	6.1
-22.0	-30	-34.4	44.6	7	-13.9	111.2	44	6.7
-20.2	-29	-33.9	46.4	8	-13.3	113.0	45	7.2
-18.4	-28	-33.3	48.2	9	-12.8	114.8	46	7.8
-16.6	-27	-32.8	50.0	10	-12.2	116.6	47	8.3
-14.8	-26	-32.2	51.8	11	-11.7	118.4	48	8.9
-13.0	-25	-31.7	53.6	12	-11.1	120.2	49	9.4
-11.2	-24	-31.1	55.4	13	-10.6	122.0	50	10.0
-9.4	-23	-30.6	57.2	14	-10.0	123.8	51	10.6
-7.6	-22	-30.0	59.0	15	-9.4	125.6	52	11.1
-5.8	-21	-29.4	60.8	16	-8.9	127.4	53	11.7
-4.0	-20	-28.9	62.6	17	-8.3	129.2	54	12.2
-2.2	-19	-28.3	64.4	18	-7.8	131.0	55	12.8
-0.4	-18	-27.8	66.2	19	-7.2	132.8	56	13.3
1.4	-17	-27.2	68.0	20	-6.7	134.6	57	13.9
3.2	-16	-26.7	69.8	21	-6.1	136.4	58	14.4
5.0	-15	-26.1	71.6	22	-5.6	138.2	59	15.0
6.8	-14	-25.6	73.4	23	-5.0	140.0	60	15.6
8.6	-13	-25.0	75.2	24	-4.4	141.8	61	16.1
10.4	-12	-24.4	77.0	25	-3.9	143.6	62	16.7
12.2	-11	-23.9	78.8	26	-3.3	145.4	63	17.2
14.0	-10	-23.3	80.6	27	-2.8	147.2	64	17.8
15.8	-9	-22.8	82.4	28	-2.2	149.0	65	18.3
17.6	-8	-22.2	84.2	29	-1.7	150.8	66	18.9
19.4	-7	-21.7	86.0	30	-1.1	152.6	67	19.4
21.2	-6	-21.1	87.8	31	-0.6	154.4	68	20.0
23.0	-5	-20.6	89.6	32	0.0	156.2	69	20.6
24.8	-4	-20.0	91.4	33	0.6	158.0	70	21.1



APPENDIX E

TEMPERATURE CONVERSION TABLE

$$(^{\circ}\text{C} \times \frac{9}{5}) + 32 = ^{\circ}\text{F} \quad (^{\circ}\text{F} - 32) \times \frac{5}{9} = ^{\circ}\text{C}$$

To convert			To convert			To convert		
To $^{\circ}\text{F}$	From	To $^{\circ}\text{C}$	To $^{\circ}\text{F}$	From	To $^{\circ}\text{C}$	To $^{\circ}\text{F}$	From	To $^{\circ}\text{C}$
159.8	71	21.7	226.4	108	42.2	293.0	145	62.8
161.6	72	22.2	228.2	109	42.8	294.8	146	63.3
163.4	73	22.8	230.0	110	43.3	296.6	147	63.9
165.2	74	23.3	231.8	111	43.9	298.4	148	64.4
167.0	75	23.9	233.6	112	44.4	300.2	149	65.0
168.8	76	24.4	235.4	113	45.0	302.0	150	65.6
170.6	77	25.0	237.2	114	45.6	303.8	151	66.1
172.4	78	25.6	239.0	115	46.1	305.6	152	66.7
174.2	79	26.1	240.8	116	46.7	307.4	153	67.2
176.0	80	26.7	242.6	117	47.2	309.2	154	67.8
177.8	81	27.2	244.4	118	47.8	311.0	155	68.3
179.6	82	27.8	246.2	119	48.3	312.8	156	68.9
181.4	83	28.3	248.0	120	48.9	314.6	157	69.4
183.2	84	28.9	249.8	121	49.4	316.4	158	70.0
185.0	85	29.4	251.6	122	50.0	318.2	159	70.6
186.8	86	30.0	253.4	123	50.6	320.0	160	71.1
188.6	87	30.6	255.2	124	51.1	321.8	161	71.7
190.4	88	31.1	257.0	125	51.7	323.6	162	72.2
192.2	89	31.7	258.8	126	52.2	325.4	163	72.8
194.0	90	32.2	260.6	127	52.8	327.2	164	73.3
195.8	91	32.8	262.4	128	53.3	329.0	165	73.9
197.6	92	33.3	264.2	129	53.9	330.8	166	74.4
199.4	93	33.9	266.0	130	54.4	332.6	167	75.0
201.2	94	34.4	267.8	131	55.0	334.4	168	75.6
203.0	95	35.0	269.6	132	55.6	336.2	169	76.1
204.8	96	35.6	271.4	133	56.1	338.0	170	76.7
206.6	97	36.1	273.2	134	56.7	339.8	171	77.2
208.4	98	36.7	275.0	135	57.2	341.6	172	77.8
210.2	99	37.2	276.8	136	57.8	343.4	173	78.3
212.0	100	37.8	278.6	137	58.3	345.2	174	78.9
213.8	101	38.3	280.4	138	58.9	347.0	175	79.4
215.6	102	38.9	282.2	139	59.4	348.8	176	80.0
217.4	103	39.4	284.0	140	60.0	350.6	177	80.6
219.2	104	40.0	285.8	141	60.6	352.4	178	81.1
221.0	105	40.6	287.6	142	61.1	354.2	179	81.7
222.8	106	41.1	289.4	143	61.7	356.0	180	82.2
224.6	107	41.7	291.2	144	62.2	357.8	181	82.8



