FIRE AND EXPLOSION HAZARDS HANDBOOK OF INDUSTRIAL CHEMICALS

by

Tatyana A. Davletshina
Nicholas P. Cheremisinoff, Ph.D.

np

NOYES PUBLICATIONS
Westwood, New Jersey, U.S.A.

Library of Congress Catalog Card Number: 98-22341
ISBN: 0-8155-1429-8
Printed in the United States

Published in the United States of America by
Noyes Publications
Fairview Avenue, Westwood, New Jersey 07675

10 9 8 7 6 5 4 3 2 1

Library of Congress Cataloging-in-Publication Data

Davletshina, Tatyana.
Fire and explosion hazards handbook of industrial chemicals / by Tatyana A. Davletshina, Nicholas P. Cheremisinoff.
p. cm.
Includes bibliographical references and index.
ISBN 0-8155-1429-8
1. Chemicals--Safety measures. 2. Chemicals--Fires and fire prevention. 3. Explosions. I. Cheremisinoff, Nicholas P. II. Title.
TP149.D34 1998
660'.2804--dc21 98-22341
CIP

About the Authors

Tatyana A. Davletshina is consultant to the United States Agency for International Development on environmental and safety management issues for industrial operations in the republics of the former Soviet Union. For the last two years she has been on assignment in Ukraine, assisting in industrial waste management issues at steel plant operations and in the chemical manufacturing sector. Miss Davletshina is a safety engineer with degrees from the Donetsk State University, Ukraine, and West Virginia University, where she obtained a masters degree. She is also a member of the faculty of the Donetsk State Technical University, Ukraine and visiting professor to West Virginia University. She has worked extensively with Ukraine's National Academy of Sciences and has interacted on environmental issues with the Russian Academy of Sciences. She has contributed to the industrial press extensively and is the author of Noyes Publication's *Industrial Fire Safety Deskbook.*

Nicholas P. Cheremisinoff is consultant to the United States Agency for International Development on world health and environmental issues impacting on sustainable development in transitioning countries. At the writing of this volume, he was on assignment in Ukraine as Manager of the Donetsk Industrial Waste Management Program under the Environmental Policy and Technology Project (EPT), addressing sustainable development and environmental policy issues. Under the EPT Program, he additionally assisted the United Nations Development Program and the United States Environmental Protection Agency – Agency for International Affairs, in establishing a Regional Environmental Center, now serving Eastern Europe. Dr. Cheremisinoff has nearly twenty years of industry experience, providing technical consulting to major international corporations and governments. Additionally he has established and assisted several academic institutions in developing training programs dealing with worker safety, hazardous materials handling, and remediation operations. He has contributed extensively to the industrial press as the author, co–author or editor of more than 100 technical books. Dr. Cheremisinoff received his B.S., M.S. and Ph.D. degrees in chemical engineering from Clarkson College of Technology. Contacts with the author can be made through Noyes Publications.

Preface

This book is a compendium of chemical specific fire and chemical reactivity data and information. More than 1000 chemicals have been researched and organized into a reference handbook for fire specialists, chemical handling specialists, and plant safety engineers. The specific information provided for chemicals includes the flammability characteristics, recommended fire extinguishing practices, fire extinguishing agents not to be used, behavior in fires, burning characteristics, chemical reactivity with regard to water and common materials, incompatible chemical mixtures, containment and neutralization methods for spills. This reference book has been designed as a data bank for the hazardous materials handling specialist and industrial safety managers dealing with large chemical inventories. It is intended to be used by fire and loss prevention specialists and as a basis for developing procedures for safe storing and handling of chemicals. The authors have included an extensive physical properties section on chemicals, with information most pertinent to fire response situations.

The intent of the volume is to provide easily understood information that can assist in the proper management and handling of chemicals, as well as providing basic information and guidance that can aid first responders to a hazardous materials incident involving spills and fires. There are numerous data bases and publications on hazardous materials. Depending on the nature and extent of the reader's chemical handling, management and or level of responsibilities for chemicals and worker safety issues, these other references, including electronic data bases may have to be consulted. Additionally, authoritative organizations such as the NFPA, ACGIH, OSHA, NIOSH, IARC, UNDP, USDOT and others, as well as local and company specific safety practices should be heavily consulted when dealing with fire safety issues. Chemical specific fire safety information is provided along with an explanation of important terms used throughout the handbook along with detailed explanation on the organization of materials and how to apply them. The reader is provided detailed explanation of these terms and the limitations of data that have been organized. A substantial Glossary of Terms is also provided in the handbook for the reader's convenience. The data and information was derived from reviews of company specific material safety data sheets (MSDS).

Tatyana A. Davletshina, M.S.
Nicholas P. Cheremisinoff, Ph.D.

Table of Contents

1

Organization of the Book

1.1 INTRODUCTION

The handbook provides ready information on the fire and chemical reactivity of commonly used chemicals. Its purpose is to provide basic information important to the safe handling of chemicals and to help provide guidance in responding to a hazardous materials incident, in particular, incidents involving reactive chemicals and materials posing fire and explosion hazards. The data and information on each chemical have been compiled from several sources, including the CHRIS data base, material safety data sheets from chemical manufacturers and suppliers, and various references cited at the end of this first chapter. This first chapter provides an explanation of the terms used in chemical specific discussions and also provides basic guidance on how to extract information from the handbook.

The volume has been written for chemical handling specialists, first responders to hazardous materials incidents, and firefighters. The basic definition used for a hazard materials incident is any situation that may potentially lead to catastrophic fire or explosion, and or human exposure to a toxic chemical. This situation may result from a spill of a hazardous material, a leak from a storage vessel or shipping container, or the mixing of incompatible chemicals whereby a chemical reaction could occur resulting in the release of energy and generation of toxic and perhaps flammable by-products. The volume provides chemical specific information, providing the reader with rigorous information on the chemical of interest.

There are four chapters to the handbook with specific terms, acronyms and terminology pertinent to each section and the data contained therein. This chapter provides first an overview of the informational data base and second, it provides specific description of the terms pertinent to the four chapters.

1.2 INDEX TO CHEMICAL NAMES AND SYNONYMS

Chapter 2 provides an index of synonyms for chemical compound names. Data sections of the handbook that provide chemical specific information on fire and explosion, and chemical reactivity identify the chemical compound by its most common chemical name. Therefore, if a synonym name is known, the reader may refer to Chapter 2 for a listing of synonyms that cross reference the name to the most common chemical compound name.

Additionally, Chapter 2 provides a listing of regulated chemicals that are known to be flammable or combustible products. This listing is derived from the Hazardous Materials Table of of the Code of Federal Regulations (49 CFR, Parts 100 to 177, Section 173). This information lists chemicals according to their proper shipping name, as designated by the U.S. Department of Transportation, along with their 4-digit shipping number designation. The chemical listing is organized according to the UN hazard class and division, and only those chemicals representing fire and explosion hazards, or are chemically unstable/reactive are listed. Finally, Chapter 2 provides a table that gives the NFPA hazard rating for a large list of chemicals.

1.3 ORGANIZATION OF FIRE, EXPLOSION AND CHEMICAL REACTIVITY DATA

The handbook contains information needed to help personnel make the proper response to handling chemicals and in particular during an emergency situation; as such, this handbook could be carried to the actual scene of a hazardous materials incident. In the latter case, it is intended for use by personnel and others who may be the first to arrive at the site of an accidental discharge or fire and who need readily available and easily understood information about the hazardous properties of the chemical involved. The information provided can assist in determining the proper actions that should be taken immediately to safeguard life and property and to prevent contamination of the environment.

General information on fire safety and toxic chemicals is provided in Chapter 3. This chapter also provides an extensive glossary of fire and hazardous materials handling terminology that the reader may refer to. Chapter 4 contains detailed information on specific chemicals. In particular, Chapter 4 provides chemical specific information on fire and explosion hazards, which represents a class of situations which can be referred to being immediately dangerous to life and health (IDLH). Chemicals that fall into this category pose imminent danger to human health and the environment. Information on the fire characteristics of common chemicals can be found in Chapter 4. Basic fire property data on chemicals is included. Fire terms and terminology that are used in the information in Chapter 4 can be found in the section below. Information on chemical reactivity can also be found in Chapter 4. This information is particularly useful for assessing chemical compatability.

1.4 IMPORTANT TERMS

This section explains the special terms used in the handbook, gives the sources of specific items, and includes other information that will be useful to the reader in interpreting the data.

The expression "Not Pertinent" means that the data item either has no real meaning (such as the flash point of a inflammable chemical) or is not required for assessing a hazardous situation. The expression "Data Not Available" means that the information sought was not found in the general data sources consulted during the preparation of this handbook. In a few cases where important data were not available, values were estimated by usually reliable procedures; all such values are labeled "(est.)". If more accurate values for those items are found, they will be included in later revisions.

The *name* used for each of the chemicals included is either (1) that specified in the Code of Federal Regulations (CFR), Titles 46 and 49 or (2) a common name for those chemicals known to be hazardous during shipment. In this regard, for most chemical names, the shipping name recommended by the USDOT is used as it appears in Title 49 of the CFRs. The data are arranged in alphabetical order by chemical name.

1.4.1 Response to Discharges

In every case of a discharge or leak, it is obvious that an effort should be made to reduce, stop, or contain the flow of material at its source if this can be done safely. The purpose of the terms used in this section is to describe in a general way the cautionary and corrective responses that are well recognized by trained emergency response personnel.

- *"Issue warning"* is used when the chemical is a *poison*, has a *high flammability*, is a *water contaminant*, is an *air contaminant* (so as to be hazardous to life), is an *oxidizing material*, or is *corrosive*. This type of response warning is most often applied for cautionary purposes to restrict ignition, and to restrict contaminated water for human use, farm use, and industrial use.

- *"Restrict access"* is used only for those chemicals that are unusually and immediately hazardous to personnel unless they are protected properly by respirators, eye goggles, protective clothing, etc. This type of cautionary response is sometimes used in a broader sense to ensure exclusion of spectators and others who might ignite flammable compounds.

- *"Evacuate area"* is used primarily for unusually poisonous chemicals or those that ignite easily. The same expression can be used for a cautionary response.

- *"Mechanical containment"* is used for water-insoluble chemicals that float and do not evaporate readily. The corresponding corrective response is *"Contain"*.

- *"Should be removed"* is used for chemicals that cannot be allowed to disperse because of their harmful effect on humans or on the ecological system in general. The term is not used unless there is a reasonable chance of preventing dispersal, after a discharge or leak, by chemical and physical treatment.

- *"Chemical and physical treatment"* is recommended for chemicals that can be removed by skimming, pumping, dredging, burning, neutralization, absorption, coagulation, or precipitation. The corrective response may also include the use of dispersing agents, sinking agents, and biological treatment.

- *"Disperse and flush"* is used for chemicals that can be made non-hazardous to humans by simple dilution with water. In a few cases the response is indicated even when the compound reacts with water because, when proper care is taken, dilution is still the most effective way of removing the primary hazard.

1.4.2 Chemical Designations

Synonyms —Alternative systematic chemical names and commonly used trivial names are given. Commercial or trade names are shown in a few cases where they are in common use. An index of synonyms is included in Chapter 2.

Chemical Compatibility Classification — The U.S. Coast Guard defines 43 cargo groups listed in Navigation and Vessel Inspection Circular No. 4-75, "Guide to Compatibility of Chemicals."

Packing Group — This designation has been given by the USDOT and is assigned to all hazardous materials being shipped. A packing group designation defines the relative hazard of a chemical shipment. The packing group appears as an upper case Roman Numeral **I**, **II** or **III**, depending on the degree of hazard. The meanings of these designations are as follows: **I** refers to Most Hazardous (or Most Regulated); **II** refers to Moderately Hazardous (or Moderately Regulated); **III** refers to Least Hazardous (or Least Regulated). The reader should refer to Section 172.101, part f of Title 49 of the US Code of Federal Regulations (parts 100 to 177) when engaged in the shipment of hazardous materials.

1.4.3 Health Hazards

Personal Protective Equipment — The items are those recommended by (a) manufacturers, either in technical bulletins or in Material Safety Data Sheets, (b) the Manufacturing Chemists Association, or (c) the National Safety Council, for use by personnel while responding to fire or accidental discharge of the chemical. They are intended to protect the lungs, eyes, and skin.

Toxicity by Inhalation (Threshold Limit Value) — The threshold limit value (TLV) is usually expressed in units of parts per million (ppm) - i.e., the parts of vapor (gas) per million parts of contaminated air by volume at 25°C (77°F) and atmospheric pressure. For a chemical that forms a fine mist or dust, the concentration is given in milligrams per cubic meter (mg/m^3). The TLV is defined as the concentration of the substance in air that can be breathed for five consecutive eight-hour workdays (40-hour work week) by most people without adverse effect. (This definition is given by American Conference of Governmental Industrial Hygienists, "Threshold Limit Values for Substance in Workroom Air, Adopted by ACGIH for 1972"). As some people become ill after exposure to concentrations lower than the TLV, this value cannot be used to define exactly what is a "safe" or "dangerous" concentration.

Short-Term Inhalation Limits — The parts of vapor (gas per million parts of contaminated air by volume at 25°C (77°F) and atmospheric pressure is given. The limits are normally given in milligrams per cubic meter for chemicals that can form a fine mist or dust. The values given are the maximum permissible average exposures for the time periods specified. The term Short Term

Exposure Limit (STEL) is also used and is considered interchangeable with Short - Term Inhalation Limit. The STEL designation is derrived from OSH standards.

In some instances the values disagree, or the short-term limits overlap the TLV. These are not errors; the values were supplied by several laboratories, each of which used its own experimental techniques and methods of calculation.

Toxicity by Ingestion — The term LD_{50} (meaning "lethal dose at the 50th percentile population") signifies that about 50% of the animals given the specified dose by mouth will die. Thus, for a chemical whose LD_{50} is below 50 mg/kg, the toxic dose for 50% of animals weighing 70 kg (150 lb) is 70x 50 = 3500 mg = 3.5 g, or less than one teaspoonful; it might be as little as a few drops. For a chemical with an LD_{50} of between 5 to 15g/kg, the LD_{50} would be between a pint and a quart for a 150-lb man. All LD_{50} values have been obtained using small laboratory animals such as rodents, cats, and dogs. The substantial risks taken in using these values for estimating human toxicity are the same as those taken when new drugs are administered to humans for the first time.

Late Toxicity — Where there is evidence that the chemical can cause cancer, mutagenic effects, teratogenic effects, or a delayed injury to vital organs such as the liver or kidney, a qualitative description of the effect is often given on a material safety data sheet. The term can be interpreted as implying long term or chronic effects due to exposure to the chemical. In this respect, a distinction must be made between acute and chronic effects. An acute effect is one in which there is a short term or immediate response, usually due to exposure of the chemical at a high concentration. A chronic effect implies a long term exposure to small doses, with symptoms sometimes taking years to materialize.

Vapor (Gas) Irritant Characteristics — Since MSDSs often provide non-qualifying statements, the most appropriate of five statements listed below is given. (Source: National Academy of Sciences, Committee on Hazardous Materials, "Evaluation of the Hazard of Bulk Water Transportation of Industrial Chemicals, A Tentative Guide," Washington, D.C., 1970.)

1. Vapors are nonirritating to eyes and throat.
2. Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
3. Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
4. Vapors are moderately irritating such that personnel will not usually tolerate moderate or high concentrations.
5. Vapors cause severe irritation of eyes and throat and can cause eye and lung injury. They cannot be tolerated even at low concentrations.

1.4.4 Fire Hazards

Flash Point — This is defined as the lowest temperature at which vapors above a volatile combustible substance will ignite in air when exposed to a flame. Depending on the test method used, the values given are either Tag Closed Cup (C.C.) (ASTM D56) or Cleveland Open Cup (O.C.) (ASTM 093). The values, along with those given below, provide an indication of the relative flammability of the chemical. In general, the open cup value is about 10° to 15°F higher than the closed cup value.

Flammable Limits in Air — The percent concentration in air- (by volume) is given for the lower (LFL) and upper (UFL) limit. The values, along with those for flash point and ignition temperature, give an indication of the relative flammability of the chemical. The limits are sometimes referred to as "lower explosive limit" (LEL) and "upper explosive limit" (UEL). Chapter 3 provides a detailed technical explanation.

Flammabilty Range — Defined as the difference between the UFL and LFL. This difference provides an indication of how wide the falmmability limits of a chemical are. Generally, the wider the range, the more hazardous the chemical may be considered from a fire standpoint.

Fire Extinguishing Agents — The agents are listed in Chapter 4 for specific chemicals in decreasing order of importance. The general capabilities of all agents are described in the fire safety references cited at the end of this chapter.

Fire Extinguishing Agents Not to be Used — The agents listed for specific chemicals in Chapter 4 must not be used because they react with the chemical and create an additional hazard. In some cases they are listed because they are ineffective in putting out the fire.

Special Hazards of Combustion Products — Some chemicals decompose or burn to give off toxic and irritating gases. Such gases may also be given off by chemicals that vaporize in the heat of a fire without either decomposing or burning. If no entry appears with a chemical citation in Chapter 4, the combustion products are thought to be similar to those formed by the burning of oil, gasoline, or alcohol; they include carbon monoxide (poisonous), carbon dioxide, and water vapor. The specific combustion products are usually not well known over the wide variety of conditions existing in fires; some may be hazardous.

Behavior in Fire — Any characteristic behavior that might increase significantly the hazard involved in a fire is described for specific chemicals in Chapter 4. The formation of dense smoke or flammable vapor clouds, and the possibility of polymerization and explosions is stated. Unusual difficulty in extinguishing the fire is also noted.

Ignition Temperature — This is the minimum temperature at which the material will ignite without a spark or flame being present. Along with the values of flash point and flammable limits in air, it gives an indication of the relative flammability of the chemical. It is sometimes called the "autoignition temperature." The method of measurement is given in ASTM A2155.

Electrical Hazard — The ease with which the chemical is ignited by electrical equipment is indicated by the Group and Class assignment made in "Fire Codes," Vol. 5, National Fire Protection Association, Boston, Mass" 1972, pp. 70-289.

Burning Rate — The value is the rate (in millimeters per minute) at which the depth of a pool of liquid decreases as the liquid burns. Details of measurement are given by D.S. Burgess, A. Strasser, and J. Grumer, "Diffusive Burning of Liquid Fuels in Open Trays," Fire Research Abstracts and Reviews, 3,177 (1961).

1.4.5 Chemical Reactivity

Reactivity with Water — The term "No Reaction" means that no hazard results when the chemical reacts or mixes with water. Where a hazard does result, it is described for specific chemicals cited in Chapter 4.

Reactivity with Common Materials — This is limited to hazardous reactions with fuels and with common materials of construction such as metal, wood, plastics, cement, and glass. The nature of the hazard, such as severe corrosion or formation of a flammable gas, is described for specific chemicals in Chapter 4.

Stability During Transport — The term "Stable" means that the chemical will not decompose in a hazardous manner under the conditions of temperature, pressure, and mechanical shock that are normally encountered during shipment; the term does not apply to fire situations. Where there is a possibility of hazardous decomposition, an indication of the conditions and the nature of the hazard is given for specific chemicals cited in Chapter 4.

Neutralizing Agents for Acids and Caustics — In all cases involving accidental discharge, dilution with water may be followed by use of the agent specified, particularly if the material cannot be flushed away; the agent specified need not necessarily be used. This information can be found in Chapter 4.

Polymerization — A few chemicals can undergo rapid polymerization to form sticky, resinous materials, with the liberation of much heat. Under these conditions the chemical's containers may explode due to internal pressure buildup. For these chemicals the conditions under which the reaction can occur are given in Chapter 4.

Inhibitor of Polymerization — The chemical names and concentrations of inhibitors added by the manufacturer to prevent polymerization are given where apropriate.

1.4.6 Hazard Classifications

Code of Federal Regulations — The hazard class specified in the Code of Federal Regulations, Title 49,Part 172. Chemicals not specifically listed therein have been classified as "Flammable" if their flash point (closed cup) is below 100°F.

UN Hazard Classes and Divisions — The hazard class of a material is indicated either by its class (or division) number, or its class name. For a placard corresponding to the primary hazard class of a material, the hazard class or division number must be displayed in the lower corner of the placard. The UN (United Nations) hazard classes are as follows:

Class 1 *Explosives*
- Division 1.1 Explosives with a mass explosion hazard
- Division 1.2 Explosives with a projection hazard
- Division 1.3 Explosives with predominantly a fire hazard
- Division 1.4 Explosives with no significant blast hazard
- Division 1.5 Very insensitive explosives; blasting agents

Division 1.6 Extremely insensitive detonating substances
Class 2 *Gases*
Division 2.1 Flammable gas
Division 2.2 Non-flammable, non-poisonous compressed gas
Division 2.3 Gas poisonous by inhalation
Division 2.4 Corrosive gas
Class 3 *Flammable liquid and Combustible liquid*
Class 4 *Flammable Solid; Spontaneously combustible material; and Dangerous when wet material*
Class 5 *Oxidizers and Organic Peroxides*
Division 5.1 Oxidizer
Division 5.2 Organic peroxide
Class 6 *Poisonous material and infectious substance*
Division 6.1 Poisonous materials
Division 6.2 Infectious substance
Class 7 *Radioactive material*
Class 8 *Corrosive material*
Class 9 *Miscellaneous hazardous material*

NFPA Hazard Classifications — The indicated ratings are given in "Fire Protection Guide on Hazardous Materials," National Fire Protection Association. The classifications are defined in Table 1.

Table 1. Explanation of NFPA Hazard Classifications

Classification	Definition
Health Hazard (blue)	
4	Materials which on very short exposure could cause death or major residual injury even though prompt medical treatment were given.
3	Materials which on short exposure could cause serious temporary or residual injury even though prompt medical treatment were given.
2	Materials which on intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical treatment is given.
1	Materials which on exposure would cause irritation but only minor residual injury even if no treatment is given,
0	Materials which on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material.
Flammabllity (red)	
4	Materials which will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature, or which are readily dispersed in air and which will burn readily.

Table 1 Continued

3	Liquids and solids that can be ignited under almost all ambient temperature conditions.
2	Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.
1	Materials that must be preheated before ignition can occur.
0	Materials that will not burn.
Reactivity (yellow)	
4	Materials which in themselves are readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.
3	Materials which in themselves are capable of detonation or explosive reaction but require a strong initiating source or which must be heated under confinement before initiation or which react explosively with water.
2	Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate. Also materials which may react violently with water or which may form potentially explosive mixtures with water.
1	Materials which in themselves are normally stable, but which can become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.
0	Materials which in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.
Other (white)	
~~W~~	Materials which react so violently with water that a possible hazard results when they come in contact with water, as in a fire situation. Similar to Reactivity Classification.
Oxy	Oxidizing material; any solid or liquid that readily yields oxygen or other oxidizing gas, or that readily reacts to oxidize combustible materials.

1.4.7 Physical and Chemical Properties

Physical State at 15°C and 1 atm — The statement indicates whether the chemical is a solid, liquid, or gas after it has reached equilibrium with its surroundings at "ordinary" conditions of temperature and pressure.

Molecular Weight — The value is the weight of a molecule of the chemical relative to a value of 12 for one atom of carbon. The molecular weight is useful in converting from molecular units to weight units, and in calculating the pressure, volume and temperature relationships for gaseous materials. The ratio of the densities of any two gases is approximately equal to the ratio of their molecular weights. The molecular weights of mixtures can be calculated if both the identity and quantity of each component of the mixture are known.

Boiling Point at 1 atm — The value is the temperature of a liquid when its vapor pressure is 1 atm. For example, when water is heated to 100 °C (212 °F) its vapor pressure rises to 1 atm and the liquid boils. The boiling point at 1 atm indicates whether a liquid will boil and become a gas at any particular temperature and sea-level atmospheric pressure.

Freezing Point — The freezing point is the temperature at which a liquid changes to a solid. For example, liquid water changes to solid ice at 0°C (32°F). Some liquids solidify very slowly even when cooled below their freezing point. When liquids are not pure (for example, salt water) their freezing points are lowered slightly.

Specific Gravity — The specific gravity of a chemical is the ratio of the weight of the solid or liquid to the weight of an equal volume of water at 4°C (or at some other specified temperature). If the specific gravity is less than 1.0 (or less than 1.03 in seawater) the chemical will float; if higher, it will sink.

Vapor (Gas) Specific Gravity — The value is the ratio of the weight of vapor to the weight of an equal volume of dry air at the same conditions of temperature and pressure. Buoyant vapors have a vapor specific gravity less than one. The value may be approximated by the ratio M/29, where M is the molecular weight of the chemical. In some cases the vapor may be at a temperature different from that of the surrounding air. For example, the vapor from a container of boiling methane at -172°F sinks in warm air, even though the vapor specific gravity of methane at 60°F is about 0.6.

Latent Heat of Vaporization — The value is the heat that must be added to the specified weight of a liquid before it can change to vapor (gas). It varies with temperature; the value given is that at the boiling point at 1 atm. The units used are Btu per pound, calories per gram, and joules per kilogram. No value is given for chemicals with very high boiling points at 1 atm, because such substances are considered essentially nonvolatile.

Heat of Combustion — The value is the amount of heat liberated when the specified weight is burned in oxygen at 25°C. The products of combustion, including water, are assumed to remain as gases; the value given is usually referred to as the "lower heat value." A negative sign before the value indicates that heat is given off when the chemical burns. The units typically used are Btu per pound, calories per gram, and joules per kilogram.

Heat of Decomposition — The value is the amount of heat liberated when the specified weight decomposes to more stable substances. Most chemicals are stable and do not decompose under the conditions of temperature and pressure encountered during shipment. A negative sign before the value simply indicates that heat is given off during the decomposition. The value does not include heat given off when the chemical burns. The units typically used are Btu per pound, calories per gram, and joules per kilogram.

Heat of Solution — The value represents the heat liberated when the specified weight of chemical is dissolved in a relatively large amount of water at 25°C ("infinite dilution"). A negative sign before the value indicates that heat is given off, causing a rise in temperature. (A few chemicals absorb heat when they dissolve, causing the temperature to fall.) The units used are Btu per pound, calories per gram, and joules per kilogram. In those few cases where the chemical reacts with water and the reaction products dissolve, the heat given off during the reaction is included in the heat of solution.

Heat of Polymerization — The value is the heat liberated when the specified weight of the compound (usually called the monomer) polymerizes to form the polymer. In some cases the heat liberated is so great that the temperature rises significantly, and the material may burst its container or catch fire. The negative sign before the value indicates that heat is given off during the polymerization reaction. The units used are Btu per pound, calories per gram, and joules per kilogram.

Liquid Heat Capacity — The value is the heat (in Btu) required to raise the temperature of one pound of the liquid one degree Fahrenheit at constant pressure. For example, it requires almost 1 Btu to raise the temperature of 1 pound of water from 68°F to 69°F. The value is useful in calculating the increase in temperature of a liquid when it is heated, as in a fire. The value increases slightly with an increase in temperature.

Liquid Viscosity — The value (in centipoise) is a measure of the ability of a liquid to flow through a pipe or a hole; higher values indicate that the liquid flows less readily under a fixed pressure head. For example, heavy oils have higher viscosities (i.e., are more viscous) than gasoline. Liquid viscosities decrease rapidly with an increase in temperature. A basic law of fluid mechanics states that the force per unit area needed to shear a fluid is proportional to the velocity gradient. The constant of proportionality is the viscosity.

Solubility in Water — The value represents the pounds of a chemical that will dissolve in 100 pounds of pure water. Solubility usually increases when the temperature increases. The following terms are used when numerical data are either unavailable or not applicable: The term "Miscible" means that the chemical mixes with water in all proportions. The term "Reacts" means that the substance reacts chemically with water; thus, its solubility has no real meaning. "Insoluble" usually means that one pound of the chemical does not dissolve entirely in 100 pounds of water. (Weak solutions of "Insoluble" materials may still be hazardous to humans, fish, and waterfowl, however.)

1.4.8 Information Systems

Chemical Transportation Emergency Center (CHEMTREC) — In the United States, the Manufacturing Chemists Association operates CHEMTREC 24 hours a day. By calling the appropriate toll-free number listed below, one can consult experts on chemicals and spill response.

Continental United States (except Alaska & District of Columbia) 800-424-9300

Alaska, Hawaii, and District of Columbia 202-483-7616

National Fire Protection Association (NFPA) — The NFPA's "Recommended System for the Identification of the Fire Hazards of Materials" (NFPA No. 704M) provides basic warning information to fire fighters in industrial plants and storage facilities. This system uses a diamond-shaped warning symbol. The top, left, and right boxes refer to flammability, health, and reactivity hazards respectively and contain a number from 0 to 4. The exact meaning of each number is explained in Table 1 of this chapter, and the applicable numbers for each chemical are listed in Chapter 4. The bottom box is used for special hazards; the most common of these is a warning against the use of water, indicated by the symbol ~~W~~.

Department of Transportation (DOT) — The DOT provides guidelines and mandatory requirements for the safe transportation of hazardous materials. This information can be found in Title 49 of the Code of Federal Regulations (CFR).

1.5 REFERENCES AND RECOMMENDED READINGS

This section cites the primary references that were used in compiling the data for the handbook, and provides an organized summary of key references that the reader should refer to for additional information.

1.5.1 References

In addition to a review of several thousand material safety data sheets, the author consulted and extracted information from the following sources :

1. Cheremisinoff, N.P., J.A. King, Dangerous Properties of Industrial and Consumer Chemicals, Marcel Dekker Publishers, Inc., New York, 1994.
2. NIOSH and OSHA Guidebook to Chemical Hazards, SciTech Publishers, Inc., Morganville, New Jersey, 1987.
3. Title 49 of the Code of Federal regulations, Parts 100 to 177, Washington, DC, Oct. 1993.
4. Emergency Response Guidebook, U.S. Department of Transportation, Washington, DC, 1995.
5. OSHA Analytical Methods Manual, Second Edition, Occupational Safety and Health Administration, Salt Lake City, Utah, 1990.
6. NIOSH Manual of Analytical Methods. Volumes 1 - 7, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1981.
7. Industrial Ventilation, 21st Edition, A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1992.
8. Pocket Handbook for Air Conditioning Heating Ventilation Refrigeration, American Society of Heating, Refrigeration and Air-Conditioning Engineers, Atlanta, Georgia, 1987.
9. Clayton, G.D. and Clayton, F.E., Editors, Patty's Industrial Hygiene and Toxicology, Fourth Edition, Volume 1, John Wiley & Sons, Inc., New York, 1991.
10. McDermott, H. J., Handbook of Ventilation for Contaminant Control. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1981.
11. Mody, V. and Jakhete, R., Dust Control Handbook, Noyes Data Corporation, Park Ridge, New Jersey, 1988.
12. ACGIH, Guide to Occupational Exposure Values, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1990.
13. ACGIH, Industrial Ventilation, 21st Edition, A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1992.
14. ACGIH, Industrial Noise Manual, American Industrial Hygiene Association, Akron, Ohio, 1994.
15. AIHA. Industrial Hygiene. A Guide to Technical Information Sources. American Industrial Hygiene Association, Akron, Ohio, 1984.
16. Aitio, A.V., Riihimaki and H. Vainio. Biological Monitoring and Surveillance of Workers Exposed to Chemicals, Hemisphere Publishing Corporation, Washington, D.C., 1984.
17. Alien, M.D., Ells and A. W. Hart, Industrial Hygiene. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1976.

18. ASHRAE, Pocket Handbook for Air Conditioning Heating Ventilation Refrigeration, American Society of Heating, Refrigeration and Air-Conditioning Engineers, Atlanta, Georgia, 1987.

1.5.2 Recommended Readings

The following references should be consulted for either general information about a specific subject or more detailed data and information. These references are organized for the reader by subject category.

Chemical Specific Data and Information References:

1. Hazards Associated with Organic Chemical Manufacturing: Vinyl Acetate by Hydroacetylation, Mitre Corp., McLean, VA, Report No. MTR-7900378-04, April 1980.
2. Hazards Associated with Organic Chemical Manufacturing: Oxychlorination and Pyrolysis Processes for Vinyl Chloride Production, Mitre Corp., McLean, VA, Report No. MTR-79W00378-03, April 1980.
3. Hazards Associated with Organic Chemical Manufacturing: Esterification Process for Acrylic Acid Esters Production, Mitre Corp., McLean, VA, Report No. MTR-79W00378-01, April 1980.
4. Hazards Associated with Organic Chemical Manufacturing: Condensation Process for DL-Methionine Production, Mitre Corp., McLean, VA, Report No. MTR-79W00378-02, April 1980.
5. Hazards Associated with Organic Chemical Manufacturing: Tetraalkyl Lead by Lead Alkylation, Mitre Corp., McLean, VA, Report No. MTR-78W00364-03, May 1979.
6. Hazards Associated with Organic Chemical Manufacturing: Polymerization Processes for Polyvinyl Chloride and Polyether Glycols, Mitre Corp., McLean, VA, Report No. MTR-79W00364-04, May 1979.
7. Hazards Associated with Organic Chemical Manufacturing: Acetic Acid by Methanol Carbonylation, Mitre Corp., McLean, VA, Report No. MTR-79W00364-01, February 1979.
8. Hazards Associated with Organic Chemical Manufacturing: Acetaldehyde by Liquid Phase Ethylene Oxidation, Mitre Corp., McLean, VA, Report No. MTR-79W00364-02, April 1979.
9. Cheremisinoff, N.P., J.A. King , Dangerous Properties of Industrial and Consumer Chemicals, Marcel Dekker Publishers, Inc., New York, 1994.
10. Federal Motor Carrier Safety Regulations, U. S. Department of Transportation: Federal Highway Administration, Washington, DC, 1992.
11. Driver's Pocket Guide to Hazardous Materials, Tri-State Motor transit Co, Joplin, Missouri, J. J. Keller & Assoc., Wisconsin, 1995.
12. Existing Chemicals of Environmental Relevance: Criteria and List of Chemicals, VCH Verlagsgesellschaft, Federal Republic of Germany, 1989.
13. Nutt, A. R., Toxic Hazards of Rubber Chemicals, Elsevier Applied Science Publishers, Inc., New York, 1984.
14. NIOSH and OSHA Guidebook to Chemical Hazards, SciTech Publishers, Inc., Morganville, New Jersey, 1987.
15. NFPA 72 E, Automatic Fire Detectors, National Fire Protection Association, Qunicy, MA, 1990.
16. Sax, I., Dangerous Properties of Industrial Materials, 5th edition, Van Norstrand Reinhold Publishing Co., New York, 1979.
17. Title 49 of the Code of Federal regulations, Parts 100 to 177, Washington, DC, Oct. 1993.

18. Emergency Response Guidebook, U.S. Department of Transportation, Washington, DC, 1995.
19. Baselt R.C., Biological Monitoring Methods for Industrial Chemicals. Second Edition, PSG Publishing Company, Inc., Littleton, MA, 1988.
20. Clayton G.D. and F. E. Clayton, Editors. Patty's Industrial Hygiene and Toxicology, Fourth Edition. Volume 1. John Wiley & Sons, Inc., New York, 1991.
21. Cralley L.V. and L.J. Cralley, Editors. Industrial Hygiene Aspects of Plant Operations, Volume 1, Process Flows. Macmillan Publishing Co., Inc., New York, 1982.
22. Cralley L.V. and L.J. Cralley, Editors. Patty's Industrial Hygiene and Toxicology. Third Edition, Volumes 1 - 3. John Wiley & Sons, New York, 1979.
23. Garrett J.T., L.J. Cralley and L.V. Cralley, Editors. Industrial Hygiene Management, John Wiley & Sons, New York, 1988.
24. Halliday D.A., Editor. Air Monitoring Methods for Industrial Contaminants, Biomedical Publications, Davis, CA, 1983.
25. Hawkins N.C., S.K. Norwood and J.C. Rock, Editors. A Strategy for Occupational Exposure Assessment. American Industrial Hygiene Association, Akron, OH, 1991.
26. Klaassen C.D., M.O. Amdur and J. Doull, Editors. Casarett and Doull's Toxicology, Third Edition. Macmillan Publishing Company, New York, 1986.
27. Linch A.L., Biological Monitoring for Industrial Chemical Exposure Control, CRC Press, Cleveland, Ohio, 1974.
28. MacMahon B. and T.F. Pugh, Epidemiology Principles and Methods. Little, Brown and Company, Boston, 1970.
29. McDermott H.J., Handbook of Ventilation for Contaminant Control. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1981.
30. Mody V., and R. Jakhete. Dust Control Handbook. Noyes Data Corporation, Park Ridge, New Jersey, 1988.
31. NIOSH, NIOSH Manual of Analytical Methods. Volumes 1 - 7. National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1981.
32. NIOSH, NIOSH Pocket Guide to Chemical Hazards. National Institute for Occupational Safety and Health, Cincinnati, Ohio, June 1990.
33. NIOSH, The Industrial Environment - Its Evaluation & Control, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1973.
34. Olishifski J.B., and E.R. Harford, Editors. Industrial Noise and Hearing Conservation, National Safety Council, Chicago, IL, 1975.
35. OSHA, OSHA Analytical Methods Manual. Second Edition. Occupational Safety and Health Administration, Salt Lake City, Utah, January 1990.
36. Polg B.A., Editor. Fundamentals of Industrial Hygiene. Third Edition. National Safety Council, Chicago, IL, 1988.
37. Sheldon L., M. Umana, J. Bursey, W. Gutknecht, R. Handy, P. Hyidburg, L. Michael, A. Moseley, J. Raymer, D. Smith, C. Sparacino and M. Wamer. Biological Monitoring Techniques for Human Exposure to Industrial Chemicals. Noyes Publications, Park Ridge, N. J., 1986.
38. Wamer P.O., Analysis of Air Pollutants, John Wiley & Sons, New York, 1976.

General Information References :

1. Pipitone, D.A., Safe Storage of Laboratory Chemicals, Wiley-Interscience Publication, New York, 1984.

2. Occupational Carcinigenesis, Edited by U. Saffiotti and J. K. Wagoner, National Academy of Science, ANYAA 9, Vol. 271, New York, 1976.
3. Guide to Safe Handling of Compressed Gases, Matheson - Division of Searle Medical Products, New Jersey, 1982.
4. Baker, W., A. L. Mossman and D. Siegel, Effects of Exposure to Toxic Gases, Matheson - Division of Searle Medical Products, New Jersey, 1977.
5. Coleman, R. J. and K. H. Williams, Hazardous Materials Dictionary, Technomic Publishing Co., Lancaster, PA, 1988.
6. Burgess, W.A., Recognition of Health Hazards in Industry: A Review of Materials and Processes, Wiley-Interscience Publishers, Inc., New York, 1981.
7. Cheremisinoff, P. N., Hazardous Materials Emergency Response Pocket Handbook, Technomic Publishers, Inc., Lancaster, PA, 1989.
8. Carson, P.A. and C. J. Mumford, The Safe Handling of Chemicals in Industry, Wiley-Interscience Publishers, Inc., New York, 1988.
9. Chemical Safety Information Sources, United Nations Environment Program, Nairobi, Kenya, 1993.
10. Che Man, A. B. and D. Gold, Safety and Health in the Use of Chemicals at Work: A Training Manual, International Labor Organization, Geneva, 1993.
11. Fire, F. A., The common Sense Approach to Hazardous Materials, PennWell Publishers, New York, 1986.
12. Fawcett, H., H., Hazardous and Toxic Materials: Safe Handling and Disposal, Wiley-Interscience Publishers, Inc., New York, 1988.
13. King, R. and J. Magid, Industrial Hazard and Safety Handbook, Newnes-Butterworth Publishers, Oxford, 1979.
14. Knudsin, R.B., Editor, Airborne Contagion, Anals of the New York Academy of Sciences, Vol. 353, New York, 1980.
16. Landis, W. G., J. S. Hughes and M. A. Lewis. Editors, Environmental Toxicology and Risk Assessment,
ASTM Publication Code 04-011790-16, American Society of Testing Materials, Philadelphia, PA, 1993.
17. Gorsuch, J. W., F. J. Dwyer, et. Al. Editors, Environmental Toxicology and Risk Assessment - Vol. 2, ASTM Publication Code 04-012160-16, American Society of Testing Materials, Philadelphia, PA, 1993.
18. Hughes, J.S., G.R. Biddinger and E. Mones, Editors, Environmental Toxicology and Risk Assessment, ASTM Publication Code 04-012180-16, American Society of Testing Materials, Philadelphia, PA, 1995.
19. International Agency for Research on Cancer, IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Vol. 20, World Health Organization, Lyon, 1978.
20. Cheremisinoff, N. P. and P. N. Cheremisinoff, Hazardous Materials and Waste Management: A Guide for the Professional Hazards Manager, Noyes Publications, Park Ridge, New Jersey, 1995.
21. Cheremisinoff, N. P., Transportation of Hazardous Materials: A Guide to Compliance, Noyes Publications, Park Ridge, New Jersey, 1994.
22. Cheremisinoff, N. P., Handbook of Pollution and Hazardous Materials Compliance, Marcel Dekker Publishers, New York, 1996.
23. DePol, D. R. and P. N. Cheremisinoff, Emergency Response to Hazardous Materials Incidents, Technomic Publishers, Inc., Lancaster, PA, 1984.

24. Henry, R.J., Clinical Chemistry: Principles and Technics, Harper and Row Publishers, Los Angeles, CA, 1968.
25. Cheremisinoff, N. P., Handbook of Emergency Response to Toxic Chemical Releases, Noyes Publishers, Inc., Park Ridge, New Jersey, 1995.

2

Index to Chemical Names and Synonyms

2.1 INTRODUCTION

This chapter is comprised of three sections that can assist the reader in extracting information on chemicals and their fire hazards and or chemical reactivity. The first section provides an extensive index of synonyms for chemical compounds. Synonym names are provided for several hundred chemicals along with their most common chemical name. The second section provides a listing of chemicals along with their NFPA hazard ratings. The NFPA number hazard rating system is explained in Chapter 1. The last section of this chapter provides a list of the DOT regulated chemicals that fall into the UN hazard categories of flammable materials, oxidizers, organic peroxides, water reactive chemicals, and flammable gases. This list has been compiled from the Hazard Materials Table of 49 CFR, Parts 100 to 177. The listing includes the proper shipping name designation and the 4-digit ID number of the chemical.

2.2 INDEX OF SYNONYMS

Following is an index of synonyms corresponding to common chemical compound names. Sections of the handbook that provide information on the hazardous properties of chemicals, reference the chemical by its most common chemical compound name. This index should be used to identify a common name if the synonym is known.

Synonym	*Compound Name*
Aatrex Herbicide	Atrazine
Acetaldehyde	Acetaldehyde
Acetic Acid	Acetic Acid
Acetic Acid, Ammonium Salt	Ammonium Acetate
Acetic Acid, Butyl Ester	n-Butyl Acetate

Synonym	*Compound Name*
Acetic Acid, Cupric Salt	Copper Acetate
Acetic Acid, Dimethylamide	Dimethylacetamide
Acetic Acid, Ethyl Ester	Ethyl Acetate
Acetic Acid, Isobutyl Ester	Isobutyl Acetate
Acetic Acid, Isopropyl Ester	Isopropyl Acetate
Acetic Acid, Methyl Ester	Methyl Acetate
Acetic Acid, Nickel (II) Salt	Nickel Acetate
Acetic Acid, Propyl Ester	n-Propyl Acetate
Acetic Acid, Sec-Butyl Ester	Sec-Butyl Acetate
Acetic Acid, Zinc Salt	Zinc Acetate
Acetic Aldehyde	Acetaldehyde
Acetic Anhydride	Acetic Anhydride
Acetic Ester	Ethyl Acetate
Acetic Ether	Ethyl Acetate
Acetoacetic Acid, Ethyl Ester	Ethyl Acetoacetate
Acetoacetic Ester	Ethyl Acetoacetate
Acetone	Acetone
Acetone Cyanohydrin	Acetone Cyanohydrin
Acetonitrile	Acetonitrile
Acetophenone	Acetophenone
Acetylacetone	Acetylacetone
Acetylbenzene	Acetophenone
Acetyl Bromide	Acetyl Bromide
Acetyl Chloride	Acetyl Chloride
Acetylene	Acetylene
Acetylene Dichloride	1,2-Dichloroethylene
Acetylene Tetrachloride	Tetrachloroethane
Acetylenogen	Calcium Carbide
Acetyl Hydroperoxide	Peracetic Acid
Acetyl Peroxide Solution	Acetyl Peroxide Solution
Acid Ammonium Carbonate	Ammonium Bicarbonate
Acid Ammonium Fluoride	Ammonium Bifluoride
Acid Calcium Phosphate	Calcium Phosphate
Acraldehyde	Acrolein
Acridine	Acridine
Acrolein	Acrolein
Acrylaldehyde	Acrolein
Acrylamide	Acrylamide
Acrylic Acid	Acrylic Acid
Acrylic Acid, Butyl Ester	N-Butyl Acrylate
Acrylic Acid. Ethyl Ester	Ethyl Acrylate

Synonym	*Compound Name*
Acrylic Acid, 2-Ethylhexyl Ester	Ethylhexyl Acrylate, Inhibited
Acrylic Acid, Isobutyl Ester	Iso-Butyl Acrylate
Acrylic Acid, Methyl Ester	Methyl Acrylate
Acrylic Aldehyde	Acrolein
Acrylic Amide, 50 %	Acrylamide
Acrylonitrile	Acrylonitrile
Activated Charcoal	Charcoal
Adacene-12	1-Dodecene
Adipic Acid	Adipic Acid
Adipic Acid, Bis(2-Ethylhexyl) Ester	Dioctyl Adipate
Adipinic Acid	Adipic Acid
Adipol 2 EH	Dioctyl Adipate
Adiponitrile	Adiponitrile
Adronal	Cyclohexanol
Aerosol Surfactant	Dioctyl Sodium Sulfosuccinate
Aerothene	Trichloroethane
Aficide	Benzene Hexachloride
Agrocide	Benzene Hexachloride
Albone	Hydrogen Peroxide
Albus	Mercuric Ammonium Chloride
Alcohol	Ethyl Alcohol
Alcohol C -10	N-Decyl Alcohol
Alcohol C-8	Octanol
Aldehyde C -10	Decaldehyde
Aldehyde-Collidine	Methylethylpyridine
Aldehydine	Methylethylpyridine
Aldifen	2.4-Dinitrophenol
Aldrin	Aldrin
Algylen	Trichloroethylene
Alkylbenzenesulfonic Acids	Alkylbenzenesulfonic Acids
Alkylbenzenesulfonic Acid, Sodium Salt	Sodium Alkylbenzenesulfonates
Allene-Methylacetylene Mixture	Methylacetylene-Propadiene Mixture
Allomaleic Acid	Fumaric Acid
Allyl Alcohol	Allyl Alcohol
Allyl Bromide	Allyl Bromide
Allyl Chloride	Allyl Chloride
Allyl Chlorocarbonate	Allyl Chloroformate
Allyl Chloroformate	Allyl Chloroformate
Allylsilicone Trichloride	Allyltrichlorosilane
Allyl Trichlorosilane	Allyltrichlorosilane
Aluminum Chloride	Aluminum Chloride