APPENDIX E

TEMPERATURE CONVERSION TABLE

$$(^{\circ}\text{C} \times \frac{9}{5}) + 32 = ^{\circ}\text{F} \quad (^{\circ}\text{F} - 32) \times \frac{5}{9} = ^{\circ}\text{C}$$

To convert			To convert			To convert		
To $^{\circ}\text{F}$	From	To $^{\circ}\text{C}$	To $^{\circ}\text{F}$	From	To $^{\circ}\text{C}$	To $^{\circ}\text{F}$	From	To $^{\circ}\text{C}$
359.6	182	83.3	410.0	210	98.9	460.4	238	114.4
361.4	183	83.9	411.8	211	99.4	462.2	239	115.0
363.2	184	84.4	413.6	212	100.0	464.0	240	115.6
365.0	185	85.0	415.4	213	100.6	465.8	241	116.1
366.8	186	85.6	417.2	214	101.1	467.6	242	116.7
368.6	187	86.1	419.0	215	101.7	469.4	243	117.2
370.4	188	86.7	420.8	216	102.2	471.2	244	117.8
372.2	189	87.2	422.6	217	102.8	473.0	245	118.3
374.0	190	87.8	424.4	218	103.3	474.8	246	118.9
375.8	191	88.3	426.2	219	103.9	476.6	247	119.4
377.6	192	88.9	428.0	220	104.4	478.4	248	120.0
379.4	193	89.4	429.8	221	105.0	480.2	249	120.6
381.2	194	90.0	431.6	222	105.6	482.0	250	121.1
383.0	195	90.6	433.4	223	106.1	483.8	251	121.7
384.8	196	91.1	435.2	224	106.7	485.6	252	122.2
386.6	197	91.7	437.0	225	107.2	487.4	253	122.8
388.4	198	92.2	438.8	226	107.8	489.2	254	123.3
390.2	199	92.8	440.6	227	108.3	491.0	255	123.9
392.0	200	93.3	442.4	228	108.9	492.8	256	124.4
393.8	201	93.9	444.2	229	109.4	494.6	257	125.0
395.6	202	94.4	446.0	230	110.0	496.4	258	125.6
397.4	203	95.0	447.8	231	110.6	498.2	259	126.1
399.2	204	95.6	449.6	232	111.1	500.0	260	126.7
401.0	205	96.1	451.4	233	111.7	501.8	261	127.2
402.8	206	96.7	453.2	234	112.2	503.6	262	127.8
404.6	207	97.2	455.0	235	112.8	505.4	263	128.3
406.4	208	97.8	456.8	236	113.3	507.2	264	128.9
408.2	209	98.3	458.6	237	113.9	509.0	265	129.4

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