Synonym	*Compound Name*
Aluminum Ethyl Dichloride EADC	Ethylaluminum Dichloride
Aluminum Ethyl Dichloride	Ethylaluminum Dichloride
Aluminum Fluoride	Aluminum Fluoride
Aluminum Nitrate	Aluminum Nitrate
Aluminum Nitrate Nonahydrate	Aluminum Nitrate
Aluminum Sulfate	Aluminum Sulfate
Aluminum Triethyl	Triethylaluminum
Aluminum Triisobutyl	Triisobutylaluminum
Amchlor	Ammonium Chloride
Aminobenzene	Aniline
1-Aminobutane	N-Butylamine
Aminocaproic Lactam	Caprolactam, Liquid
1-Amino-4-Chlorobenzene	P-Chloroaniline
2-Amino-5-Chlorotoluene	4-Chloro-O-Toluidine
Aminocyclohexane	Cyclohexylamine
Aminoethane	Ethylamine
2-Aminoethanol	Monoethanolamine
Beta-Aminoethyl Alcohol	Monoethanolamine
2-((2-Aminoethyl) Amino)Ethanol	Aminoethylethanolamine
N-(2-Aminoethyl)Ethanolamine	Aminoethylethanolamine
Aminoethylethanolamine	Aminoethylethanolamine
Aminoform	Hexamethylenetetramine
2-Aminoisobutane	Tert-Butylamine
Aminomercuric Chloride	Mercuric Ammonium Chloride
Aminomethane	Methylamine
2-Amino-1-Methylbenzene	O-Toluidine
1-Amino-2-Methylpropane	Isobutylamine
2-Amino-2-Methylpropane	Tert-Butylamine
1-Aminonaphthalene	1-Naphthylamine
1-Amino-2-Nitrobenzene	2-Nitroaniline
1-Amino-4-Nitrobenzene	4-Nitroaniline
2-Aminopropane	Isopropylamine
1-Amino-2-Propanol	Monoisopropanolamine
2-Aminotoluene	O-Toluidine
Alpha-Aminotoluene	Benzylamine
Ammate	Ammonium Sulfamate
Ammoform	Hexamethylenetetramine
Ammoneric	Ammonium Chloride
Ammonia Anhydrous	Ammonia Anhydrous
Ammonia Soap	Ammonium Oleate
Ammoniated Mercury	Mercuric Ammonium Chloride

Synonym	*Compound Name*
Ammonia Water	Ammonium Hydroxide
Amfonioformaldehyde	Hexamethylenetetramine
Ammonium Acetate	Ammonium Acetate
Ammonium Acid Fluoride	Ammonium Bifluoride
Ammonium Amidosulfonate	Ammonium Sulfamate
Ammonium Amidosulphate	Ammonium Sulfamate
Ammonium Benzoate	Ammonium Benzoate
Ammonium Bicarbonate	Ammonium Bicarbonate
Ammonium Bichromate	Ammonium Dichromate
Ammonium Bifluoride	Ammonium Bifluoride
Ammonium Carbonate	Ammonium Carbonate
Ammonium Chloride	Ammonium Chloride
Ammonium Citrate	Ammonium Citrate
Ammonium Citrate, Dibasic	Ammonium Citrate
Ammonium Decaborate Octahydrate	Ammonium Pentaborate
Ammonium Dichromate	Ammonium Dichromate
Ammonium Disulfate-Nickelate (II)	Nickel Ammonium Sulfate
Ammonium Ferric Citrate	Ferric Ammonium Citrate
Ammonium Ferric Oxalate Trihydrate	Ferric Ammonium Oxalate
Ammonium Ferrous Sulfate	Ferrous Ammonium Sulfate
Ammonium Fluoride	Ammonium Fluoride
Ammonium Fluosilicate	Ammonium Silicofluoride
Ammonium Formate	Ammonium Formate
Ammonium Gluconate	Ammonium Gluconate
Ammonium Hydrogen Carbonate	Ammonium Bicarbonate
Ammonium Hydrogen Fluoride	Ammonium Bifluoride
Ammonium Hydrogen Sulfide Solution	Ammonium Sulfide
Ammonium Hydroxide	Ammonium Hydroxide
Ammonium Hypo	Ammonium Thiosulfate
Ammonium Hyposulfite	Ammonium Thiosulfate
Ammonium Iodide	Ammonium Iodide
Ammonium Iron Sulfate	Ferrous Ammonium Sulfate
Ammonium Lactate	Ammonium Lactate
Ammonium Lactate Syrup	Ammonium Lactate
Ammonium Lauryl Sulfate	Ammonium Lauryl Sulfate
Ammonium Molybdate	Ammonium Molybdate
Ammonium Muriate	Ammonium Chloride
Ammonium Nickel Sulfate	Nickel Ammonium Sulfate
Ammonium Nitrate	Ammonium Nitrate
Ammonium Nitrate-Urea Solution	Ammonium Nitrate-Urea Solution
Ammonium Oleate	Ammonium Oleate

Synonym	*Compound Name*
Ammonium Oxalate	Ammonium Oxalate
Ammonium Oxalate Hydrate	Ammonium Oxalate
Ammonium Pentaborate	Ammonium Pentaborate
Ammonium Pentaborate Tetrahydrate	Ammonium Pentaborate
Ammonium Pentachlorozincate	Zinc Ammonium Chloride
Ammonium Perchlorate	Ammonium Perchlorate
Ammonium Peroxydisulfate	Ammonium Persulfate
Ammonium Persulfate	Ammonium Persulfate
Ammonium Phosphate	Ammonium Phosphate
Ammonium Phosphate, Dibasic	Ammonium Phosphate
Ammonium Rhodanate	Ammonium Thiocyanate
Ammonium Rhodanide	Ammonium Thiocyanate
Ammonium Silicofluoride	Ammonium Silicofluoride
Ammonium Stearate	Ammonium Stearate
Ammonium Sulfamate	Ammonium Sulfamate
Ammonium Sulfate	Ammonium Sulfate
Ammonium Sulfhydrate Solution	Ammonium Sulfide
Ammonium Sulfide	Ammonium Sulfide
Ammonium Sulfide Solution	Ammonium Sulfide
Ammonium Sulfite	Ammonium Sulfite
Ammonium Sulfocyanate	Ammonium Thiocyanate
Ammonium Sulfocyanide	Ammonium Thiocyanate
Ammonium Tartrate	Ammonium Tartrate
Ammonium Thiocyanate	Ammonium Thiocyanate
Ammonium Thiosulfate	Ammonium Thiosulfate
Ammonium Zinc Chloride	Zinc Ammonium Chloride
Amorphous Phosphorus	Phosphorus, Red
AMS	Ammonium Sulfamate
Amyl Acetate	Amyl Acetate
Amyl Acetates, Mixed Isomers	Amyl Acetate
N-Amyl Alcohol	N-Amyl Alcohol
1-Amyl Alcohol	N-Amyl Alcohol
Amyl Aldehyde	Valeraldehyde
Amyl Carbinol	Hexanol
Amyl Chloride	N-Amyl Chloride
N-Amyl Chloride	N-Amyl Chloride
Alpha-N-Amylene	1-Pentene
Amyl Hydrosulfide	N-Amyl Mercaptan
N-Amyl Mercaptan	N-Amyl Mercaptan
N-Amyl MethylKetone	N-Amyl Methyl Ketone
N-Amyl Nitrate	N-Amyl Nitrate

Synonym	*Compound Name*
Arsenic Acid	Arsenic Acid
Arsenic Chloride	Arsenic Trichloride
Arsenic Disulfide	Arsenic Disulfide
Arsenic Pentoxide	Arsenic Acid
Arsenic Sesquioxide	Arsenic Trioxide
Arsenic Trichloride	Arsenic Trichloride
Arsenic (III) Trichloride	Arsenic Trichloride
Arsenic Trioxide	Arsenic Trioxide
Arsenic T risulfide	Arsenic Trisulfide
Arsenic Yellow	Arsenic Trisulfide
Arsenious Chloride	Arsenic Trichloride
Arsenous Acid	Arsenic Trioxide
Arsenous Acid Anhydride	Arsenic Trioxide
Arsenous Chloride	Arsenic Trichloride
Arsenous Oxide	Arsenic Trioxide
Arsicodile	Sodium Cacodylate
Arsycodile	Sodium Cacodylate
Artic	Methyl Chloride
Artificial Cinnabar	Mercuric Sulfide
Asphalt	Asphalt
Asphalt Cements	Asphalt
Asphaltic Bitumen	Asphalt
Asphaltum Oil	Asphalt Blending
ATE	Triethylaluminum
Atrazine	Atrazine
10-Azaanthracene	Acridine
Azacycloheptane	Hexamethyleneimine
1-Azanaphthalene	Quinoline
Azinphosmethyl	Azinphosmethyl
Azirane	Ethyleneinine
Aziridine	Ethyleneimine
Barium Binoxide	Barium Peroxide
Barium Carbonate	Barium Carbonate
Barium Chlorate	Barium Chlorate
Barium Chlorate Monohydrate	Barium Chlorate
Barium Dioxide	Barium Peroxide
Barium Nitrate	Barium Nitrate
Barium Perchlorate	Barium Perchlorate
Barium Perchlorate Trihydrate	Barium Perchlorate
Barium Permanganate	Barium Permanganate
Barium Peroxide	Barium Peroxide

Synonym	*Compound Name*
Benzoyl Superoxide	Dibenzoyl Peroxide
Benzyl Alcohol	Benzyl Alcohol
Benzylamine	Benzylamine
Benzyl Bromide	Benzyl Bromide
Benzyl N-Butyl Phthalate	Benzyl N-Butyl Phthalate
Benzylcarbonyl Chloride	Benzyl Chloroformate
Benzyl Chloride	Benzyl Chloride
Benzyl Chlorocarbonate	Benzyl Chloroformate
Benzyl Chloroformate	Benzyl Chloroformate
Benzyltrimethylammonium Chloride	Benzyltrimethylammonium Chloride
Beryllia	Beryllium Oxide
Beryllium Chloride	Beryllium Chloride
Beryllium Fluoride	Beryllium Fluoride
Beryllium, Metallic	Beryllium, Metallic
Beryllium Nitrate	Beryllium Nitrate
Beryllium Nitrate Trihydrate	Beryllium Nitrate
Beryllium Oxide	Beryllium Oxide
Beryllium Sulfate	Beryllium Sulfate
Beryllium Sulfate Tetrahydrate	Beryllium Sulfate
Betaprone	Beta-Propiolactone
BHC	Benzene Hexachloride
Bichrome	Potassium Dichromate
Bicyclo (4,4,0) Decane	Decahydronaphthalene
Bieberite	Cobalt Sulfate
Biethylene	Butadiene, Inhibited
Biformal	Glyoxal, 40%Solution
Biformyl	Glyoxal, 40% Solution
Biphenyl-Diphenyl Ether	Dowtherm
Bis(Acetato)Dioxouranium	Uranyl Acetate
Bis(2-Aminoethyl)Amine	Diethylenetriamine
N,N-Bis(2-Aminoethyl) Ethylenediamine	Triethylenetetramine
Bis(P-Chlorobenzoyl) Peroxide	01-(P-Chlorobenzoyl) Peroxide
Bis(2-Chloroethyl) Ether	Dichloroethyl Ether
Bis(2-Chloroethyl) Ether	Dichloroethyl Ether
Bis(Dimethylthiocarbamyl) Disulfide	Thiram
Bis(Dimethylthiocarbamyl) Disulfide	Thiram
Bis(2-Ethylhexyl) Hydrogen Phosphate	Di-(2-Ethylhexyl) Phosphoric Acid
Bis-(2-Ethylhexyl)Hydrogen Phosphate	Di-(2-Ethylhexyl) Phosphoric Acid
Bis(2-Ethylhexyl) Phthalate	Dioctyl Phthalate
Bis(2-Ethylhexyl)Sodium Sulfosuccinate	Dioctyl Sodium Sulfosuccinate
Bis(2-(2-Hydroxyethoxy)Ethyl) Ether	Tetraethylene Glycol

Synonym	*Compound Name*
Bromomethane	Methyl Bromide
3-Bromopropene	Allyl Bromide
3-Bromopropylene	Allyl Bromide
Alpha-bromotoluene	Benzyl Bromide
Bromotoluene, Alpha	Benzyl Bromide
Omega-Bromotoluene	Benzyl Bromide
Brucine	Brucine
Brucine Dihydrate	Brucine
BTMAC	Benzyltrimethylammonium Chloride
Bunker C Oil	Fuel Oil: 6
1,3-Butadiene	Butadiene, Inhibited
Butadiene, Inhibited	Butadiene, Inhibited
Butal	N-butyraldehyde
Butaldehyde	N-butyraldehyde
Butanal	N-butyraldehyde
I-Butanamine, N-butyl	Di-N-Butylamine
Butane	Butane
N-Butane	Butane
1,4-Butanedicarboxylic Acid	Adipic Acid
1,4-Butanediol	1,4-Butanediol
1-butanethiol	N-Butyl Mercaptan
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-Butanone	Methyl Ethyl Ketone
Trans-2-Butenal	Crotonalcehyde
1-Butene	Butylene
Cis-Butenedioic Acid	Maleic Acid
Trans-Butenedioic Acid	Fumaric Acid
Cis-Butenedioic Anhydride	Maleic Anhydride
1,4-Butenediol	1,4-Butenediol
Cis-2-Butene-1,4-Diol	1,4-Butenediol
3-Buten-2-One	Methyl Vinyl Ketone
1-Butene Oxide	Butylene Oxide
Butene Resins	Polybutene
1-Butoxybutane	Di-N-Butyl Ether
Butoxydiethylene Glycol	Diethylene Glycol Monobutyl Ether
Butoxydiclycol	Diethylene Glycol Mohobutyl Ether
2-Butoxyethanol	Ethylene Glycol Monobutyl Ether

Synonym	*Compound Name*
1,2-Butylene Oxide	Butylene Oxide
Butyl Ethanoate	N-Butyl Acetate
Butyl Ether	Di-N-Butyl Ether
N-Butylether	Di-N-Butyl Ether
Butylethylacetaldehyde	Ethylhexaldehyde
Tert-Butyl Hydroperoxide	Tert-Butyl Hydroperoxide
N-Butyl Mercaptan	N-Butyl Mercaptan
Butyl Methacrylate	N-butyl Methacrylate
N-butyl Methacrylate	N-Butyl Methacrylate
Butyl 2-methacrylate	N-Butyl Methacrylate
N-butyl Methyl Ketone	Methyl N-Butyl Ketone
Butyl 2-Methyl-2-Propenoate	N-Butyl Methacrylate
P-Tert-Butylphenol	P-Tert-Butylphenol
Butyl Phthalate	Dibutyl Phthalate
Butyl 2-Propenoate	N-Butyl Acrylate
Butyl Titanate	Tetrabutyl Titanate
Butyl Titanate Monomer	Tetrabutyl Titanate
Butyl 2,4,5-Trichlorophenoxyacetate	2,4,5-T(Esters)
Butyltrichlorosilane	Butyltrichlorosilane
N-butyltrichlorosilane	Butyltrichlorosilane
1,4-Butynediol	1,4-Butynediol
2-butyne-1,4-Diol	1,4-Butynediol
Butyral	N-Butyraldehyde
Butyraldehyde	N-butyraldehyde
Iso-Butyraldehyde	Iso-Butyraldehyde
N-Butyraldehyde	N-butyraldehyde
Butyric Acid	N-Butyric Acid
N-Butyric Acid	N-Butyric Acid
Butyric Acid, Ethyl Ester	Ethyl Butyrate
Butyric Aldehyde	N-butyraldehyde
Butyric Ether	Ethyl Butyrate
Cacodylic Acid	Cacodylic Acid
Cadmium Acetate	Cadmium Acetate
Cadmium Acetate Dihydrate	Cadmium Acetate
Cadmium Bromide	Cadmium Bromide
Cadmium Bromide Tetrahydrate	Cadmium Bromide
Cadmium Chloride	Cadmium Chloride
Cadmium Fluoborate	Cadmium Fluoroborate
Cadmium Fluoroborate	Cadmium Fluoroborate
Cadmium Fume	Cadmium Oxide
Cadmium Nitrate	Cadmium Nitrate

Synonym	*Compound Name*
Cadmium Nitrate Tetrahydrate	Cadmium Nitrate
Cadmium Oxide	Cadmium Oxide
Cadmium Sulphate	Cadmium Sulfate
Cadox HDP	Cyclohexanone Peroxide
Cadox PS	DI-(p-Chlorobenzoyl) Peroxide
Cadox TBH	Tert-Butyl Hydroperoxide
Cake Alum	Aluminum Sulfate
Calcium	Calcium Phosphate
Calcium Abietate	Calcium Resinate
Calcium Alkylbenzenesulfonate	Dodecylbenzenesulfonic Acid, Calcium Salt
Calcium Arsenate	Calcium Arsenate
Calcium Biphosphate	Calcium Phosphate
Calcium Carbide	Calcium Carbide
Calcium Chlorate	Calcium Chlorate
Calcium Chloride	Calcium Chloride
Calcium Chloride Hydrates	Calcium Chloride
Calcium Chloride, Anhydrous	Calcium Chloride
Calcium Chromate	Calcium Chromate
Calcium Chromate Dihydrate	Calcium Chromate
Calcium Chromate (VI)	Calcium Chromate
Calcium Cyanide	Calcium Cyanide
Calcium Dioxide	Calcium Peroxide
Calcium Fluoride	Calcium Fluoride
Calcium Hydroxide	Calcium Hydroxide
Calcium Hypochlorite	Calcium Hypochlorite
Calcium Monohydrogen Phosphate	Calcium Phosphate
Calcium, Metallic	Calcium, Metallic
Calcium Nitrate	Calcium Nitrate
Calcium Nitrate Tetrahydrate	Calcium Nitrate
Calcium Oxide	Calcium Oxide
Calcium Peroxide	Calcium Peroxide
Calcium Phosphate	Calcium Phosphate
Calcium	Calcium Phosphate
Calcium Phosphide	Calcium Phosphide
Calcium Resinate	Calcium Resinate
Calcium Resinate, Fused	Calcium Resinate
Calcium Rosin	Calcium Resinate
Calcium Superphosphate	Calcium Phosphate
Calochlor	Mercuric Chloride
Calomel	Mercurous Chloride

Synonym	*Compound Name*
Camphene	Camphene
Camphor Oil	Camphor Oil
Cane Sugar	Sucrose
Capraldehyde	Decaldehyde
Capric Alcohol	N-Decyl Alcohol
Capric Aldehyde	Decaldehyde
Caproaldehyde	N-Hexaldehyde
Caproic Aldehyde	N-Hexaldehyde
Epsilon-caprolactam	Caprolactam, Liquid
Caprolactam, Liquid	Caprolactam, Liquid
Capronaldehyde	N-Hexaldehyde
N-Caproylaldehyde	N-Hexaldehyde
Caprylene	1-Octene
Captan	Captan
Carbamide	Urea
Carbamide Peroxide	Urea Peroxide
Carbaryl	Carbaryl
Carbide	Calcium Carbide
Carbinol	Methyl Alcohol
Carbitol	Diethylene Glycol Monoethyl Ether
Carbobenzoxy Chloride	Benzyl Chloroformate
Carbolic Acid	Phenol
Carbolic Oil	Carbolic Oil
Carbon Bisulfide	Carbon Bisulfide
Carbon Dioxide	Carbon Dioxide
Carbon Disulfide	Carbon Bisulfide
Carbonic Acid Diethyl Ester	Diethyl Carbonate
Carbonic Acid Gas	Carbon Dioxide
Carbonic Acid,Monoammonium Salt	Ammonium Bicarbonate
Carbonic Anhydride	Carbon Dioxide
Carbon Monoxide	Carbon Monoxide
Carbon Tetrachloride	Carbon Tetrachloride
Carbonyl Chloride	Phosgene
Carbonyldiamide	Urea
Carbonyl Diamine Peroxide	Urea Peroxide
Carboxybenzene	Benzoic Acid
Carene	Carene
3-Carene	Carene
Carpeting Material	Arsenic Acid
Carpeting Medium	Asphalt Blend Stock: Straight Run Residue

Synonym	*Compound Name*
4-Chloroaniline	P-Chloroaniline
P-Chloroaniline	P-Chloroaniline
Chlorobenzene	Chlorobenzene
P-Chlorobenzoyl Peroxide	Di-(P-Chlorobenzoyl) Peroxide
Di-(4-chlorobenzoyl) Peroxide	Di-(P-Chlorobenzoyl) Peroxide
4-Chlorobutyronitrile	4-Chlorobutyronitrile
4-Chlorobutyronitrile (Practical, Mixture with 4-Bromobutyronitrile)	4-Chlorobutyronitrile
Chlorocarbonic Acid, Methyl Ester	Methyl Chloroformate
Chlorodifluoromethane	Monochlorodifluoromethane
1-Chloro-2?,3-Epoxypropane	Epichlorohydrin
Chloroethane	Ethyl Chloride
2-Chloroethanol	Ethylene Chlorohydrin
Chloroethene	Vinyl Chloride
2-Chloroethyl Alcohol	Ethylene Chlorohydrin
2-Chloro-4-Ethylamino-6-Isopropylamino-S-Triazine	Atrazene
Chloroethylene	Vinyl Chloride
Chloroform	Chloroform
Chloroformic Acid, Benzyl Ester	Benzyl Chloformate
Chloroformic Acid, Ethyl Ester	Ethyl Chloroformate
Chloroformic Acid, Methyl Ester	Methyl Chloroformate
Chloroformyl Chloride	Phosgene
Chlorohydrins (Crude)	Chlorohydrins Crude
Gamma-Chloroisobutylene	Methallyl Chloride
Chloromethane	Methyl Chloride
4-Chloro-2-Methylaniline	4-Chloro-0-Toluidine
Chloromethyl Methyl Ether	Chloromethyl Methyl Ether
Chloromethyloxirane	Epichlorohydrin
0-(3-Chloro-4-Methyl-2-Oxo-(2H)-1-Benzopyran-7-Yl)Phosphorothioate	Coumaphos
4-Chloro-0-Toluidine	4-Chloro-0-Toluidine
Chloromethyl Phenyl Ketone	Chloroacetophenone
3-Chloro-2-Methylpropene	Methallyl Chloride
1-Chloropentane	N-Amyl Chloride
4-Chlorophenol	P-Chlorophenol
P-Chlorophenol	P-Chlorophenol
4-Chlorophenylamine	P-Chloroaniline
Di-(P-Chlorophenyl) Trichloromethylcarbinol	4,4-Dichloro-Alpha-Trichloromethylbenzhydrol
Chloropicrin, Liquid	Chloropicrin, Liquid
3-Chloropropene	Allyl Chloride
3-Chloropropylene	Allyl Chloride

Synonym	Compound Name
Cobalt (II) Sulfate	Cobalt Sulfate
Coconut Butter	Oils Edible: Coconut
Coconut Oil	Oils Edible: Coconut
Cocoil	Oil: Resin
Cocoil	Oil: Rozin
Collodion	Collodion
Cologne Spirit	Ethyl Alcohol
Colonial Spirit	Methyl Alcohol
Columbian Spirit	Methyl Alcohol
Combustion Improver C12	Methylcyclopentadienylmanganese Tricarbonyl
Condensed Phosphoric Acid	Polyphosphoric Acid
Copper Acetate	Copper Acetate
Copper Acetoarsenite	Copper Acetoarsenite
Copper Arsenite	Copper Arsenite
Copperas	Ferrous Sulfate
Copper Borofluoride Solution	Copper Fluoroborate
Copper Bromide	Copper Bromide
Copper Chloride	Copper Chloride
Copper Cyanide	Copper Cyanide
Copper Fluoroborate	Copper Fluoroborate
Copper (II) Fluoborate Solution	Copper Fluoroborate
Copper Iodide	Copper Iodide
Copper Naphthenate	Copper Naphthenate
Copper Nitrate	Copper Nitrate
Copper Orthoarsenite	Copper Arsenite
Copper Oxalate	Copper Oxalate
Copper Sulfate	Copper Sulfate
Copper Sulfate Pentahydrate	Copper Sulfate
Copra Oil	Oils Edible: Coconut
Corn Sugar Solution	Dextrose Solution
Corn Syrup	Corn Syrup
Corn Syrup Solution	Dextrose Solution
Corrosive Mercury Chloride	Mercuric Chloride
Corrosive Sublimate	Mercuric Chloride
Cottonseed Oil	Oil: Cottonseed
Coumaphos	Coumaphos
Crankcase Oil	Oil: Motor
Crankcase Oil	Oil: Lubricating
Creosote, Coal Tar	Creosote, Coal Tar
Creosote Oil	Creosote, Coal Tar

Synonym	*Compound Name*
Cresol, Epoxypropyl Ether	Cresyl Glycidyl Ether
Cresols	Cresols
Cresyl Glycidyl Ether	Cresyl Glycidyl Ether
Cresylic Acid	Xylenol
Cresylic Acids	Cresols
Croplas Eh	Ethyl Hexyl Tallate
Crotenaldehyde	Crotonaldehyde
Crotonaldehyde	Crotonaldehyde
Crotonic Aldehyde	Crotonaldehyde
Crotonoel	Oils Miscellaneous: Croton
Croton Tiglium L. Oil	Oils Miscellaneous: Croton
Crude Epichlorohydrin	Chlorohydrins (Crude)
Crude Oil	Oil: Crude
Crystallized Verdigris	Copper Acetate
CTF	Chlorine Trifluoride
Cucumber Dust	Calcium Arsenate
Cumene	Cumene
Cumene Hydroperoxide	Cumene Hydroperoxide
Cumol	Cumene
Cumyl Hydroperoxide	Cumene Hydroperoxide
Cupric Acetate Monohydrate	Copper Acetate
Cupric Arsenite	Copper Arsenite
Cupric Bromide, Anhydrous	Copper Bromide
Cupric Chloride Dihydrate	Copper Chloride
Cupric Fluoborate Solution	Copper Fluoroborate
Cupric Green	Copper Arsenite
Cupricin	Copper Cyanide
Cupric Nitrate Trihydrate	Copper Nitrate
Cupric Oxalate Hemihydrate	Copper Oxalate
Cupric Sulfate	Copper Sulfate
Cupriethylenediamine Solution	Cupriethylenediamine Solution
Cupriethylenediamine Hydroxide Solution	Cupriethylenediamine Solution
Cuprous Cyanide	Copper Cyanide
Cuprous Iodide	Copper Iodide
Cyanacetic Acid	Cyanoacetic Acid
Cyanide	Potassium Cyanide
Cyanide of Calcium	Calcium Cyanide
Cyanoacetic Acid	Cyanoacetic Acid
Cyanobenzene	Benzonitrile
2-Cyanoethanol	Ethylene Cyanohydrin
Cyanoethylene	Acrylonitrile

Synonym	*Compound Name*
Cyanogas A-Dust	Calcium Cyanide
Cyanogas G-Fumigant	Calcium Cyanide
Cyanogen	Cyanogen
Cyanogen Bromide	Cyanogen Bromide
Cyanogen Chloride	Cyanogen Chloride
Cyanomethane	Acetonitrile
Cyclohexane	Cyclohexane
Cyclohexanol	Cyclohexanol
Cyclohexanone	Cyclohexanone
Cyclohexanone Peroxide	Cyclohexanone Peroxide
Cyclohexenyltrichlorosilane	Cyclohexenyltrichlorosilane
Cyclohexyl Alcohol	Cyclohexanol
Cyclohexylamine	Cyclohexylamine
Cyclohexyl Ketone	Cyclohexanone
Cyclopentane	Cyclopentane
Cyclopentane, Methyl	Methylcyclopentane
Cyclopropane	Cyclopropane
P-Cymene	P-Cymene
Cymol	P-Cymene
Cystogen	Hexamethylenetetramine
Cythion Insecticide	Malathion
2,4-D	2,4-Dichlorophenoxyacetic Acid
Dalapon	Dalapon
DBP	Dibutyl Phthalate
DCEE	Dichloroethyl Ether
DCP	Calcium Phosphate
DDD	DDD
DDT	DDT
P.P -DDT	DDT
D.D. Turpentine	Turpentine
Dea	Diethanolamine
Dead Oil	Creosote, Coal Tar
Dec	Decahydronaphthalene
Decaborane	Decaborane
Decahydronaphthalene	Decahydronaphthalene
Cis-or Trans-Decahydronaphthalene	Decahydronaphthalene
Decaldehyde	Decaldehyde
Decalin	Decahydronaphthalene
Decanal	Decaldehyde
I-Decanol	N-Decyl Alcohol
I-Decene	L-Decene

Synonym	*Compound Name*
Dibutyl Ether	Di-N-Butyl Ether
N-Dibutyl Ether	Di-N-Butyl Ether
Di-N-Butyl Ether	Di-N-Butyl Ether
Di-N-Butyl Ketone	Di-N-Butyl Ketone
Dibutyl Oxide	Di-N-Butyl Ether
Dibutylphenol	Dibutylphenol
2,6-Di-Tert-Butylphenol	Dibutylphenol
Dibutyl Phthalate	Dibutyl Phthalate
Dicalcium Phosphate (Anhydrous or Dihydrate)	Calcium Phosphate
S-(1,2-Dicarbethoxyethyl)-0,0-Dimethyl Dithiophosphate	Malathion
Dicarbomethoxyzinc	Zinc Acetate
Dichloricide	P-Dichlorobenzene
1,2-Dichlorobenzene	O-Dichlorobenzene
O-Dichlorobenzene	O-Dichlorobenzene
P-Dichlorobenzene	P-Dichlorobenzene
Di-(P-Chlorobenzoyl) Peroxide	Di-(P-Chlorobenzoyl) Peroxide
Di-(4-Chlorobenzoyl) Peroxide	Di-(P-Chlorobenzoyl) Peroxide
P,P-Dichlorobenzoyl Peroxide	Di-(P-Chlorobenzoyl) Peroxide
1,1-Dichloro-2,2-Bis(P-Chlorophenyl) Ethane	DDD
Dichlorobutene	Dichlorobutene
I,4-Dichloro-2-Butene	Dichlorobutene
Cis-1,4-Dichloro-2-Butene	Dichlorobutene
Trans-1,4-Dichloro-2-Butene	Dichlorobutene
I,4-Dichloro-2-Butylene	Dichlorobutene
Dichlorodiethyl Ether	Dichloroethyl Ether
Dichlorodifluoromethane	Dichlorodifluoromethane
Dichlorodiphenyldichloroethane	DDD
Dichlorodiphenylsilane	Diphenyldichlorosilane
Dichlorodiphenylsilicane	Diphenyldichlorosilane
Dichlorodiphenyltrichloroethane	DDT
1,2-Dichloroethane	Ethylene Dichloride
Di-(2-Chloroethyl) Ether	Dichloroethyl Ether
Di-(2-Chloroethyl) Ether	Dichloroethyl Ether
Dichloroethyl Ether	Dichloroethyl Ether
1,1-Dichloroethylene	Vinylidenechloride, Inhibited
1,2-Dichloroethylene	1,2-Dichloroethylene
Sym-Dichloroethylene	1,2-Dichloroethylene
Unsym-Dichloroethylene	Vinylidenechloride, Inhibited
Cis-or Trans-1,2-Dichloroethylene	1,2-Dichloroethylene
2,2 -Dichloroethyl Ether	2,2 -Dichloroethyl Ether

Synonym	*Compound Name*
0,0-Diethyl-0-(3-Chloro-4-Methyl-2-Oxo-(2H)-1-Benzopyran-7-Yl) Phosphorothioate	Coumaphos
Diethylenediamine	Piperazine
Diethylene Glycol	Diethylene Glycol
Diethylene Glycol Dimethyl Ether	Diethylene Glycol Dimethyl Ether
Diethylene Glycol Ethyl Ether	Diethylehe Glycol Monoethyl Ether
Diethylene Glycol Methyl Ether	Diethylene Glycol Monomethyl Ether
Diethylene Glycol Monobutyl Ether Acetate	Diethylene Glycol Monobutyl Ether Acetate
Diethylene Glycol Monoethyl Ether	Diethylene Glycol Monoethyl Ether
Diethylene Glycol Monomethyl Ether	Diethylene Glycol Monomethyl Ether
Diethyleneimide Oxide	Morpholine
Diethylene Imidoxide	Morpholine
Di(Ethylene Oxide)	1,4-Dioxane
Diethylene Oximide	Morpholine
Diethylenetriamine	Diethylenetriamine
Diethyl Ether	Ethyl Ether
Di-(2-Ethylhexyl)Acid Phosphate	Di-(2-Ethylhexyl) Phosphoric Acid
Di-(2 Ethylhexyl)Adipate	Dioctyl Adipate
Di-(2-Ethylhexyl)Phosphate	Di-(2-Ethylhexyl) Phosphoric Acid
Di-(2-Ethylhexyl)Phosphoric Acid	Di-(2-Ethylhexyl) Phosphoric Acid
Di(2-Ethylhexyl) Phthalate	Dioctyl Phthalate
Di-(2-Ethylhexyl)Sulfosuccinate Sodium Salt	Dioctyl Sodium Sulfosuccinate
0,0-Diethyl 0-(2-Isopropyl-6-Methyl -4-Pyrimidinyl)Phosphorothioate	Diazinon
0,0-Diethyl-0-(2-Isopropyl-6-Methyl-4-Pyrimidinyl) Phosphorothioate	Diazinon
0,0-Diethyl-0-2-Isopropyl-4-Methyl-6-Pyrimidyl Thio-Phosphate	Diazinon
0,0-Diethyl-0-(2-Isopropyl-6-Methyl-4-Pyrimidinyl)Thio-Phosphate	Diazinon
Diethyl 2-Isopropyl-4-Methyl-6-Pyrimidyl Thionophosphate	Diazinon
0,0-Diethyl 0-(P-Nitrophenyl)Phosphorothioate	Parathion, Liquid
0,0-Diethyl 0-(P-Nitrophenyl)Thiophosphate	Parathion, Liquid
0,0-Diethyl-0(and S-)(I-Ethylthio) Ethyl)Phosphorothioates	Demeton
Diethyl Oxide	Ethyl Ether
Diethyl Phthalate	Diethyl Phthalate
Diethylzinc	Diethylzinc
1,1-Difluoroethane	1,1-Difluoroethane
Difluorophosphorus Acid	Difluorophosphoric Acid, Anhydrous

Synonym	*Compound Name*
Difluorophosphoric Acid, Anhydrous	Difluorophosphoric Acid, Anhydrous
Diformyl	Glyoxal, 40% Solution
Diglycol	Diethylene Glycol
Diglycol Monobutyl Ether	Diethylene Glycol Monobutyl Ether
Diglycol Monobutyl Ether Acetate	Diethylene Glycol Monobutyl Ether Acetate
Diglyme	Diethylene Glycol Dimethyl Ether
Diheptyl Phthalate	Diheptyl Phthalate
Dihydrate	Cadmium Acetate
2,5-Dihydroperoxy-2,5-Dimethylhexane	Dimethylhexane Dihydroperoxide, Wet
1,2-Dihydro-3,6-Pyridazinedione	Maleic Hydrazide
1,2-Dihydroxybenzene	Catechol
1,3-Dihydroxybenzene	Resorcinol
M-Dihydroxybenzene	Resorcinol
P-Dihydroxybenzene	Hydroquinone
Dihydroxybenzol	Resorcinol
1,4-Dihydroxybutane	1,4-Butanediol
I,4-Dihydroxy-2-Butene	1.4-Butenediol
I,4-Dihydroxy-2-Butyne	1.4-Butynediol
2,2-Dihydroxydiethyl Amine	Diethanolamine
Beta, Beta-Dihydroxydiethyl Ether	Diethylene Glycol
P,P-Dihydroxydiphenyldimethylmethane	Bisphenol A
2,2-Dihydroxydipropylamine	Diisopropanolamine
1,2-Dihydroxyethane	Ethylene Glycol
Di-Beta-Hydroxyethoxyethane	Triethylene Glycol
Di(2-Hydroxyethyl)Amine	Diethanolamine
Dihydroxyethyl Ether	Diethylene Glycol
1,2-Dihydroxypropane	Propylene Glycol
Diisobutylene	Diisobutylene
Diisobutylcarbinol	Diisobutylcarbinol
Diisobutyl Ketone	Diisobutyl Ketone
I.J-Diisocyanatotoluene	Toluene 2,4-Diisocyanate (TDI)
Diisodecyl Phthalate	Diisodecyl Phthalate
Diisopropanolamine	Diisopropanolamine
Diisopropyl Ether	Isopropyl Ether
Diisopropyl Oxide	Isopropyl Ether
Diisopropyl Percarbonate	Isopropyl Percarbonate
Diisopropyl Peroxydicarbonate	Isopropyl Percarbonate
Sym-Diisopropylacetone	Diisobutyl Ketone
Diisopropylamine	Diisopropylamine
Diisopropylbenzene Hydroperoxide	Diisopropylbenzene Hydroperoxide

Synonym	*Compound Name*
Dilauroyl Peroxide	Lauroyl Peroxide
Dimazine	1,1-Dimethylhydrazine
5,8-Dimethanonaphthalene	Endrin
1.2-Dimethoxyethane	Ethylene Glycol Dimethyl Ether
Dimethoxymethane	Methyl Formal
10,11-Dimethoxystrychnine	Brucine
Dimethylacetamide	Dimethylacetamide
N,N-Dimethylacetamide	Dimethylacetamide
Dimethylacetamide Acetic Acid, Dimethylamide	Dimethylacetamide
Dimethylacetic Acid	Isobutyric Acid
Dimethylamine	Dimethylamine
Dimethylarsinic Acid	Cacodylic Acid
1,3-Dimethylbenzene	M-Xylene
1,4-Dimethylbenzene	P-Xylene
1,2-Dimethylbenzene	O-Xylene
Alpha, Alpha-Dimethylbenzene Hydroperoxide	Cumene Hydroperoxide
Dimethylbenzyl Hydroperoxide	Cumene Hydroperoxide
Dimethylbenzyloctadecylammonium Chloride	Benzyldimethuloctadecylammonium Chloride
2,2-Dimethylbutane	Neohexane
Dimethylcarbinol	Isopropyl Alcohol
Dimethyl Cellosolve	Ethylene Glycol Dimethyl Ether
Dimethyldichlorosilane	Dimethyldichlorosilane
Dimethyl Ether	Dimethyl Ether
1,1-Dimethylethylamine	Tert-Butylamine
Dimethylformal	Methyl Formal
Dimethylformamide	Dimethylformamide
N.N-Dimethylformamide	N.N-Dimethylformamide
2,6-Dimethyl-4-Heptanone	Diisobutyl Ketone
2,6-Dimethyl-4-Heptanol	Diisobutylcarbinol
Dimethylhexanals	Isooctaldehyde
Dimethylhexane Dihydroperoxide, Wet	Dimethylhexane Dihydroperoxide, Wet
2,5-Dimethylhexane-2,5- Dihydroperoxide, Wet	Dimethylhexane Dihydroperoxide, Wet
Dimethyl-1-Hexanols	Isooctyl Alcohol
1,1-Dimethylhydrazine	1,1-Dimethylhydrazine
Unsym-Dimethylhydrazine	1.1-Dimethylhydrazine
Dimethyl Ketone	Acetone
Dimethylmethane	Propane
2,2-Dimethyl-3-Methylenenorbornane	Camphene
3.3-dimethyl-2-Methylenenorcamphane	Camphene
Dimethyloctadecylbenzylammonium Chloride	Benzyldimethyloctadecylammonium Chloride

Synonym	*Compound Name*
Dipentene	Dipentene
Dipentyl Phthalate	Di-N-Amyl Phthalate
Diphenylamine	Diphenylamine
Diphenyldichlorosilane	Diphenyldichlorosilane
Diphenyl Ether	Diphenyl Ether
Diphenyl Ketone	Benzophenone
Diphenylmethanediisocyanate (MDI)	Diphenylmethanediisocyanate (MDI)
Diphenylmethannone-4,4-Diisocyanate	Diphenylmethanediisocyanate (MDI)
Diphenyl Methanone	Benzophenone
Diphenyl Oxide	Diphenyl Ether
Diphenylsilicon Dichloride	Diphenyldichlorosilane
Di-N-Propylamine	Di-N-Propylamine
N,N-Dipropyl-2,6-Dinitro-4-Trifluoro-Methylaniline	Trifluralin
Dipropylene Glycol	Dipropylene Glycol
Disodium Arsenate Heptahydrate	Sodium Arsenate
Disodium Ethylenebis (Dithiocarbamate)	Nabam
Disodium Methanearsonate	Methanearsonic Acid, Sodium Salts
Disodium Methyl Arsonate	Methanearsonic Acid, Sodium Salts
Disodium Nitrilotriacetate	Nitrilotriacetic Acid and Salts
Distillate: Flashed Feed Stocks	Distillate: Flashed Feed Stocks
Distillate: Straight Run	Distillate: Straight Run
Disulfatozirconic Acid	Zirconium Sulfate
Dithane	Nabam
Dithiopyrophosphoric Acid, 0,0,0,0-Tetraethyl Ester	Tetraethyl Dithiopyrophosphate
Divinyl	Butadiene, Inhibited
DMDT	Methoxychlor
DMF	Dimethylformamide
DMS	Dimethyl Sulfide
DMSO	Dimethyl Sulfoxide
DNT	2,4-Dinitrotoluene
DOA	Dioctyl Adipate
1-Dodecanethiol	Lauryl Mercaptan
Dodecanol	Linear Alcohols (12-15 Carbons)
Dodecanol	Dodecanol
Dodecanol Peroxide	Lauroyl Peroxide
Dodecene	Dodecene
1-Dodecene	1-Dodecene
Dodecene (Non-Linear)	Propylene Tetramer
Dodecene (Non-Linear)	Dodecene
Dodecyl Alcohol	Dodecanol
Dodecylbenzene	Dodecylbenzene

Synonym	*Compound Name*
EAA	Ethyl Acetoacetate
EADC	Ethylaluminum Dichloride
EASC	Ethylaluminum Sesquichloride
EB	Ethylbenzene
EBDC, Sodium Salt	Nabam
EDC	Ethylene Dichloride
Edible Tallow	Tallow
EDTA	Ethylenediamine Tetracetic Acid
Ektasolve DB Acetate	Diethylene Glycol Monobutyl Ether Acetate
Electrical Insulating Oil	Oil: Transformer
Embafume	Methyl Bromide
Enanthic Alcohol	Heptanol
Endrate	Ethylenediamine Tetracetic Acid
Endrin	Endrin
Epichlorohydrin	Epichlorohydrin
Epoxidized Drying Oils	Epoxidized Vegetable Oils
Epoxidized Oils	Epoxidized Vegetable Oils
Epoxidized Tall Oil, Octyl Ester	Octyl Epoxy Tallate
Epoxidized Vegetable Oils	Epoxidized Vegetable Oils
1,2-Epoxybutane	Butylene Oxide
1,2-Epoxyethane	Ethylene Oxide
1,2-Epoxypropane	Propylene Oxide
Erinitrit	Sodium Nitrite
Eriochalcite (Anhydrous)	Copper Chloride
Eskimon 11	Trichlorofluoromethane
Eskimon 12	Dichlordifluoromethane
Eskimon 22	Monochlorodifluoromethane
Essence of Mirbane	Nitrobenzene
Ethanal	Acetaldehyde
Ethane	Ethane
Ethanecarboxylic Acid	Propionic Acid
Ethanedial	Glyoxal, 40% Solution
1,2-Ethanediamine	Ethylenediamine
Ethanedinitrile	Cyanogen
Ethanedioic Acid	Oxalic Acid
Ethanedioic Acid, Disodium Salt	Sodium Oxalate
1,2-Ethanediol	Ethylene Glycol
Ethanenitrile	Acetonitrile
Ethanethiol	Ethyl Mercaptan
Ethanoic Acid	Acetic Acid

Synonym	*Compound Name*
2-Ethylcaproaldehyde	Ethylhexaldehyde
Ethylcarbinol	N-Propyl Alcohol
Ethyl Carbonate	Diethyl Carbonate
Ethyl Chloracetate	Ethyl Chloracetate
Ethyl Chloride	Ethyl Chloride
Ethyl Chloroacetate	Ethyl Chloroacetate
Ethyl Chlorocarbonate	Ethyl Chloroformate
Ethyl Chloroethanoate	Ethyl Chloroacetate
Ethyl Chloroformate	Ethyl Chloroacetate
Ethyl Dichlorophosphate	Ethyl Phosphorodichloridate
Ethyldichlorosilane	Ethyldichlorosilane
Ethylene	Ethylene
Ethylene Acetate	Ethylene Glycol Diacetate
Ethylene Bromide	Ethylene Dibromide
Ethylene Chlorhydrin	Ethylene Chlorohydrin
Ethylene Chloride	Ethylene Dichloride
Ethylene Chlorchydrin	Ethylene Chlorohydrin
Ethylene Cyanohydrin	Ethylene Cyanohydrin
Ethylene Diacetate	Ethylene Glycol Diacetate
Ethylenediamine	Ethylenediamine
Ethylenediamine Tetracetic Acid	Ethylenediamine Tetracetic Acid
Ethylene Dibromide	Ethylene Dibromide
Cis-1,2-Ethylenedicarboxylic Acid	Maleic Acid
Trans-1,2-Ethylenedicarboxylic Acid	Fumaric Acid
Ethylene Dichloride	Ethylene Dichloride
Ethylene Diglycol	Diethylene Glycol
Ethylene Dihydrate	Ethylene Glycol
(Ethylenedinitrilo)Tetraacetic Acid	Ethylenediamine Tetracetic Acid
Ethylene Glycol	Ethylene Glycol
Ethylene Glycol Diacetate	Ethylene Glycol Diacetate
Ethylene Glycol Diethyl Ether	Ethylene Glycol Diethyl Ether
Ethylene Glycol Dihydroxydiethyl Ether	Triethylene Glycol
Ethylene Glycol Dimethyl Ether	Ethylene Glycol Dimethyl Ether
Ethylene Glycol Ethyl Ether	Ethylene Glycol Monoethyl Ether
Ethylene Glycol Monobutyl Ether	Ethylene Glycol Monobutyl Ether
Ethylene Glycol Monobutyl Ether Acetate	Ethylene Glycol Monobutyl Ether Acetate
Ethylene Glycol Monoethyl Ether	Ethylene Glycol Monoethyl Ether
Ethylene Glycol Monoethyl Ether Acetate	Ethylene Glycol Monoethyl Ether Acetate
Ethylene Glycol Monomethyl Ether	Ethylene Glycol Monoethyl Ether
Ethyleneimine	Ethyleneimine

Synonym	*Compound Name*
Ethyl Parathion	Parathion, Liquid
Ethyl Phenyldichlorosilane	Ethyl Phenyldichlorosilane
Ethyl Phosphonothioic Dichloride, Anhydrous	Ethyl Phosphonothioic Dichloride, Anhydrous
Ethyl Phosphorudichlorido-Thionate	Ethyl Phosphonothioic Dichloride, Anhydrous
Ethyl Phosphorodichloridate	Ethyl Phosphorodichloridate
Ethyl Phthalate	Diethyl Phthalate
5-Ethyl-2-Picoline	Methylethylpyridine
Ethyl 2-Propenoate	Ethyl Acrylate
2-Ethyl-3-Propylacrolein	2-Ethyl-3-Propylacrolein
2-Ethyl-3-Propylacrylaldehyde	2-Ethyl-3-Propylacrolein
Ethyl Pyrophosphate	Tetraethyl Pyrophosphate
Ethyl Silicate	Ethyl Silicate
Ethyl Silicate Condensed	Ethyl Silicate
Ethyl Silicate 40	Ethyl Silicate
Ethyl Silicon Trichloride	Ethyltrichlorosilane
Ethyl Silicone Trichloride	Ethyltrichlorosilane
Ethyl Sulfhydrate	Ethyl Mercaptan
Ethyl Thionophosphonyl Dichloride	Ethyl Phosphonothioic Dichloride Anhydrous
Ethyltrichlorosilane	Ethyltrichlorosilane
Ethyl Zinc	Diethylzinc
Ethyne	Acetylene
Eufin	Diethyl Carbonate
Exitelite	Antimony Trioxide
Fermentation Alcohol	Ethyl Alcohol
Fermentation Amyl Alcohol	Isoamyl Alcohol
Fermentation Butyl Alcohol	Isobutyl Alcohol
Ferric Ammonium Citrate	Ferric Ammonium Citrate
Ferric Ammonium Citrate, Brown	Ferric Ammonium Citrate
Ferric Ammonium Citrate, Green	Ferric Ammonium Citrate
Ferric Ammonium Oxalate	Ferric Ammonium Oxalate
Ferric Chloride	Ferric Chloride
Ferric Chloride, Anhydrous	Ferric Chloride
Ferric Chloride, Hexahydrate	Ferric Chloride
Ferric Glycerophosphate	Ferric Glycerophosphate
Ferric Nitrate	Ferric Nitrate
Ferric Nitrate Nonahydrate	Ferric Nitrate
Ferric Sulfate	Ferric Sulfate
Ferrous Ammonium Sulfate	Ferrous Ammonium Sulfate
Ferrous Ammonium Sulfate Hexahydrate	Ferrous Ammonium Sulfate

Synonym	*Compound Name*
Frigen 11	Trichlorofluoromethane
Frigen 12	Dichlorodifluoromethane
No. 1 Fuel Oil	Kerosene
Fumigrain	Acrylonitrile
Fuming Liquid Arsenic	Arsenic Trichloride
Fuming Sulfuric Acid	Oleum
Fural	Furfural
2-Furaldehyde	Furfural
2-Furancarbinol	Furfuryl Alcohol
2,5-Furanedione	Maleic Anhydride
Furfural	Furfural
Furfuralcohol	Furfuryl Alcohol
Furfuraldehyde	Furfural
Furfurole	Furfural
Furfuryl Alcohol	Furfuryl Alcohol
2-Furylcarbinol	Furfuryl Alcohol
Alpha-Furylcarbinol	Furfuryl Alcohol
Fusel Oil	Isoamyl Alcohol
Fyde	Formaldehyde Solution
Gallic Acid	Gallic Acid
Gallic Acid Monohydrate	Gallic Acid
Gallotannic Acid	Tannic Acid
Gallotannin	Tannic Acid
Gammexane	Benzene Hexachloride
Gas Oil: Cracked	Gas Oil: Cracked
Gerhardite	Copper Nitrate
Gexane	Benzene Hexachloride
Glacial Acetic Acid	Acetic Acid
D-Glucitol	Sorbitol
Glucose Solution	Dextrose Solution
Glutaraldehyde Solution	Glutaraldehyde Solution
Glycerine	Glycerine
Glycerite	Tannic Acid
Glycerol	Glycerine
Glycroyl Methacrylate	Glycidyl Methacrylate
Glycidyl Alpha-Methyl Acrylate	Glycidyl Methacrylate
Glycol	Ethylene Glycol
Glycol Butyl Ether	Ethylene Glycol Monobutyl Ether
Glycol Chlorohydrin	Ethylene Chlorohydrin
Glycol Cyanohydrin	Ethylene Cyanohydrin
Glycol Diacetate	Ethylene Glycol Diacetate

Synonym	*Compound Name*
Hexahydric Alcohol	Sorbitol
Hexahydroaniline	Cyclohexylamine
Hexahydro-2H-Azepin-2-One	Caprolactam, Liquid
Hexahydroazepine	Hexamethyleneimine
Hexahydrobenzene	Cyclohexane
Hexahydrophenol	Cyclohexanol
Hexahydropyrazine	Piperazine
N-Hexaldehyde	N-Hexaldehyde
Hexalin	Cyclohexanol
Hexamethylene	Cyclohexane
Hexamethyleneamine	Hexamethylenetertamine
Hexamethylenediamine	Hexahethylenediamine
Hexametpyleneimine	Hexamethyleneimine
Hexamethylenetetramine	Hexahethylenetetramine
Hexamine	Hexahethylenetetramine
Hexanal	N-Hexaldehyde
Hexanaphthene	Cyclohexane
Hexane	Hexane
1,6-Hexanediamine	Hexamethylenediamine
Hexanedioic Acid	Adipic Acid
Hexanol	Hexanol
1-Hexanol	Hexanol
2-Hexanone	Methyl N-Butyl Ketone
Alpha-Hexene	1-Hexene
1-Hexene	1-Hexene
Hexone	Methyl Isobutyl Ketone
Hexyl Acetate	Methyl Amyl Acetate
Hexyl Alcohol	Hexanol
Sec-Hexyl Alcohol	Ethyl Butanol
Hexylene Glycol	Hexylehe Glycol
HGI	Benzene Hexachloride
HHDN	Aldrin
Home Heating Oil	Fuel Oil No. 2
Homopiperidine	Hexamethyleneimine
Household Ammonia	Ammonium Hydroxide
Hydracrylic Acid, Beta-Lactone	Beta-Prop Iolactone
Alpha-Hydroxytoluene	Benzyl Alcohol
Beta-Hydroxytricarballylic Acid	Citric Acid
Beta-hyoroxytricarboxylic Acid	Citric Acid
2-Hydroxy-M-Xylene	Xylenol
Illuminating Oil	Kerosene

Synonym	*Compound Name*
2,2-Iminodiethanol	Diethanolamine
1,1-Iminodi-2-Propanol	Diisopropanolmine
Imperial Green	Copper Acetoarsenite
Inedible Tallow	Tallow
Insulating Oil	Oil, Transforuer
Iron Ahhoniuu Slilpate	Ferrous Ammonium Sulfate
Iron (1111 Chloride	Febric Chloride
Iron Dichloride	Ferric Chloride
Iron(ous)sulfate	Ferrous Sulfate
Iron Perchlomde	Ferric Chloride
Iron Protochloride	Ferrous Chloride
Iron Protoxalate	Ferrous Oxalate
Iron Sesouisulfate	Ferric Sulfate
Iron (1111 Sulfate	Ferric Sulfate
Iron Tersulfate	Ferric Sulfate
Iron Trichloride	Ferric Chloride
Iron Vitriol	Ferrous Sulfate
Isceon Ii	Trichlorofluoromethane
Isoamyl Alcohol	Isoamyl Alcohol
Isobutane	Isobutane
Isobutanol	Isobutyl Alcohol
Isobutene	Isobutylene
Isobutenyl Hethyl Ketone	Mesityl Oxide
Isobutyl Acetate	Isobutyl Acetate
Isobutyl Alcohol	Isobutyl Alcohol
Isobutylaldehyde	Iso-Butyraldehyde
Iso-butylamine	Isobutylamine
Isobutylamine	Isobutylamine
Isobutylcarbinol	Isoamyl Alcohol
Iscbutylene	Isobutylene
Isobutyl Hethyl Carbinol	Methyl Isobutyl Carbinol
Isobutylhethyl Carbinol	Methyl Amyl Alcohol
Isobutyl Hethyl Ketone	Methyl Isobutyl Ketone
Isobutylhethylmethanol	Methyl Amyl Alcohol
Isobutyraloehyde	Iso-Butyraldehyde
Isobutyric Acid	Isobutyric Acid
Isobutyric Aloehyde	Iso-Butyraldehyde
Isobutyronitrile	Isobutyronitrile
Isocyanic Acid, 4-Methyl-N-Phenylene	Toluene 2,4-Diiscoyanate (TDI)Ester
Isodecaldehyde	Isodecaldehyde
Isodecaldehyde, Mixed Isomers	Isodecaldehyde

Synonym	*Compound Name*
Iso-Decyl Acrylate	Isodecyl Acrylate, Inhibited
Isodecyl Acrylate, Inhibited	Isodecyl Acrylate, Inhibited
Isodecyl Alcohol	Isodecyl Alcohol
Isodiprene	Carene
Isohexane	Isohexane
Isonitropropane	2-Nitropropane
Isooctaldehyde	Isooctaldehyde
Isooctyl Alcohol	Isooctyl Alcohol
Isooctyl Aldehyde	Isooctaldehyde
Isooctyl Trichlorophenoxyacetate	2,4,5-T(Esters)
Isopentane	Isopentane
Isopentyl Alcohol	Isoamyl Alcohol
Isopentyl Nitrite	Iso-Amyl Nitrite
Isophorone	Isophorone
Isophthalic Acid	Isophthalic Acid
Isoprene	Isoprene
Isopropanol	Isopropyl Alcohol
Isopropanolamine	Monoisopropanolamine
Isopropenylbenzene	Alpha-Methylstyrene
Isopropenyl Methyl Ketone	Methyl Isopropeuyl Ketone, Inhibited
2- Isopropoxypropane	Isopropyl Ether
Isopropyl Acetate	Isopropyl Acetate
Isopropylacetone	Ethyl Isobutyl Ketone
Isopropyl Alcohol	Isopropyl Alcohol
Iso-Propylamine	Isopropylamine
Isopropylamine	Isopropylamine
Isopropylbenzene	Cumene
Isopropylbenzene Hydroperoxide	Cumene Hydroperoxide
Isopropylcarbinol	Isobutyl Alcohol
Isopropylcumyl Hydroperoxide	Diisopropylbenzene Hydroperoxide
Isopropyl Cyanide	Isobutyronitrile
Isopropyl 2,4-Dichlorophenoxy Acetate	2,4-D Esters
Isopropyl Ether	Isopropyl Ether
Isopropylformic Acid	Isobutyric Acid
Isopropylideneacetone	Mesityl Oxide
4,4 -Isopropylidenediphenol	Bisphenol A
4,4-Isopropylidenediphenolepichlorohydrin	Bisphehol A Diglycidyl Ether Resin
Isopropyl Mercaptan	Isopropyl Mercaptan
Isopropyl Percarbonate	Isopbopyl Percarbonate
Isopropyl Peroxydicarbonate	Isopropyl Percarbonate
P-Isopropyltoluene	P-Cymene

Synonym	*Compound Name*
Lauryl Sodium Sulfate	Dodecyl Sulfate, Sodium Salt
Lauryl Sulfate, Magnesium Salt	Dodecyl Sulfate, Magnesium Salt
Lauryl Sulfate, Sodium Salt	Dodecyl Sulfate, Sodium Salt
Lauryl Sulfate, Triethanolamine Salt	Docecyl Sulfate, Triethianolamine Salt
Lead (IV) Acetate	Lead Tetraacetate
Lead Acetate	Lead Acetate
Lead Acetate Trihydrate	Lead Acetate
Lead Arsenate	Lead Arsenate
Lead Arsenate, Acid	Lead Arsenate
Lead Difluoride	Lead Fluoride
Lead Fluoborate	Lead Fluoroborate
Lead Fluoride	Lead Fluoride
Lead Fluoroborate	Lead Fluoroborate
Lead Fluoroborate Solution	Lead Fluoroborate
Lead Iodide	Lead Iodide
Lead Monoxide	Litharge
Lead Nitrate	Lead Nitrate
Lead Oxide. Yellow	Litharge
Lead Protoxide	Litharge
Lead Sulfocyanate	Lead Thiocyanate
Lead Tetraacetate	Lead Tetraacetate
Lead Tetraethyl	Tetraethyl Lead
Lead Tetramethyl	Tetramethyl Lead
Lead Thiocyanate	Lead Thiocyanate
Leaf Lard	Oils Edible, Lard
Leucol	Quinoline
Lichenic Acid	Fumaric Acid
Light Naphtha	Naphtha Solvent
Light Naphtha	Naptha VM + P (75 % Naptha)
Light Oil	Oil: Coal Tar
Limed Wood Rosin	Calcium Resinate
Limonene	Dipentene
Lindane	Benzene Hexachloride
Linear Alcohols (12-15 Carbons)	Linear Alcohols (12-15 Carbons)
Liquefied Natural Gas (LNG)	Liquefied Natural Gas (LNG)
Liquefied Petroleum Gas (LPG)	Liquefied Petroleum Gas (LPG)
Liquid Ammonia	Ammonia Anhydrous
Liquid Asphalt	Asphalt Blending Stocks
Liquid Asphalt	Oil , Road
Liquid Bleach	Sodium Hypochlorite
Liquid Gum Camphor	Camphor Oil

Synonym	*Compound Name*
Malonic Mononitrile	Cyanoacetic Acid
MAOH	Methyl Isobutyl Carbinol
MAOH	Methyl Amyl Alcohol
Mapp Gas	Methylacetylene - Propadiene Mixture
Marlate 50	Methoxychlor
Marsh Gas	Methane
Marshite	Copper Iodide
Massicot	Litharge
MCB	Chlorobenzene
MCP	Calcium Phosphate
MDI	Diphenylmethanediisocyanate (MDI)
Meadow Green	Copper Acetoarsenite
ME CB	Dlethylene Glycol Momomethyl Ether
MEK	Methyl Ethyl Ketone
Mendrin	Endrin
MEP	Pethylethylpyridine
Mercaptoethane	Ethyl Mercaptan
Mercaptomethane	Methyl Mercaptan
Mercaptosuccinic Acid, S-Ester with 0,0-Dimethyl Dithiophosphate	Malathion
Mercurialin	Methylamine
Mercuric Acetate	Mercuric Acetate
Mercuric Ammonium Chloride	Mercuric Ammonium Chloride
Mercuric Chloride	Mercuric Chloride
Mercuric Chloride. Ammoniated	Mercuric Ammonium Chloride
Mercuric Cyanide	Mercuric Cyanide
Mercuric Iodide	Mecuric Iodide
Mercuric Iodide, Red	Mercuric Iodide
Mercuric Nitrate	Mercuric Iodide
Mercubic Nitrate Monohydrate	Mercuric Nitrate
Mercuric Oxide	Mercuric Oxide
Mercuric Oxide, Red (Red Precipitate)	Mercuric Oxide
Mercuric Oxide, Yellow (Yellow Precipitate)	Mercuric Oxide
Mercuric Sulfide	Mercuric Sulfide
Mercuric Sulfide, Black (Ethiops Mineral)	Mercuric Sulfide
Mercuric Sulfide, Red (Vermillion,Artificial Cinnabar, Chinese Red)	Mercuric Sulfide
Mercurous Chloride	Mercurous Chloride
Mercurous Nitrate	Mercurous Nitrate
Mercurous Nitrate Monohydrate	Mercurous Nitrate
Mercury	Mercury
Mercury Ammonium Chloride	Mercuric Ammonium Chloride

Synonym	*Compound Name*
Methoxydiglycol	Diethylebe Glycol Monomethyl Ether
Methylacetylene-Allene Mixture	Methylacetylene - Propadiene Mixture
Methylacetylene - Propadiene Mixture	Methylacetylene-Propadiene Mixture
Beta-Methylacrolein	Crotonaldehyde
Methyl Acrylate	Methyl Acrylate
Methylal	Methyl Formal
Methyl Alcohol	Methyl Alcohol
Beta-Methylallyl Chloride	Methallyl Chloride
Methylamine	Methylamine
N-Methylaminobenzene	N-Methylaniline
Methyl Amyl Acetate	Methyl Amyl Acetate
Methyl Amyl Alcohol	Methyl Amyl Alcohol
Methylamyl Alcohol	Methyl Isobutyl Carbinol
Methyl Amyl Ketone	N-Amyl Methyl Ketone
O-Methylaniline	O-Toluidine
2-Methylaniline	O-Toluidine
N-Methylamiline	N-Methylaniline
Methylamiline (Mono)	N-Methylaniline
2-Methylaziridine	Propyleneimime, Inhibited
Methylbenzene	Toluene
Methylbenzenesulfonic Acid	P-Toluenesulfonic Acid
Methylbenzol	Toluene
Beta-Methylbivinyl	Isoprene
Methyl Bromide	Methyl Bromide
2-Methyl-1,3-Butadiene	Isoprene
3-Methylbutanal	Isovaleraldehyde
2-Methylbutane	Isopentane
3-Methyl-1-Butanol	Isoamyl Alcohol
2-Methyl-1-Butene-3-One	Methyl Isopropenyl Ketone, Inhibited
Methyl N-Butyl Ketone	Methyl N-Butyl Ketone
3-Methylbutyl Nitrite	Iso-Amyl Nitrite
3-Methylbutyraldehyde	Isovaleraldehyde
Methyl Carbitol	Diethylene Glyccl Monomethyl Ether
Methyl Cellosolve	Ethylene Glycol Momomethyl Ether
Methyl Chloride	Methyl Chloride
Methyl Chlorocarbonate	Methyl Chloroformate
Methyl Chloroform	Trichloroethane
Methyl Chloroformate	Methyl Chloroformate
Methyl Chloromethyl Ether, Anhydrous	Chloromethyl Methyl Ether
Methyl Cyanide	Acetonitrile
Methylcyclopentadienylmanganese	Methylcyclopehtadienylmanganese

Synonym	*Compound Name*
2-Methyl-2-Pentanone	Methyl Isobutyl Ketone
4-Methyl-3-Pentene-2-One	Mesityl Oxide
4-Methyl-2-Pentyl Acetate	Methyl Amyl Acetate
1-Methyl-1-Phenylethylene	Alpha-Methylstyrene
Methyl Pentyl Ketone	N-Amyl Methyl Ketone
Methylphenols	Cresols
Methylphenylamine	N-Methylaniline
Methyl Phenyl Ketone	Acetophenone
Methyl Phosphonothioic Dichloride(Anhydrous)	Methyl Phosphonothioic Dichloride(Anhydrous)
2-Methylpropanal	Iso-Butyraldehyde
2-Methylpropane	Isobutane
2-Methylpropanenitrile	Isobutyronitrile
2-Methylpropanoic Acid	Isobutyric Acid
2-Methyl-1-Propanol	Isobutyl Alcohol
2-Methyl-2-Propanol	Tert-Butyl Alcohol
2-Methylpropene	Isobutylene
Methyl 2-Propendate	Methyl Acrylate
Alpha-Methylpropionic Acid	Isobutyric Acid
2-Methylpropionitrile	Isobutyronitrile
2-Methyl-1-Propyl Acetate	Isobutyl Acetate
Methyl Propyl Benzene	P-Cymene
Beta-Methylpropyl Ethanoate	Isobutyl Acetate
1-Methyl-2-(3-Pyridyl) Pyrrolidine	Nicotine
I-Methyl-2-(3-Pyridyl) Pyrrolidine«3-(1-Methyl-2-Pyrrolidyl) Pyridine	Nicotine
N-Methylpyrrolidinone	1-Methylpyrrolidone
1-Methyloyrrolidone	1-Methylpyrrolidone
N-Methyl-Pyrrolidone	1-Methylpyrrolidone
1-Methyl-2-Pyrrolidinone	1-Methylpyrrolidone
N-Methyl-Alpha-Pyrrolidone	1-Methylpyrrolidone
3-(2-Methyl-2-Pyrrolidyl)Pyridine	Nicotine
Methylstyrene	Vinyltoluene
Alpha-Methylstyrene	Alpha-Methylstyrene
Methyl Sulfhydrate	Methyl Mercaptan
Methyl Sulfide	Dimethyl Sulfide
4-(Methylsulfonyl)-2,6-Dinitro-N,N-Dipropylaniline	Thiram
Methyl Sulfoxide	Dimethyl Sulfoxide
Methyl Thiram	Thiram
Methyltrichlorosilane	Methyltrichlorosilane
Methyl Tuads	Thiram

Synonym	*Compound Name*
Monoethanolamine	Monoethanolamine
Monoethylamine	Ethylamine
Monoethylene Glycol	Ethylene Glycol
Monofluoro Ethylene	Vinyl Fluoride
Monoglyme	Ethylene Glycol
Monohydrate	Calcium Phosphate
Monoisobutylamine	Isobutylamine
Monoisopropanolamine	Monoisopropanolamine
Monoisopropylamine	Isopropylamine
Monomethylamine, Anhydrous	Methylamne
Monomethylhydrazine	Methylcrazine
Mononitrogen Monoxide	Nitric Oxide
Mono PE	Pentaerythritol
Monosodium Methanearsonate	Methanearsonic Acid, Sodium Salts
Monosodium Methyl Arsonate	Methanearsonic Acid, Sodium Salts
Monoxide	Carbon Monoxide
Morpholine	Morpholine
Mortopal	Tetraethyl Pyrophosphate
Moss Green	Copper Acetoarsenite
Motor Oil	Oil, Lubricating
MPT	Methyl Parathion
MPTD	Methyl Phosphonothioic Dichloride (Ahyrous)
MSMA	Methanearsonic Acid, Sodium Salts
Muriatic Acid	Hydrochloric Acid
Myristic Alcohol	Tetradecanol
Myristyl Alcohol	Tetradecanol
Naphtha	Mineral Spirits
Naphtha Coal Tar	Naphtha Coal Tar
Naphtha Solvent	Naphtha Solvent
Naphtha Stodord Solvent	Naphtha Stodard Solvent
Naptha VM + P (75 % Naptha)	Naptha VM + P (75 % Naptha)
Naphthalane	Decahydronaphthalene
Naphthalene, Molten	Naphthalene, Molten
Naphthalin	Naphthalene, Molten
Naphthane	Decahydronaphthalene
Napthenic Acids	Napthenic Acids
Alpha-naphthylamine	1-Naphthylamine
1-naphthylahine	1-Naphthylamine
I-naphthyl N-methylcarbamate	Carbaryl
Natural Gasoline	Gasoline: Casinghead

Synonym	*Compound Name*
Neatsfoot Oil	Oil: Neatsfoot
Necatorina	Carbon Tetrachloride
Nechexane	Neohexane
Neutral Ahhonium Pluoride	Ammonium Fluoride
Neutral Anhydrous Calcium Hypochlcrite	Calcium Hypochlorite
Neutral Lead Acetate	Lead Acetate
Neutral Nicotine Sulfate	Nicotine Sulfate
Neutral Potassium Chromate	Potassium Chromate
Neutral Sodium Chromatetanhydrous	Sodium Chromate
Neutral Verdigris	Copper Acetate
Nickel Acetate	Nickel Acetate
Nickel Acetate Tetrahyorate	Nickel Acetate
Nickel Ammonium Sulfate	Nickel Ammonium Sulfate
Nickel Ammonium Sulfate Hexahydrate	Nickel Ammonium Sulfate
Nickel Bromide	Nickel Bromide
Nickel Bromide Trihydrate	Nickel Bromide
Nickel Carbonyl	Nickel Carbonyl
Nickel Chloride	Nickel Chloride
Nickel Chloride	Nickel Chloride
Nickel Cyanide	Nickel Cyanide
Nickel Iiu Fluoborate	Nickel Fluoroborate
Nickel Fluoroborate Solution	Nickel Fluoroborate
Nickel Fluoroborate	Nickel Fluoroborate
Nickel Formate	Nickel Formate
Nickel Formate Dihyorate	Nickel Formate
Nickel Nitrate	Nickel Nitrate
Nickel Nitrate Hexahydrate	Nickel Nitrate
Nickel Sulfate	Nickel Sulfate
Nickel Tetracarbokyl	Nickel Carbonyl
Nickelous Acetate	Nickel Acetate
Nickelous Sulfate	Nickel Sulfate
Nicotine	Nicotine
Nicotine Sulfate	Nicotine Sulfate
Nifos	Tetraethyl Pyrophosphate
Nitralin	Nitralin
Nitram	Ammonium Nitrate
O-Nitraniline	2-Nitroaniline
P-Nitraniline	4-Nitroaniline
Nitric Acid	Nitric Acid
Nitric Acid, Aluminum Salt	Aluminum Nitrate
Nitric Acid, Iron (111) Salt	Ferric Nitrate

Synonym	*Compound Name*
Nitric Acid, Lead (II) Salt	Lead Nitrate
Nitric Oxide	Nitric Oxide
Nitrilotriacetic Acid and Salts	Nitrilotriacetic Acid and Salts
2,2,2-Nitrilotriethanol	Triethanolamine
O-Nitroaniline	2-Nitroaniline
4-Nitroaniline	4-Nitroaniline
P-Nitroaniline	4-Nitroaniline
2-Nitroaniline	2-Nitroaniline
Nitrobenzene	Nitrobenzene
Nitrobenzol	Nitrobenzene
Nitrocarbol	Nitromethane
Nitrocellulose Gum	Collodion
Nitrocellulose Solution	Collodion
Nitrochloroform	Chloropicrin, Liquid
Nitroethane	Nitoethane
Nitrogen Dioxide	Nitrogen Tetroxide
Nitrogen, Liquefied	Nitrogengen, Liquefied
Nitrogen Monoxide	Nitric Oxide
Nitrogen Peroxide	Nitrogen Tetroxide
Nitrogen Tetroxide	Nitrogen Tetroxide
Nitromethane	Nitromethane
O-Nitrophenol	2-Nitophenol
2-Nitrophenol	2-Nitophenol
P-Nitrophenol	4-Nitophenol
4-Nitrophenol	4-Nitophenol
Sec-Nitropropane	2-Nitropropane
2-Nitropropane	2-Nitropropane
Nitrosyl Chloride	Nitosyl Chloride
Nitrotrichloromethane	Chloropicrin, Liquid
Nitrous Ether	Ethyl Nitrite
Nitrous Oxide	Nitrous Oxide
N-Nonane	Nonane
Nonane	Nonane
Nonanol	Nonanol
1-Nonanol	Nonanol
5-Nonanone	Di-N-Butyl Ketone
Nonene	Nonene
1-Nonene	1-Nonene
Nonene (Non-linear)	Nonene
Nonyl Alcohol	Nonanol
Nonylcarbinol	N-Decyl Alcohol

Synonym	*Compound Name*
Oil: Fish	Oil: Fish
Oil: Lubricating	Oil: Lubricating
Oil: Mineral	Oil: Mineral
Oil: Mineral Seal	Oil: Mineral Seal
Oil: Motor	Oil: Motor
Oil: Neatsfoot	Oil: Neatsfoot
Oil of Bitter Almond	Benzaldehyde
Oil of Merbane	Nitrobenzene
Oil of Vitriol	Sulfuric Acid
Oil: Olive	Oil: Olive
Oil: Peanut	Oil: Peanut
Oil: Penetrating	Oil: Penetrating
Oil: Range	Oil: Range
Oil: Resin	Oil: Resin
Oil: Road	Oil: Road
Oil: Rosin	Oil: Rosin
Oil. Tanners	Oil, Tanners
Oils Edible, Coconut	Oils Edible, Coconut
Oils Edible, Lard	Oils Edible, Lard
Oils Edible, Palm	Oils Edible, Palp
Oils Edible, Safflower	Oils Ediblel, Safflower
Oils Edible, Tucum	Oils Edible, Tucum
Oils Miscellaneous: Croton	Oils Miscellaneous: Croton
Oils Miscellaneous: Linseed	Oils Miscellaneous: Linseed
Oils Miscellaneous: Turbine	Oils Miscellaneoss: Turbine
Oil: Soya Bean	Oil: Soya Bean
Oil: Sperm	Oil: Sperm
Oil: Spindle	Oil: Spindle
Oil: Spray	Oil: Spray
Oil: Tall	Oil: Tall
Oil: Transformer	Oil: Trausformer
Oil: Vegetable	Oil: Vegetable
Olefiant Gas	Ethylene
Oleic Acid	Oleic Acid
Oleic Acid, Ammonium Salt	Ammonium Oleate
Oleic Acid, Potassium Salt	Oleic Acid, Potassium Salt
Oleic Acid, Sodium Salt	Oleic Acid, Sodium Salt
Oleum	Oleum
Olive Oil	Oil: Olive
Orpiment	Arsenic Trisulfide
Orthoarsenic Acid	Arsenic Acid

Synonym	Compound Name
Parathion-Methyl	Methyl Parathion
Paraxylene	P-Xylene
Paris Green	Copper Acetoarsenite
Parrot Green	Copper Acetoarsenite
Patent Alum	Aluminum Sulfate
PCB	Polychlorinated Biphenyl (PCB)
PE	Pentaerythritol
Peanut Oil	Oil, Peanut
Pearl White	Bismuth Oxychloride
Pelargonic Alcohol	Nonanol
Penetrating Oil	Oil, Penetrating
Penta	Pentachlorophenol
Pentaborane	Pentaborane
(9)-Pentaboron Nonahydride	Pentaborane
Pentachlorophenol	Pentachlorophenol
Pentadecanol	Pentadecanol
1-Pentadecanol	Pentadecanol
Pentadecanol	Linear Alcohcls (12-15 Carbons)
Pentadecyl Alcohol	Pentadecanol
Pentadecylbenzenesulfonic Acid	Alkylbenzenesulfonic Acids
Pentaerythrite	Pentaerythritol
Pentaerythritol	Pentaerythritol
Pentamethylene	Cyclopentane
Pentanal	Valeraldehyde
Pentane	Pentane
1.5-Pentanedial Solution	Glutaraldehyde Solution
2,4-Pentanedione	Acetylacetone
1-Pentanethiol	N-Amyl Mercaptan
1-Pentanol	N-Amyl Alcohol
Pentek	Pentaerythritol
1-Pentene	1-Pentene
Pentyl Acetates	Amyl Acetate
Pentyl Alcohol	N-Amyl Alcohol
Sec-Pentyl Carbinol	Ethyl Butanol
1-Pentyl Chloride	N-Amyl Chloride
Pentyl Methyl Ketone	N-Amyl Methyl Ketone
Pentylsilicon Trichloride	N-Amyltrochlorosilane
Peracetic Acid	Peracetic Acid
Percarbamide	Urea Peroxide
Perchloric Acid	Perchloric Acid
Perchloric Acid Solution	Perchloric Acid

Synonym	*Compound Name*
Phenoxybenzene	Diphehyl Ether
Phenylamine	Aniline
N-Phenylaniline	Diphenylamine
Phenylarsenic Dichloride	Phenyldichloroarsine, Liquid
Phenyl Bromide	Bromobenzene
Phenylcarbinol	Benzyl Alcohol
Phenyl Chloride	Chlorobenzene
Phenyl Chloromethyl Ketone	Chloroacetophenone
Phenylcyanide	Benzonitrile
1-Phenyldecane	N-Decylbenzene
Phenyldichloroarsine, Liquid	Phenyldichloroarsine, Liquid
1-Phenyldodecane	Dodecylbenzene
Phenylethane	Ethylbenzene
Phenylethylene	Styrene
Phenyl Ether	Diphenyl Ether
Phenylhydrazine Hydrochloride	Phenylhydrazine Hydrochloride
Phenylhydrazinium Chloride	Phenylhydrazine Hydrochloride
Phenyl Hydroxide	Phenol
Phenylmethanol	Benzyl Alcohol
Phenylmethyl Alcohol	Benzyl Alcohcl
Phenylmethyl Amine	Benzylamine
Phenylphosphine Dichloride	Benzene Phosphorus Dichloride
Phenylphosphine Thiodichloride	Benzene Phosphorus Thiodichloride
Phenylphosphonothioic Dichloride	Benzene Phosphorus Thiodichloride
Phenyl Phosphonous Dichloride	Benzene Phosphorus Dichloride
Phenylpropylene	Alpha-Methylstyrene
1-Phenyltetradecane	Tetradecylbenzene
1-Phenylundecane	N-Undecylbenzene
Phosgene	Phosgene
Phosphoric Acid	Phosphoric Acid
Phosphoric Sulfide	Phosphorus Pentasulfide
Phcsphorodichloridic Acid, Ethyl Ester	Ethyl Phosphorodichloridate
Phosphorothioic Acid, 0,0-Diethyl Ester	Cemeton
Phosphorothioic Acid, 0,0-Diethyl O-P-Nitrophenyl Ester	Parathion, Liquid
Phosphorus Bromide	Phosphorus Tribromide
Phosphorus Oxychloride	Phosphorus Oxychloride
Phosphorus Pentasulfide	Phosphorus Pentasulfide
Phosphorus Persulfide	Phosphorus Pentasulfide
Phosphorus Tribromide	Phosphorus Tribromide
Phosphorus Trichloride	Phosphorus Trichloride

Synonym	*Compound Name*
Poly(Oxyethyl) Myristyl Ether	Ethoxylated Tetradecanol
Poly(Oxyethyl) Pentadecyl Ether	Ethoxylated Pentadecanol
Poly(Oxyethyl) Tetradecyl Ether	Ethoxylated Tetradecanol
Poly(Oxyethyl) Tridecyl Ether	Ethoxylated Tridecanol
Polyoxymethylene	Paraformaldehyde
Polyoxymethylene Glycol	Paraformaldehyde
Polyoxypropylene Glycol	Polypropylene Glycol
Polyoxypropylene Glycol Methyl Ether	Polypropylene Glycol Methyl Ether
Polyphosphoric Acid	Polyphosphoric Acid
Polypropylene	Polypropylene
Polypropylene Glycol	Polypropylene Glycol
Polypropylene Glycol Methyl Ether	Polypropylene Glycol Methyl Ether`
Potassium Chromate	Potassium Chromate
Potassium Chromate (VI)	Potassium Chromate
Potassium Cyanide	Potassium Cyanide
Potassium Dichloro-S-Triazinetrione	Potassium Dichloro-S-Triazinetrione
Potassium Dichromate	Potassium Dichromate
Potassium Hydroxide Solution	Caustic Potash Solution
Potassium Iodide	Potassium Iodide
Potassium Dihyorogen Arsenate	Potassium Arsenate
Potassium Hydroxide	Potassium Hydroxide
Potassium, Metallic	Potassium, Metallic
Potassium Oleate	Oleic Acid, Potassium Salt
Potassium Oxalate	Potassium Oxalate
Potassium Oxalate Monohydrate	Potassium Oxalate
Potassium Permanganate	Potassium Permanganate
Potassium Peroxide	Potassium Peroxide
Potassium Superoxide	Potassium Peroxide
Potatospirit Oil	Isoamyl Alcohol
Poterate	Potassium Chlorate
Preservative Oil	Oil: Penetrating
Primary Calcium Phosphate	Calcium Phosphate
Prime Steam Lard	Oils Edible, Lard
Propaldehyde	Propionaldehyde
Propanal	Propionaldehyde
Propane	Propane
Propane-Butane-(Propylene)	Liquefied Petroleum Gas (LPG)
Propane-2-Carboxylic Acid	Isobutyric Acid
Propanecarboxylic Acid	N-Butyric Acid
1,2-Propanediol	Propylene Gylcol
1,2-Propanediol 1-Acrylate	Hydroxypropyl Acrylate

Synonym	*Compound Name*
Propylene Tetramer	Propylene Tetramer
Propylene Tetramer	Dodecene
Propylene Trimer	Nonene
Propyleneimine, Inhibited	Propyleneimine, Inhibited
Propylethylene	1-Pentene
N-Propyl Mercaptan	N-Propyl Mercaptan
N-N-Propyl-L-Propanamine	Ci-N-Propylamide
Prussic Acid	Hydrogen Cyanide
Pseudohexyl Alcohol	Ethyl Butanol
Pyrazine Hexahydride	Piperazine
Pyridine	Pyridine
Pyrocatechin	Catechol
Pyrocatechinic Acid	Catechol
Pyrocatechol	Catechol
Pyrocatechuic Acid	Catechol
Pyrofax	Liquefied Petroleum Gas (LPG)
Pyrogallic Acid	Pyrogallic Acid
Pyrogallol	Pyrogallic Acid
Pyrogentisic Acid	Hydroquinone
Pyromucic Aldehyde	Furfural
Pyroxylic Spirit	Methyl Alcohol
Pyroxylic Solution	Collodion
Quicklime	Calcium Oxide
Quicksilver	Mercury
Quinol	Hydroquinone
Quinoline	Quinoline
Racemic Lactic Acid	Lactic Acid
Range Oil	Fuel Oil: No (Kerosene)
Range Oil	Kerosene
Range Oil	Jet Fuel: JP-(Kerosene)
Raw Linseed Oil	Oils Miscellaneous Linseed
RC Plasticizer DBP	Dibutyl Phthalate
RC Plasticizer DBP	Dioctyl Phthalate
Realgar	Arsenic Disulfide
Red Arsenic Glass	Arsenic Disulfide
Red Arsenic Sulfide	Arsenic Disulfide
Red Oil	Cleic Acid
Red Opriment	Arsenic Disulfide
Red Oxide of Nitrogen	Nitrogen Tetroxide
Red TR Base	4-Chloro-O-Toluidine
Residual Oil	Asphalt Blending Stock

Synonym	*Compound Name*
Signal Oil	Oil: Mineral Seal
Silibond	Ethyl Silicate
Silicochloroform	Trichlorosilane
Silicofluoric Acid	Fluosilicic Acid
Silicon Chloride	Silicon Tetrachloride
Silicone Fluids	Dimethyl Polysiloxahe
Silicon Tetrachloride	Silicon Tetrachloride
Silver Acetate	Silver Acetate
Silver Carbonate	Silver Carbonate
Silver Fluoride	Silver Fluoride
Silver Iodate	Silver Iodate
Silver Monofluoride	Silver Fluoride
Silver Nitrate	Silver Nitrate
Silver Oxide	Silver Oxide
Silver Sulfate	Silver Sulfate
Silvisar 510	Cacodylic Acid
Slaked Lime	Calcium Hydroxide
Slow-Curing Asphalt	Oil: Road
Sodamide	Sodium Amide
Sodium	Sodium
Sodium Acid Sulfite	Sodium Bisulfite
Sodium Alkylbenzenesulfonates	Sodium Alkylbenzenesulfonates
Sodium Alkyl Sulfates	Sodium Alkyl Sulfates
Sodium Amide	Sodium Amide
Sodium Arsenate	Sodium Arsenate
Sodium Arsenate, Dibasic	Sodium Arsenate
Sodium Arsenite	Sodium Arsenite
Sodium Azide	Sodium Azide
Socius Biborate	Sodium Borate
Sodium Bisulfide	Sodium Hydrosulfide Solution
Sodium Bisulfite	Sodium Bisulfite
Sodium Borate	Sodium Borate
Sodium Borohydrade	Sodium Borohydride
Sodium Cacodylate	Sodium Cacodylate
Sodium Cetyl Sulfate Solution	Hexadecyl Sulfite, Sodium Salt
Sodium Chlorate	Sodium Chlorate
Sodium Chromate	Sodium Chromate
Sodium Chromate(VI)	Sodium Chromate
Sodium Cyanide	Sodium Cyanide
Sodium Dichloroisocyanurate	Sodium Dichloro-S-Triazinetrione
Sodium Dichloro-S-Triazinetrione	Sodium Dichloro-S-Triazinetrione

Synonym	*Compound Name*
Sorbol	Sorbitol
Soybean Oil	Oil: Soya Bean
Sperm Oil	Oil: Sperm
Spindle Oil	Oil: Spindle
Spirit	Ethyl Alcohol
Spirit of Ether Nitrite	Ethyl Nitrite
Spirits of Turpentine	Turpentine
Spirits of Wine	Ethyl Alcohol
Spotting Naphtha	Naphtha Stoddard Solvent
Spray Oil	Oil: Spray
Steam Turbine Lube Oil	Oils Miscellaneous: Turbine
Steam Turbine Oil	Oils Miscellaneous: Turbine
Stearic Acid	Stearic Acid
Stearic Acid, Ammonium Salt	Ammonium Stearate
Stearophanic Acid	Stearic Acid
Stearyl Alcohol, Crude	Tallow Fatty Alcohol
Steinbuhl Yellow	Calcium Chromate
Streunex	Benzene
Styrene	Styrene
Styrol	Styrene
Styrolene	Styrene
Sucrose	Sucrose
Sugar	Sucrose
Sugar of Lead	Lead Acetate
Sulfamic Acid, Monoammonium Salt	Ammonium Sulfate
Sulfated Neatsfoot Oil, Sodium Salt	Oil, Tanners
Sulfate of Copper	Copper Sulfate
Sulfate Turpentine	Turpentine
Sulfolane	Sulfolane
Sulfolane-W	Sulfolane
Sulfonated Alkylbenzene, Sodium Salt	Sodium Alkylbenzenesulfolat
Sulfur Dioxide	Sulfur Dioxide
Sulfuretted Hydrogen	Hydrogen Sulfide
Sulfuric Acid	Sulfuric Acid
Sulfuric Acid, Spent	Sulfuric Acid, Spent
Sulfuric Ether	Ethyl Ether
Sulfur (Liquid)	Sulfur (Liquid)
Sulfur Monochloride	Sulfur Monochloride
Sulfuryl Chloride	Sulfuryl Chloride
Sulphur (Liquid)	Sulfur(Liquid)
Sulphuretted Hydrogen	Hydrogen Sulfide

Synonym	*Compound Name*
Teta	Triethylenetetramine
Tetrabutyl Titanate	Tetrabutyl Titanate
1,1,2,2-Tetrachloroethane	Tetrachloroethane
Tetrachloroethane	Tetrachloroethane
Tetrachloroethylene	Tetrachloroethylene
Tetrachloromethane	Carbon Tetrachloride
1-Tetradecanol	Tetradecanol
Tetradecanol	Tetradecanol
Tetradecanol	Linear Alcohols (12-15 Carbons)
1-Tetradecene	1-Tetradecene
N-Tetradecyl Alcohol	Tetradecanol
Tetradecylbenzene	Tetradecylbenzene
Tetradecylbenzenesulfonic Acid	Alkylbenzenesulfonic Acids
Tetraethyl Dithionopyrophosphate	Tetraethyl Dithiopyrophosphate
Tetraethyl Dithiopyrophosphate	Tetraethyl Dithiopyrophosphate
Tetraethyl Lead	Tetraethyl Lead
Tetraethyl Orthosilicate	Ethyl Silicate
Tetraethyl Pyrophosphate	Tetraethyl Pyrophosphate
0,0,0,0-Tetraethyl Pyrophosphorodithionate	Tetraethyl Dithiopyro phosphate
Tetraethylene Glycol	Tetraethylene Glycol
Tetraethylenepentamine	Tetraethylenepentamine
Tetraethyl Silicate	Ethyl Silicate
Tetrafluoroethylene Inhibited	Tetrafluoroethylene, Inhibited
Tetrahydrofuran	Tetrahydrofuran
Tetrahydronaphthalene	Tetrahydronaphthalene
Tetrahydro-P-Oxazine	Morpholine
Tetrahydro-2H-1,4-Oxazine	Morpholine
Tetrahydrothiophene-1,1-Dioxide	Sulfolane
Tetrahydroxymethylmethane	Pentaerythritol
Tetralin	Tetrahydronaphthalene
Tetramethyleneglycol	1,4-Butanediol
Tetramethylene Oxide	Tetrahydrofuran
Tetramethylene Sulfone	Sulfolane
Tetramethyl Lead	Tetramethyl Lead
Tetramethylolmethane	Pentaerythritol
Tetramethylthiuram Disulfide	Thiram
Tetranap	Tetrahydronaphthalene
Tetrapropylene	Propylene Tetramer
Tetrapropylene	Dodecene
Tetrine Acid	Ethylediamine Tetracetic Acid
Tetron	Tetraethyl Pyrophosphate

Synonym	*Compound Name*
Tri-6	Benzene Hexachloride
Tricalcium Arsenate	Calcium Arsenate
Tricalcium Orthoarsenate	Calcium Arsenate
Trichloran	Trichloroethylene
Trichloroamylsilane	H-Amyltrichlorosilane
1,1,1-Trichloro-2,2-Bis (P-Chlorophenyl)Ethane	DDT
1,1,1-Trichloroethane	Trichloroethane
Trichloroethane	Trichloroethane
Trichloroethene	Trichloroethylene
Trichloroethylene	Trichloroethylene
Trichloroethylsilane	Ethyltrichlorosilane
Trichloroethylsilicane	Ethyltrichlorosilane
Trichlorofluoromethane	Trichlorofluoromethane
Trichloroiminoisocyanuric Acid	Trichloro-S-Triazinetrione
Trichloroisocyanuric Acid	Trichloro-S-Triazinetrione
Trichloromethane	Chloroform
Trichloromethane	Calcium Fluoride
Trichloromethane Sulphuryl Chloride	Perchloromethyl Mercaptan
Trichloromethanesulfenyl Chloride	Perchloromethyl Mercaptan
Trichloromethyl Sulphochloride	Perchloromethyl Mercaptan
Trichloromethylsilane	Methyltrichlorosilane
Trichloromethylsulfur Chloride	Perchloromethyl Mercaptan
N-Trichloromethylthio-Cis-Cyclohexene-1,2-Dicarboximide	Captan
Trichloromonosilane	Trichlorosilane
Trichloronitromethane	Chloropicrin, Liquid
Trichlorooxo Vanadium	Vanadium Oxytrichloride
N-Tolylene Diisocyanate	Toluene 2,4-Diisocyanate (TDI)
2,4-Tolylene Diisocyanate	Toluene 2,4-Diisocyanate (TDI)
Tolyl Epoxypropyl Ether	Cresyl Glycidyl Ether
Tolyl Glycidyl Ether	Cresyl Glycidyl Ether
Tosic Acid	P-Toluenesulfonic Acid
Toxaphene	Toxaphene
Toxichlor	Chloroane
Toxilic Acid	Maleic Acid
Toxilic Anhydride	Maleic Anhydride
Transformer Oil	Oil: Transformer
Transmission Oil	Oil: Motor
Transmission Oil	Oil: Lubricating
Treflan	Trifluralin
Trethylene	Trichloroethylene

Synonym	*Compound Name*
Tricresyl Phosphate	Tricresyl Phosphate
Tri-P-Cresyl Phosphate	Tricresyl Phosphate
1-Tridecanol	Tridecanol
Tridecanol	Tridecanol
Tridecanol	Linear Alcohols (12-15 Carbons)
1-Tridecene	1-Tridecene
Tridecylbenzenesulfonic Acid	Alkylbenzenesulfonic Acids
Trielene	Trichloroethylene
Trien	Triethylenetetramine
Triethanolamine	Triethanolamine
Triethanolamine Dodecylbenzenesulfonate	Dodecylbenzenesulfonic Acid Triethanolamine Salt
Triethanolamine Lauryl Sulfate	Dodecyl Sulfate, Triethanolamine Salt
Triethylaluminum	Triethylaluminum
Triethylamine	Triethylamine
Triethylbenzene	Triethylbenzene
Sym-Triethylbenzene	Triethylbenzene
1,3,5-Triethylbenzene	Triethylbenzene
Triethylene Glycol	Triethylene Glycol
Triethylene Glycol Monoethyl Ether	Ethoxy Triglycol
Triethylenephosphoramide	Tris(Aziridinyl)Phosphine Oxide
Triethylenetetramine	Triethylenetetramine
Triethylolamine	Triethanolamine
Trifluorochloroethylene	Trifluorochloro-ethylene
Trifluoromonochloroethylene	Trifluorochloroethylene
Trifluorovinyl Chloride	Trifluorochloroethylene
Trifluralin	Trifluralin
Triglycine	Nitrilotriacetic Acid and Salts
Triglycol	Triethylene Glycol
Triglycol Monoethyl Ether	Ethoxy Triglycol
1,2,3-Trihydroxybenzene	Pyrogallic Acid
3,4,5-Trihydroxybenzoic Acid	Gallic Acid
1,2,3-Trihydroxypropane	Glycerine
Trihydroxytriethylamine	Triethanolamine
Trilsobutylaluminum	Trilsobutylaluminum
Trilene	Trichloroethylene
Triline	Trichloroethylene
Trimar	Trichloroethylene
Trimethylamine	Trimethylamine
Trimethylaminomethane	Tert-Butylamine
Trimethylbenzylammonium Chloride	Benzyltrimethylammonium Chloride

Synonym	*Compound Name*
Uranyl Acetate	Chloroform
Uranyl Acetate Dihydrate	Uranyl Acetate
Uranyl Nitrate	Uranyl Nitrate
Uranyl Sulfate	Uranyl Sulfate
Uranyl Sulfate Trihydrate	Uranyl Sulfate
Urea	Urea
Urea Hydrogen Peroxide	Urea Peroxide
Urea Peroxide	Urea Peroxide
Uritone	Hexamethylenetetramine
Urotropin	Hexamethylenetetramine
Valentinite	Antimony Trioxide
Valeral	Valeraldehyde
Valeraldehyde	Valeraldehyde
Valeric Aldehyde	Valeraldehyde
Vam	Vinyl Acetate
Vanadic Anhydride	Vanadium Pentoxide
Vanadium Oxysulfate	Vanadyl Sulfate
Vanadium Oxytrichloride	Vanadium Oxytrichloride
Vanadium Pentaoxide	Vanadium Pentoxide
Vanadium Pentoxide	Vanadium Pentoxide
Vanadyl Chloride	Vanadium Oxytrichloride
Vanadyl Sulfate	Vanadyl Sulfate
Vanadyl Sulfate Dihydrate	Vanadyl Sulfate
Vanadyl Trichloride	Vanadium Oxytrichloride
Vanicide	Captan
Vapotone	Tetraethyl Pyrophosphate
Vaseline	Petrolatum
VC	Vinyl Chloride
VCL	Vinyl Chloride
VCH	Vinyl Chloride
Vegetable Carbon	Charcoal
Vegetable Charcoal	Charcoal
Vegetable Oil	Oil: Vegetable
Velsicol	Heptachlor
Velsicol 1068	Chlordane
Vemtox	Acrylonitrile
Versene Acid	Ethylenediamine Tetracetic Acid
Vic-M-Xylenol	Xylenol
Vienna Green	Copper Acetoarsenite
Vilrathane 4300	Diphenylmethanediisocyanate (MDI)
Vinegar Acid	Acetic Acid

Synonym	*Compound Name*
Yellow Phosphorus	Phosphorus, White
Zinc Acetate	Zinc Acetate
Zinc Acetate Dihydrate	Zinc Acetate
Zinc Ammonium Chloride	Zinc Ammonium Chloride
Zinc Arsenate	Zinc Arsenate
Zinc Borate	Zinc Borate
Zinc Bromide	Zinc Bromide
Zinc 0,0-Di-N-Butylphosphorodithioate	Zinc Dialkyldithiophosphate
Zinc Chloride	Zinc Chloride
Zinc Chromate	Zinc Chromate
Zinc Chromate(VI)Hydroxide	Zinc Chromate
Zinc Diacetate	Zinc Acetate
Zinc Dialkyldithiophosphate	Zinc Dialkyldithiophosphate
Zinc Diethyl	Diethylzinc
Zinc Dihexyldithiophosphate	Zinc Dialkyldithiophosphate
Zinc Dihexylphosphorodithioate	Zinc Dialkyldithiophosphate
Zinc Dimethyl	Dimethylzinc
Zinc Ethyl	Diethylzinc
Zinc Fluoborate Solution	Zinc Fluoroborate
Zinc Fluoroborate	Zinc Fluoroborate
Zinc Fluosilicate	Zinc Sulicofluoride
Zinc Hexafluorosilicate	Zinc Silicofluoride
Zinc Methyl	Dimethylzinc
Zinc Nitrate	Zinc Nitrate
Zinc Nitrate Hexahydrate	Zinc Nitrate
Zinc P-Phenolsulfonate	Zinc Phenolsulfonate
Zinc Phenolsulfonate	Zinc Phenolsulfonate
Zinc Phenolsulfonate Octahydrate	Zinc Phenolsulfonate
Zinc Phosphide	Zinc Phosphide
Zinc Silicofluoride	Zinc Silicofluoride
Zinc Silicofluoride Hexahydrate	Zinc Silicoflouoride
Zinc Sulfate	Zinc Sulfate
Zinc Sulfate Heptahydrate	Zinc Sulfate
Zinc Sulfocarbolate	Zinc Phenolsulfonate
Zinc Sulfophenate	Zinc Phenolsulfonate
Zinc Vitriol	Zinc Sulfate
Zinc Yellow	Zinc Chromate
Zirconium Acetate	Zirconium Acetate
Zirconium Acetate Solution	Zirconium Acetate
Zirconium Nitrate	Zirconium Nitrate
Zirconium Nitrate Pentahydrate	Zirconium Nitrate

Synonym	*Compound Name*
Zirconium Oxide Chloride	Zirconium Oxychloride
Zirconium Oxychloride	Zirconium Oxychloride
Zirconium Oxychloride Hydrate	Zirconium Oxychloride
Zirconium Sulfate	Zirconium Sulfate
Zirconium Sulfate Tetrahydrate	Zirconium Sulfate
Zirconyl Chloride	Zirconium Oxychloride

2.3 NFPA HAZARD CLASSIFICATION INFORMATION

The following table provides a listing of chemicals along with their NFPA hazard ratings. Refer to Chapter 1 for a definition of the hazard ratings. The terms ~~W~~ and *oxy* refer to water reactive and oxidizer, respectively.

			NFPA Hazard Classification			
Chemical Name	Synonyms	Hazard Classification	Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
ACETALDEHYDE	Acetic Aldehyde, Ethanal, Ethyl Aldehyde	Flammable Liquid, I	2	4	2	
ACETIC ACID	Glacial Acetic Acid, Ethanoic Acid, Vinegar Acid	Corrosive Material, II	2	2	1	
ACETIC ANHYDRIDE	Ethanoic Anhydride	Corrosive Material, II	2	2	1	~~W~~
ACETONE	Dimethyl Ketone, Propanone	Flammable Liquid, II	1	3	0	
ACETONE CYANOHYDRIN	2-Methyl Lactonitrile, Alpha-Hydroxy Isobutronitrile	Poisonous Liquid or Solid, Class B, I	4	1	2	
ACETONITRILE	Methyl Cianide, Cyanomethane, Ethanenitrile	Flammable Liquid	2	3	0	
ACETOPHENONE	Acetylbenzene, Methyl Plenyl Ketone	Combustible Liquid	1	2	0	
ACETYLACETONE	2,4-Pentanedione, Diacetylmethane	Not Listed	2	2	0	
ACETYL CHLORIDE	None	Corrosive Material, II	3	3	2	~~W~~
ACETYLENE	Ethyne, Ethine	Flammable Compressed Gas	1	4	2	
ACETYL PEROXIDE SOLUTION	Diacetyl Peroxide Solution	Organic Peroxide	1	2	4	
ACRIDINE	Dibenzo [b,e] Pyridine, 10-Azaanthracene, Benzo(b)-Quinoline	Poison, III	NL	NL	NL	
ACROLEIN	Acraldehyde, Acrylic Aldehyde, Allyl Aldehyde, Ethylene Aldehide, 2-Propenal, Acrylaldehyde	Flammable Liquid, III	3	3	2	
ACRYLIC ACID	Propenoic Acid	Corrosive Material, II	3	2	2	
ACRYLONITRILE	Cyanoethylene, Fumigrain, Ventox, Vinyl Cyanide	Flammable, I Liquid	4	3	2	
ADIPIC ACID	Adipinic Acid, 1,4 -Butane-dicarboxylic Acid, Hexanedioic Acid		1	1	0	
ADIPONITRILE	1,4-Dicyanobutane	Combustible Liquid, III	4	2	0	
ALDRIN	1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4-endo-exo-5,8-dimethanonaph-thalene	Poisonous liquid or solid, Class B, II	2	0	0	
ALLYL ALCOHOL	Vinyl Carbinol, 2-Propen-1-ol	Flammable Liquid, I	3	3	0	
ALLYL BROMIDE	Bromallylene, 3-bromopropene, 3-bromopropylene	Flammable Liquid, I	3	3	1	
ALLYL CHLORIDE	3-Chloropropene, 3-Chloropropylene	Flammable Liquid, I	3	3	1	

			NFPA Hazard Classification			
Chemical Name	Synonyms	Hazard Classification	Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
ALLYL CHLOROFORMATE	Allyl Chlorocarbonate	Flammable Liquid, I	3	3	1	
ALLYLTRICHLORO-SILANE	Allylsilicone Trichloride	Corrosive Material, II	3	4	4	
ALUMINUM CHLORIDE	Anhydrous Aluminum Chloride	NL, II	3	0	2	W
ALUMINUM FLUORIDE	None	NL	1	0	0	
AMMONIA (ANHYDROUS)	Liquid Ammonia	Non-flammable Compressed Gas, III	3	1	0	
AMMONIUM BIFLUORIDE	Acid Ammonium Fluoride, Ammonium Acid Fluoride, Ammonium Hydrogen Fluoride	Corrosive Material	3	0	1	
AMMONIUM NITRATE	Nitram	Oxidizing Material, III	2	1	3	oxy
AMMONIUM NITRATE-UREA SOLUTION	Solar Nitrogen Solutions, Nitrex Nitrogen Solutions	NL	0	2	0	
AMMONIUM PERCHLORATE	None	Oxidizing Material, II	2	1	4	oxy
AMYL ACETATE	Amyl Acetate, Mixed Isomers, Pentyl Acetates	Flammable Liquid, III	1	3	0	
n-AMYL ALCOHOL	1-Amyl Alcohol, n-Butylcarbinol, 1-Pentanol, Pentyl Alcohol	Flammable Liquid, II	1	3	0	
n-AMYL CHLORIDE	Amyl Chloride, n-Butylcarbinyl Chloride, 1-Chloropentane, Chloride of Amyl	Flammable Liquid, II	1	3	0	
n-AMYL MERCAPTAN	1-Pentanethiol, Amyl Hydrosulfide, Amyl Sulfhydrate, Amyl Thioalcohol	Flammable Liquid, II	2	3	0	
n-AMYL NITRATE	Mixed Primary Amyl Nitrates	Combustible Liquid, III	2	2	0	oxy
iso-AMYL NITRITE	Amyl Nitrite, 3-Metylbutyl Nitrite, Isopentyl Nitrite	Flammable Liquid, II	1	NL	2	
n-AMYLTRI-CHLOROSILANE	Trichloropentyl-silane, Pentylsilicon Trichloride, Trichloroamyl-silane	Corrosive Material, II	4	2	4	W
ANILINE	Aminobenzene, Aniline Oil, Phenylamine	Poisonous Liquid or Solid, Class B, II	3	2	0	
ANTHRACENE	Paranaphthalene	NL	0	1	NL	
ANTIMONY PENTACHLORIDE	Antimony Perchloride	Corrosive Material, II	4	0	3	
ARSENIC ACID	Arsenic Pentoxide, Orthoarsenic Acid	Poisonous, Class B, I(L) II(S)	4	0	2	
ASPHALT	Asphaltic Bitumen, Petroleum Asphalt, Bitumen	Combustible Liquid, III	0	1	0	
ASPHALT BLENDING STOCK (ROOFERS FLUX)	Asphaltum Oil, Flux Oil, Petroleum Tailings, Road Oil, Residual Oil,	NL	0	1	0	
ASPHALT BLENDING STOCK (STRAIGHT RUN RESIDUE)	Petroleum Asphalt, Petroleum Pitch, Road Binder	NL	0	1	0	
ATRAZINE	2-Chloro-4-ethyl-amino-6-isopropylamino-s-triazine, Aatrex Herbicide	NL	2	0	1	
BARIUM CHLORATE	None	Oxidizing Material, II	1	0	2	oxy
BARIUM NITRATE	None	Oxidizing Material, II	1	0	0	oxy
BARIUM PEROXIDE	Barium Dioxide, Barium Binoxide	Oxidizing Material, II	1	0	0	oxy
BENZALDEHYDE	Benzoic Aldehyde, Oil of Bitter Almond	Combustible Liquid	2	2	0	

Chemical Name	Synonyms	Hazard Classification	NFPA Hazard Classification: Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
BENZENE	Benzol, Benzole	Flammable Liquid, II	2	3	0	
BENZENE HEXACHLORIDE	Gammexane, Lindane	Poisonous liquid or solid, Class B	2	1	0	
BENZOYL CHLORIDE	Benzencarbonyl Chloride	Corrosive Material, II	3	2	1	W
BENZYL ALCOHOL	Benzencarbinol, Phenylmethanol, Phenylmethyl Alcohol	NL	2	1	0	
BENZYL BROMIDE	alpha-Bromotoluene, omega- Bromotoluene	Corrosive Material, II	2	2	0	
BENZYL n-BUTYL PHTHALATE	Butyl benzyl phthalate, Phthalic Acid, Benzyl Butyl Ester	NL	1	1	0	
BENZYL CHLORIDE	Chlorotoluene, alpha	Corrosive Material, II	2	2	1	
BENZYL CHLOROFORMATE	Chloroformic Acid, Benzylcarbonyl Chloride, Benzyl Chlorocarbonate	Corrosive Material, I	3	1	3	
BERYLLIUM METALLIC	None	NL	4	1	1	
BISPHENOL A DIGLYCIDYL ETHER	Diglycidyl Ether, Bisphenol A-epichlorohydrin Resin	NL	1	1	2	
BORON TRICHLORIDE	Boron Chloride	Corrosive Material	4	0	4	
BROMINE	None	Corrosive Material, I	4	0	0	oxy
BROMINE PENTAFLUORIDE	None	Oxidizer, I	4	0	3	W, oxy
BROMOBENZENE	Monobromo-benzene, Phenyl Bromide, Bromobenzol	Combustible Liquid, III	2	2	0	
BUTADIENE (INHIBITED)	Biethylene, 1,3-Butadiene, Bivinyl, Divinyl, Vinylethylene	Flammable Compressed Gas	2	4	2	
BUTANE	n-Butane	Flammable Compressed Gas	1	4	0	
n-BUTYL ACETATE	Acetic Acid, Butyl Acetate, Butyl Ethanoate	Flammable Liquid, II	1	3	0	
sec-BUTYL ACETATE	Acetic Acid, sec-Butyl Ester	Flammable Liquid	1	3	0	
iso-BUTYL ACRYLATE	Acrylic Acid, Isobutyl Ester	Flammable Liquid, II	1	2	3	
n-BUTYL ACRYLATE	Acrylic Acid, Butyl Ester, Butyl Acrylate, Butyl 2-Propenoate	Combustible Liquid, II	2	2	2	
n-BUTYL ALCOHOL	Butanol, Butyl Alcohol, 1-Butanol, 1-Hydroxybutane, n-Propylcarbinol	Flammable Liquid, II	1	3	0	
sec-BUTYL ALCOHOL	2-Butanol, Butylene Hydrate, 2-Hydroxybutane, Methylethyl-carbinol	Flammable Liquid, II	1	3	2	
tert-BUTYL ALCOHOL	2-Methyl-2 Propanol, Trimethylcarbinol	Flammable Liquid, II	1	3	0	
n-BUTYLAMINE	1-Aminobutane, Butylamine, Norvalamine	Flammable Liquid	2	3	0	
sec-BUTYLAMINE	None	Flammable Liquid	3	3	NL	
BUTYLENE OXIDE	1-Butene Oxide, alpha-Butylene Oxide, 1,2-Epoxybutane	Flammable Liquid	2	3	2	
tert-BUTYL HYDROPEROXIDE	Cadox TBH	Flammable Liquid	1	4	4	oxy
n-BUTYL MERCAPTAN	1-Butanethiol, Thiobutyl Alcohol	Flammable Liquid, II	2	3	0	
n-BUTYL METHACRYLATE	Methacrylic Acid, butyl ester, Butyl Methacrylate, n-Butyl alpha-methyl acrylate, Butyl 2-methyl-2-propenoate	NL, III	2	2	0	

Chemical Name	Synonyms	Hazard Classification	NFPA Hazard Classification: Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
BUTYLTRICHLORO-SILANE	n-Butyltrichloro-silane	Corrosive Material, II	2	2	0	
iso-BUTYRALDEHYDE	Isobutyric Aldehyde Isobutylaldehyde, 2-Methylpropanal	Flammable Liquid, II	2	3	0	
n-BUTYRALDEHYDE	Butanal, Butyraldehyde, Butyl Aldehyde, Butyric Aldehyde	Flammable Liquid, II	2	3	0	
n-BUTYRIC ACID	Butanic Acid, Butanoic Acid, Butyric Acid, Ethylacetic Acid	Corrosive Material, III	2	2	0	
CADMIUM FLUOROBORATE	Cadmium Fluoborate, Cadmium Fluoborate Solution	NL, I	1	0	0	
CADMIUM NITRATE	Cadmium Nitrate Tetrahydrate	NL, I	2	0	0	oxy
CADMIUM SULFATE	None	NL, I	1	0	0	
CALCIUM CARBIDE	Carbide Acetylenogen	Flammable Solid, II	1	4	2	~~W~~
CALCIUM CYANIDE	Cyanide of Calcium, Cyanogas G-Fumigant	Poisonous, Class B, I	3	0	0	
CALCIUM HYPOCHLORITE	HTH, HTH Dry Chlorine, Sentry	Oxidizing Material, II	2	0	2	oxy
CALCIUM, METALLIC	None	Flammable Solid	1	1	2	~~W~~
CALCIUM OXIDE	Unslaked Lime, Quick Lime	ORM - B, III	1	0	1	
CARBOLIC OIL	Middle Oil, Liquefied Phenol	Poisonous Liquid or Solid, Class B	3	2	0	
CARBON BISULFIDE	Carbon Disulfide	Flammable liquid, I	2	3	0	
CARBON MONOXIDE	Monoxide	Flammable Compressed Gas	2	4	0	
CARBON TETRACHLORIDE	Carbon Tet, Tetrachloro-methane, Benzinoform	ORM - A, II	3	0	0	
CAUSTIC POTASH SOLUTION	Potassium Hydroxide Solution, Lye	Corrosive Material, II	3	0	1	
CAUSTIC SODA SOLUTION	Sodium Hydroxide Solution, Lye	Corrosive Material, II	3	0	1	
CHLORINE	None	Non-flammable Compressed Gas	3	0	0	oxy
CHLOROACETO-PHENONE	Phenacyl Chloride, omega-Chloroaceto-phenone, Phenyl Chloromethyl Ketone, Tear Gas	Irritant	2	1	0	
CHLOROACETYL CHLORIDE	Chloracetyl Chloride	Corrosive Liquid, II	3	0	0	
CHLOROBENZENE	Benzene Chloride, MCB, Monochloro-benzene, Phenyl Chloride	Flammable Liquid, II	2	3	0	
CHLOROFORM	Trichloromethane	ORM - A, III	2	0	0	
CHLOROHYDRINS (CRUDE)	Crude Epichlorohydrin	Poison, Class B, II	3	3	2	
p-CHLOROPHENOL	4-Chlorophenol	NL, III	3	1	0	
CHLOROPICRIN, LIQUID	Tricloronitro-methane, Nitrochloroform, Picfume, Nitrotrichloro-methane	Poisonous, Class B, I	4	0	3	
CHLOROSULFONIC ACID	Chlorsulfonic Acid	Corrosive, I	3	0	2	~~W~~, oxy
CHROMIC ANHYDRIDE	Chromic Oxide, Chromic Trioxide, Chromic Acid	Oxidizing Material, I (S)	3	0	1	
COBALT NITRATE	Cobalt (II) Nitrate, Cobaltous Nitrate Hexahydrate	NL	1	0	0	oxy

			NFPA Hazard Classification			
Chemical Name	Synonyms	Hazard Classification	Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
COLLODION	Cellulose Nitrate Solution, Nitrocellulose Solution, Pyroxylin Solution, Box Toe Gum	Flammable Liquid, II	2	3	3	
COPPER CHLORIDE	Cupric Chloride Dihydrate, Eriocholcite (anhydrous)	ORM - B, III	0	0	0	
COPPER FLUOROBORATE	Copper Borofluoride Solution, Copper (II) Fluoborate Solution, Cupric Fluoborate Solution	NL	1	0	0	
COPPER NITRATE	Cupric Nitrate Trihydrate, Gerhardite	NL	1	0	0	oxy
CREOSOTE, COAL TAR	Creosote Oil, Dead Oil	Combustible Liquid	2	2	0	
CRESOLS	Cresylic Acids, Hydroxytoluenes, Methylphenols, Tar Acids	Poisous Liquid or Solid, Class B, II	3	2	0	
CROTONALDEHYDE	beta-Methylacrolein, Crotenaldehyde, Crotonic Aldehyde, trans-2-Butenal	Flammable Liquid, II	3	3	2	
CUMENE	Cumol, Isopropylbenzene	Combustible Liquid	0	2	0	
CUMENE HYDROPEROXIDE	alpha, alpha-DimethylbenzeneHydroperoxide, Dimethylbenzyl Hydroperoxide, Isopropylbenzene Hydroperoxide	Organic Peroxide	1	2	4	oxy
CUPRIETHYLENE-DIAMINE SOLUTION	Cupriethylene-diamine Hydroxide Solution	Corrosive	4	4	2	
CYANOACETIC ACID	Cyanacetic Acid,Malonic Mononitrile	NL, I	3	1	0	
CYANOGEN	Ethanedinitrile, Dicyan, Oxalonitrile, Dicyanogen	Poisonous, Class A, I	4	4	2	
CYANOGEN BROMIDE	None	Poisonous Liquid or Solid, I	3	0	2	
CYCLOHEXANE	Hexahydro-benzene, Hexamethylene, Hexanaphthene	Flammable Liquid, I	1	3	0	
CYCLOHEXANOL	Hexalin, Adronal, Anol, Cyclohexyl Alcohol	Combustible Liquid	1	2	0	
CYCLOHEXYL-AMINE	Aminocyclo-hexane, Hexahydroaniline	Flammable Liquid, II	2	3	0	
CYCLOPENTANE	Pentamethylene	Flammable Liquid, II	1	3	0	
CYCLOPROPANE	Trimethylene	Flammable Compressed gas	1	4	0	
p-CYMENE	Cymol, p-Isopropyltoluene, Isopropyltoluol, Methyl Propyl Benzene	NL	2	2	0	
DECABORANE	None	Flammable Solid, III	3	2	1	
DECAHYDRO-NAPHTHALENE	Bicyclo [4,4,0] Decane, Naphthalane, Perhydro-naphthalene, Decalin	Combustible Liquid, II	2	2	0	
n-DECYLBENZENE	Decylbenzene, 1-Phenyldecane	NL	2	1	0	
DIACETONE ALCOHOL	Diacetone, 4-Hydroxy-4-Methyl-2-Pentanone, Tyranton	Flammable Liquid, III	1	2	0	
Di-n-AMYL PHTHALATE	Diamyl Phthalate, Dipentyl Phthalate, Phthalic Acid, diamyl ester, Phthalic Acid, dipentyl ester	NL	0	1	0	
DIBENZOYL PEROXIDE	Benzoyl Peroxide, Benzoyl Superoxide, BPO, Oxilite	Organic Peroxide	1	4	4	oxy
Di-n-BUTYLAMINE	1-Butalamine, N-Butyl, Dibutylamine	NL, II	3	2	0	
DI-n-BUTYL ETHER	n-Dibutyl Ether, n-Butyl Ether, Butyl Ether, Dibutyl Oxide	NL	2	3	0	
o-DICHLORO-BENZENE	1,2-Dichlorobenzene, Dowtherm E, Orthodichloro-benzene	ORM-A, II	2	2	0	

Chemical Name	Synonyms	Hazard Classification	NFPA Hazard Classification Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
DICHLORODI-FLUOROMETHANE	Arcton 6, Eskimon 12, F-12, Freon 12, Genetron 12	Non-flammable Compressed Gas	0	0	0	
1,2-DICHLORO-ETHYLENE	Acetylene Dichloride, Sym-Dichloroethylene, Dioform, cis- or trans- 1,2-Dichloroethylene	Flammable Liquid, II	2	3	2	
DICHLORO-METHANE	Methylene Chloride, Methylene Dichloride	ORM-A, III	2	1	0	
DICHLORO-PROPANE	1,2-Dichloropropane, Propylene Dichloride	Flammable Liquid, II	2	3	0	
DIETHYLENE GLYCOL	DEG, Diglycol, 2,2'-Oxybisethanol, 2,2'-Dihydroxydiethyl Ether	NL	1	1	0	
DIETHYLENE-GLYCOL MONOBUTYL ETHER	Butoxydiethylene Glycol, Butoxydiglycol, Diglycol Monobutyl Ether, Butyl "Carbinol", Dowanol DB	NL	1	2	0	
DIETHYLENE-GLYCOL MONOBUTYL ETHER ACETATE	Diglycol Monobutyl Ether Acetate, Butyl "Carbinol" Acetate, Ektasolve DB Acetate	NL		1	0	
DIETHYLENE-TRIAMINE	Bis(2-aminoethyl) Amine, 2,2'-Diamino-diethylamine	Corrosive Material, II	3	1	0	
DIETHYL PHTHALATE	Phalatic Acid, diethyl ester, Ethyl Phthalate, 1,2-Benzenedi-carboxylic Acid, diethyl ester	NL	0	1	0	
DIETHYLZINC	Zinc Diethyl, Ethyl Zinc, Zinc Ethyl	Flammable Liquid, I	0	3	3	W
DIISOBUTYL KETONE	DIBK, sym-Diiso-propylacetone, 2,6-Dimethyl-4-heptanone, Isovalerone	Combustible Liquid, III	1	2	0	
DIISO-PROPANOLAMINE	2-2'-Dihydroxydi-propylamine, 1,1'-Iminodi-2-propanol	NL	3	3	0	
DIISOPROPYL-AMINE	None	Flammable Liquid, II	3	3	0	
DIMETHYLAMINE	None	Flammable Compressed Gas	3	4	0	
DIMETHYLDI-CHLOROSILANE	None	Flammable Liquid	3	3	1	
DIMETHYL ETHER	Methyl Ether, Wood Ether	Flammable Compressed Gas	2	4	0	
1,1-DIMETHYL-HYDRAZINE	Dimazine, UDMH, unzym-Dimethyl-hydrazine	Flammable Liquid	3	3	1	
DIMETHYL SULFATE	Methyl Sulfate	Corrosive Material, I	4	2	0	
DIMETHYL SULFIDE	Methyl Sulfide, 2-Thiapropane, Methanethio-methane	Flammable Liquid, II	4	4	0	
2,4-DINITROANILINE	2,4-Dinitraniline	NL, II	3	1	3	
2,4-DINITROTOLUENE	2,4-Dinitrotoluol, 1-Metyul-2,4-Dinitrobenzene, DNT	NL, II	3	1	3	
1,4-DIOXANE	Dioxane, p-Dioxane, Di(Ethylene Oxide)	Flammable Liquid, II	2	3	1	
DIPENTENE	Limonene, p-Methal,8-diene, Terpinene, delta-1,8-Terpodiene	NL, III	0	2	0	
DIPHENYLAMINE	Anilinobenzene, N-Phenylaniline	NL, I	3	1	0	
DIPHENYL ETHER	Phenyl Ether, Diphenyl Oxide, Phenoxybenzene	NL, II	1	1	0	
Di-n-PROPYLAMINE	N-n-Propyl-1-Propanamine	Flammable Liquid	3	3	0	
DODECENE	Propylene Tetramer, Tetrapropylene	Combustible Liquid	0	2	0	
ENDRIN	Hexadrin, Mendrin, 1,2,3,4,10,10-hexachloro-,6,7-epoxy-1,4,4a,5,6,7,8,8a-Dimethano-naphthalene	Poisonous, Class B	3	1	0	

Chemical Name	Synonyms	Hazard Classification	NFPA Hazard Classification Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
EPICHLOROHYDRIN	1-Chloro-2,3-Epoxypropane, 3-Chloro-1,2-Propylene Oxide	Poison, Class B	3	3	2	
ETHOXYDIHYDRO-PYRAN	2-Ethoxy-3,4-Dihydro-2H-Pyran	NL	2	2	1	
ETHYL ACETATE	Acetic Acid, ethyl ester, Acetic Ester, Acetic Ether, Vinegar Naphtha,	Flammable Liquid, II	1	3	0	
ETHYL ACETOACETATE	Acetoacetic Acid,ethyl ester, Acetoacetic Ester, Diacetic Ether, EAA	NL	2	2	0	
ETHYL ACRYLATE	Acrylic Acid, ethyl ester, Ethyl 2-propenoate	Flammable Liquid, II	2	3	2	
ETHYL ALCOHOL	Ethanol. Alcohol, Grain Alcohol, Denatured Alcohol	Flammable Liquid	0	3	0	
ETHYLAMINUM DICHLORIDE	EADC, Aluminum Ethyl Dichloride	Flammable Liquid	3	3	3	W
ETHYLALUMINUM SESQUICHLORODE	EASC	Flammable Liquid	-	3	3	W
ETHYLAMINE	Aminoethane, Monoethylamine,	Flammable Liquid	3	4	0	
ETHYLBENZENE	EB, Phenylethane	Flammable Liquid	2	3	0	
ETHYL BUTANOL	Pseudohexyl Alcohol, sec-Pentylcarbinol, sec-Hexyl Alcohol, 2-Ethyl-1-butanol	Combustible Liquid	1	2	0	
ETHYL BUTYRATE	Ethyl Butanoate, Butyric Acid,ethyl ester, Butyric Ether	Flammable Liquid, III	0	3	0	
ETHYL CHLORIDE	Chloroethane, Monochloro-ethane	Flammable Liquid	2	4	0	
ETHYL CHLOROACETATE	Ethyl Chloroacetate, Ethyl Chloroethanoate, Monochloroacetic Acid,ethyl ester, Chloroacetic Acid,ethyl ester	Combustible Liquid, III	-	3	0	
ETHYL CHLOROFORMATE	Chloroformic Acid,ethyl ester, Ethyl Chlorocarbonate	Flammable Liquid, I	-	3	1	
ETHYLENE	Ethene, Olefiant Gas	Flammable Compressed Gas	1	4	2	
ETHYLENE CHLOROHYDRIN	2-Chloroethanol, 2-Chlorethanol, 2-Chloroethyl Alcohol, Glycol Chlorohydrin	Poison, Class B, II	3	2	0	
ETHYLENE CYANOHYDRIN	Hydracrylonitrile, 2-Cyanoethanol, Glycol Cyanohydril, 3-Hydroxy-propanenitrile	NL	2	1	1	
ETHYLENEDIAMINE	1,2-Diaminoethane, 1,2-Ethanediamine	NL	3	2	0	
ETHYLENE DIBROMIDE	1,2-Dibromoethane, Glycol Dibromide, Bromofume, Ethylene Bromide	ORM-A, II	3	0	0	
ETHYLENE DICHLORIDE	1,2-Dichloroethane, Ethylene Chloride, EDS	Flammable Liquid, II	2	3	0	
ETHYLENE GLYCOL	Glycol, Monoethylene Glycol, 1,2-Ethanediol	NL, II	1	1	0	
ETHYLENE GLYCOL DIACETATE	Ethylene Acetate, Glycol Diacetate, Ethylene Diacetate	NL	1	1	0	
ETHYLENE GLYCOL MONOBUTYL ETHER	2-Butoxyethanol, Butyl Cellosolve, Dowanol EB, Poly-Solv EB	Combustible Liquid	2	2	0	
ETHYLENEIMINE	Aziridine, Azirane	Flammable Liquid	3	3	2	
ETHYLENE OXIDE	Oxirane, 1,2-Epoxyethane	Flammable Liquid	2	4	3	
ETHYL ETHER	Anesthesia Ether, Diethyl Ether, Diethyl Oxide, Ethoxyethane, Sulfuric Ether	Flammable Liquid	2	4	1	
ETHYL FORMATE	Ethyl Formic Ester, Ethyl Methanoate, Formic Acid, ethyl ester	Flammable Liquid, II	2	3	0	

			NFPA Hazard Classification			
Chemical Name	**Synonyms**	**Hazard Classification**	**Health (Blue)**	**Flammability (Red)**	**Reactivity (Yellow)**	**Special (White)**
ETHYLHEXALDEHYDE	2-Ethylhexanal, Butylethyl-acetaldehyde, Octyl Aldehyde, 2-Ethyl Hexaldehyde	Combustible Liquid, III	2	2	1	
2-ETHYL HEXANOL	2-Ethyl-1-Hexanol, 2-Ethylhexyl Alcohol	Combustible Liquid	2	2	0	
2-ETHYLHEXYL ACRYLATE, INHIBITED	Acrylic Acid, 2-ethyl-hexyl ester, 2-Ethylhexyl, 2-propenoate	NL, II	2	2	1	
ETHYL LACTATE	Lactic Acid, ethyl ester, Ethyl 2-hydroxy-propioate, Ethyl 2-hydroxy-propanoate	Combustible Liquid, III	2	2	0	
ETHYL MERCAPTAN	Ethanethiol, Ethyl Sulfhydrate, Thioethyl Alcohol,	Flammable Liquid, I	2	4	0	
ETHYL METHACRYLATE	Ethyl 2-Methacrylate, Ethyl Methacrylate - Inhibited, Methacrylic Acid, ethyl ester	Flammable Liquid, II	2	3	0	
ETHYL NITRITE	Nitrous Ether, Sweet Spirit of Nitre, Spirit of Ether Nitrite	Flammable Liquid, I	2	4	4	
ETHYL SILICATE	Tetraethyl Silicate, Silibond, Tetraethyl Orthosilicate, Ethyl Orthosilicate, Ethyl Silicate 40	Combustible Liquid, III	2	2	0	
ETHYLTRICHLOROSILANE	Ethyl Silicone Trichloride, Ethyl Silicon Trichloride, Trichloroethyl-silane, Trichloroethyl-silicane	Flammable Liquid	3	3	0	
FLUORINE	None	Non-Flammable Gas	4	0	3	~~W~~, oxy
FLUOSILICIC ACID	Fluorosilicic Acid, Hexafluosilicic Acid, Hydrofluosilicic Acid, Sand Acid, Silicofluoric Acid	Corrosive Liquid, II	3	0	0	
FORMALDEHYDE SOLUTION	Formalith, Formalin, Formic Aldehyde, Methanal, Fide	Combustible Liquid, III	2	2	0	
FORMIC ACID	Methanoic Acid, Formylic Acid	Corrosive Material, II	3	2	0	
FURFURAL	Pyromucic Aldehyde, 2-Furaldehyde, Furfuraldehyde, Fural	Combustible Liquid, III	2	2	0	
FURFURAL ALCOHOL	2-Furancarbinol, Furfuralcohol, 2-Furylcarbinol, 2-Hydroxymethyl-furan	NL, III	1	2	1	
GALLIC ACID	Gallic Acid Monohydrate, 3,4,5-Trihydroxy-benzoic Acid	NL	0	1	0	
GAS OIL: CRACKED	None	Flammable Liquid, III	1	3	0	
GASOLINES: AUTOMOTIVE (<4,23g lead/gal)	Motor Spirit, Petrol	Flammable Liquid, II	1	3	0	
GASOLINES: AVIATION (<4,86g lead/gal)	None	Flammable Liquid, II	1	3	0	
GASOLINE BLENDING STOCKS: REFORMATES	None	Flammable Liquid	1	3	0	
GASOLINES: CASINGHEAD	Natural Gasoline	Flammable Liquid	1	3	0	
GASOLINES: POLYMER	None	Flammable Liquid	1	3	0	
GASOLINES: STRAIGHT RUN	None	Flammable Liquid	1	3	0	
GLYCERINE	Glycerol, 1,2,3-Propanetriol, 1,2,3-Trihydroxy-propane	NL	1	1	0	
n-HEXALDEHYDE	Caproaldehyde, Caproic Aldehyde, Capronaldehyde, n-Caproylaldehyde, Hexanal	Flammable Liquid, III	2	3	1	
HEXANE	n-Hexane	Flammable Liquid, II	1	3	0	

			NFPA Hazard Classification			
Chemical Name	**Synonyms**	**Hazard Classification**	**Health (Blue)**	**Flammability (Red)**	**Reactivity (Yellow)**	**Special (White)**
HEXYLENE GLYCOL	2-Methyl-2,4-pentanediol	Corrosive Material	3	3	2	
HYDRAZINE	None	Flammable Liquid, I	3	3	2	
HYDROCHLORIC ACID	Muriatic Acid	Corrosive Material	3	0	0	
HYDROFLUORIC ACID	None	Corrosive Material, I	4	0	0	
HYDRIGEN BROMIDE	Hydrobromic Acid	Non-flammable Compressed Gas	3	0	0	
HYDROGEN CHLORIDE	Hydrochloric Acid, anhydrous	Non-flammable Compressed gas	3	0	0	
HYDROGEN CYANIDE	Hydrocyanic Acid, Prussic Acid	Poisonous Gas or Liquid, Class A, I	4	4	2	
HYDROGEN FLUORIDE	Hydrofluoric Acid,anhydrous	Corrosive Material, I	4	0	0	
HYDROGEN, LIQUEFIED	Liquid Hydrogen, para Hydrogen	Flammable Compressed Gas	0	4	0	
HYDROGEN PEROXIDE	Peroxide, Albone, Superoxol	Oxidizer, II	2	0	3	oxy
HYDROGEN SULFIDE	Sulfuretted Hydrogen	Flammable Compressed Gas	3	4	0	
HYDROXYPROPYL ACRYLATE	1,2-Propanediol 1-acrylate, Propylene glycol mon- acrylate	NL	1	1	0	
ISOAMYL ALCOHOL	Fermentation amyl alcohol, Fusel oil, Isopentyl alcohol, 3-Methyl-1-butanol	Combustible Liquid	1	2	0	
ISOBUTYL ACETATE	Acetic Acid, Isobutyl ester	Flammable Liquid, II	1	3	0	
ISOBUTYL ALCOHOL	Isobutanol, Isopropylcarbinol, 2-Methyl-1-propanol	Flammable Liquid, III	1	3	0	
ISOBUTYLAMINE	Monoisobutyl-amine, 1-Amino-2-methylpropane, iso-Butylamine	Flammable Liquid	2	3	0	
ISOBUTYLENE	Isobutene, 2-Methylpropene	Flammable Compressed gas	1	4	0	
ISOPHORONE	3,5,5-Trimethyl-2-cyclohexane-1-one	NL, III	2	2	0	
ISOPRENE	2-Methyl-1,3-butadiene, beta-Methylbivinyl	Flammable Liquid, I	2	4	2	
ISOPROPYL ACETATE	Acetic Acid, isopropyl ester, 2-Propyl acetate	Flammable Liquid, II	1	3	0	
ISOPROPYL ALCOHOL	Dimethylcarbinol, Isopropanol, Petrohol, 2-Propanol, Rubbing alcohol	Flammable Liquid, II	1	3	0	
ISOPROPYLAMINE	2-Aminopropane, Monoisopropyl-amine, iso-Propylamine	Flammable Liquid, I	3	4	0	
ISOPROPYL ETHER	Diisopropyl ether, Diisopropyl Oxide, 2-Isoproxypropane	Flammable Liquid, II	2	3	1	
JET FUELS: JP-1	Kerosene, Kerosine, Range Oil, Fuel Oil ¹1	Combustible Liquid, I	0	2	0	
JET FUELS: JP-3	None	Combustible Liquid, I	0	2	0	
JET FUELS: JP-4	None	Flammable Liquid, I	0	2	0	
JET FUELS: JP-5	Kerosene, heavy	Combustible Liquid, I	0	2	0	
KEROSENE	Illuminating Oil, Kerosine, Range Oil, JP-1, Fuel Oil ¹1	Combustible Liquid, III	0	2	0	
LAUROYL PEROXIDE	Dilauroyl peroxide, Dodecanoyl peroxide	Organic Peroxide	0	2	3	oxy
LAURYL MERCAPTAN	1-Dodecanethiol, Dodecyl mercaptan	NL	2	1	0	

Chemical Name	Synonyms	Hazard Classification	NFPA Hazard Classification Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
KEROSENE	Illuminating Oil, Kerosine, Range Oil, JP-1, Fuel Oil [1]	Combustible Liquid, III	0	2	0	
LAUROYL PEROXIDE	Dilauroyl peroxide, Dodecanoyl peroxide	Organic Peroxide	0	2	3	oxy
LAURYL MERCAPTAN	1-Dodecanethiol, Dodecyl mercaptan	NL	2	1	0	
LEAD ARSENATE	Lead arsenate, acid, Plumbous arsenate	Poisonous Liquid Or Solid, Class B, II	2	0	0	
LEAD FLUOROBORATE	Lead fluoborate, Lead Fluoborate solution	NL	1	0	0	
LEAD NITRATE	Nitric Acid, Lead II salt	Oxidizing Material, II	1	0	0	oxy
LEAD THIOCYANATE	Lead Sulfocyanate	Poison, Class B	1	1	1	
LIQUEFIED PETROLEUM GAS	Bottled Gas, LPG Propane-butane-(propylene) Pyrofax,	Flammable Compressed Gas	1	4	0	
LITHIUM ALUMINUM HYDRIDE	LAH	Flammable Solid, I	3	1	2	W
LITHIUM HYDRIDE	None	Flammable Solid, I	1	4	2	W
LITHIUM, METALLIC	None	Flammable Solid	1	1	2	W
MAGNESIUM	None	Flammable Solid, III	0	1	2	W
MAGNESIUM PERCHLORATE	Anhydrone, Dehydrite, Magnesium perchlorate, anhydrous, Magnesium perchlorate hexahydrate	Oxidizing Materisl, II	1	0	0	oxy
MALEIC ANHYDRIDE	Toxilic Anhydride, cis-Butenedioic anhydride	NL, III	3	1	1	
MESITYL OXIDE	Methyl isobutenyl ketone, Isopropylideneacetone, 4-Methyl-3-pentene-2-one	Flammable Liquid, III	3	3	0	
METHYL ACETATE	Acetic Acid, methyl ester	Flammable Liquid, II	1	3	0	
METHYL ACRYLATE	Acrylic Acid,methyl ester, Methyl 2-propenoate	Flammable Liquid, II	2	3	2	
METHYL ALCOHOL	Colonial Spirit, Columbian Spirit, Methanol, Wood Alcohol	Flammable Liquid, II	1	3	0	
METHYLAMINE	Aminomethane, Mercurialin, Monomethyl-amine, anhydrous	Flammable Compressed Gas, II	3	4	0	
METHYL AMYL ACETATE	Hexyl Acetate, MAAc, 4-Methyl-2-pentyl acetate, 4-Methyl-2-pentanol acetate	Flammable Liquid, II	1	2	0	
METHYL AMYL ALCOHOL	Isobutylmethyl carbinol, Isobutyl methyl- methanol, 4-Methyl-2-pentanol	Combustible Liquid, II	2	2	0	
METHYL BROMIDE	Bromomethane, Embafume, M-B-C Fumigant, Monobromo-methane	Poisonous Liquid or Solid, Class B	3	1	0	
METHYL n-BUTYL KETONE	N-Butyl methyl ketone	NL, I	2	3	0	
METHYL CHLORIDE	Arctic, Chloromethane	Flammable Compressed gas	2	4	0	
METHYL CYCLOPENTANE	Cyclopentane, methyl	Flammable Liquid	2	3	0	
METHYL-DICHLOROSILANE	None	Flammable Liquid	3	3	2	W
METHYL ETHYL KETONE	MEK, 2-Butanone, Ethyl methyl ketone	Flammable Liquid, II	1	3	0	
METHYLETHYLPYRIDINE	MEP, 5-Ethyl-2-methyl pyridine, 5-Ethyl-2-picoline	Corrosive Material, III	2	2	0	

Chemical Name	Synonyms	Hazard Classification	NFPA Hazard Classification: Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
METHYL FORMAL	Methylal, Methylene dimethyl ether, Dimethoxy-methane, Dimethyl formal	Flammable Liquid, II	2	3	2	
METHYL FORMATE	FormicAcid, methyl ester	Flammable Liquid, I	2	4	0	
METHYL-HYDRAZINE	Monomethyl-hydrazine, MMH	Flammable Liquid	3	3	1	
METHYL ISOBUTYL CARBINOL	Isobutyl methyl carbinol, Methylamyl Alcohol, MAOH, MIBC, MIC	Flammable Liquid, III	2	2	0	
METHYL ISOBUTYL KETONE	MIBK, MIK, Hexone, Isobutyl methyl ketone, Isopropylacetone	Flammable Liquid, II	2	3	0	
METHYL ISOPROPENYL KETONE, INHIBITED	2-Methyl-1-butene-3-one	Flammable Liquid, II	2	-	0	
METHYL MERCAPTAN	Methanethiol, Methyl sulfhydrate, Thiomethyl alcohol, Mercaptomethane	Flammable Compressed Gas	2	4	0	
METHYL METHACRYLATE	Methacrylic Acid, methyl ester, Methacrylate monomer, Methyl 2-methyl-2-propenoate	Flammable Liquid, II	2	3	2	
METHYL PARATHION	Metron, MPT, Paridol, Alkron, Nitran, Wolfatox	Poisonous Liquid or Solid, Class B, II	4	3	2	
1-METHYL-PYRROLIDONE	1-Methyl-2-pyrrolidone, N-Methyl-pyrrolidone	NL	2	1	0	
alpha-METHYLSTYRENE	Isopropenyl-benzene, 1-Methyl-1-phenylethylene, Phenylpropylene	NL	1	2	1	
METHYL-TRICHLOROSILANE	Trichloromethyl-silane	Flammable Liquid	3	3	2	W
METHYL VINYL KETONE	3-Buten-2-one	Flammable Liquid, II	2	3	2	
MINERAL SPIRITS	Naphtha, Petroleum spirits	Combustible Liquid, II	0	2	0	
MONOCHLORO-ACETIC ACID	Chloroacetic Acid, Chloracetic Acid	Corrosive Liquid, II	3	1	0	
MONO-ETHANOLAMINE	2-Aminoethanol, beta-Aminoethyl alcohol, Ethanolamine, 2-Hydroxy-ethylamine	Corrosive Material, III	2	2	0	
MORPHOLINE	Tetrahydro-2H-2,4-oxazine, Tetrahydro-p-oxazine, Diethylene imidoxide	Flammable Liquid, III	2	3	0	
NAPHTHALENE, MOLTEN	Naphthalin, Tar Camphor	ORM-A, III	2	2	0	
NAPHTHA: STODDARD SOLVENT	Petroleum solvent, Dricleaner naphtha, Spotting Naphtha	Combustible Liquid, II	0	2	0	
1-NAPHTHYLAMINE	1-Amino-naphthalene, alpha-Naphthylamine	NL, III	2	1	0	
NEOHEXANE	2,2-Dimethylbutane	Flammable Liquid, II	1	3	0	
NICKEL ACETATE	Acetic Acid, nickel (2+) salt, Nickelous acetate, Nickel acetate tetrahydrate	NL, II	1	1	0	
NICKEL CARBONYL	Nickel Tetracarbonyl	Flammable Liquid, I	-	3	1	W
NICKEL CHLORIDE	Nickel chloride hexahydrate	NL	1	0	0	
NICKEL FLUOROBORATE	Nickel (II) fluoborate, Nickel fluoborate solution	NL	1	0	0	
NICKEL NITRATE	Nickel nitrate hexahydrate	NL, III	1	0	0	oxy
NICOTINE	1-Methyl-2-(3-pyridyl) pyrrolidine, 3-(1-Methyl-2-pyrrolidyl) pyridine	Poisonous, Class B, II	4	1	0	
NITRIC ACID	None	Oxidizer, I	2	0	0	oxy

Chemical Name	Synonyms	Hazard Classification	NFPA Hazard Classification Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
4-NITROANILINE	p-Nitroaniline, 1-Amino-4-nitrobenzene, Azoic Diazo Component 37, Fast Red IG base	Poisonous Solid, Class B, II	3	1	0	
NITROBENZENE	Nitrobenzol, Essence of Mirbane, Oil of Mirbane	Poisonous Liquid, Class B, II	3	2	0	
NITROETHANE	None	Flammable Liquid, III	1	3	3	
NITROGEN TETROXIDE	Nitrogen peroxide, Nitrogen dioxide, Red oxide of nitrogen, Oxides of nitrogen	Poisonous Gas or Liquid, Class A	3	0	0	oxy
NITROMETHANE	Nitrocarbol	Flammable Liquid, II	1	3	3	
4-NITROPHENOL	p-Nitrophenol, 4-Hydroxy-nitrobenzene, PNP	NL, III	3	1	0	
2-NITROPROPANE	Isonitropropane, 1- NP, sec-Nitropropane	Flammable Liquid, III	1	3	3	
NONANE	n-Nonane	NL, III	0	3	0	
NONYLPHENOL	None	NL	1	1	0	
OCTANE	n-Octane	Flammable Liquid, II	0	3	0	
OILS: CRUDE	Petroleum	Combustible Liquid, I	1	3	0	
OILS: DIESEL	Fuel Oil 1-D, Fuel Oil 2-D	Combustible Liquid	0	2	0	
OILS, EDIBLE: COCONUT	Coconut butter, Copra oil, Coconut oil	NL	0	1	0	
OILS, EDIBLE: COTTONSEED	None	NL	0	1	0	
OILS, EDIBLE: LARD	Kettle-rendered lard, Leaf lard, Prime steam lard	NL	0	1	0	
OILS, EDIBLE: PALM	Palm fruit oil, Palm butter, Palm oil	NL	0	1	0	
OILS, EDIBLE: PEANUT	None	NL	0	1	0	
OILS, EDIBLE: SOYA BEAN	Soybean oil	NL	0	1	0	
OILS, EDIBLE: TUCUM	American palm kernel oil, Aouara oil, Palm seed oil	NL	0	1	0	
OILS, EDIBLE: VEGETABLE	None	NL	0	1	0	
OILS, FUEL: 6	Bunker C oil, Residual fuel oil Nº6	Combustible Liquid	0	2	0	
OILS, FUEL: 2	Home heating oil	Combustible Liquid	0	2	0	
OILS, FUEL: 4	Residual fuel oil Nº4	Combustible Liquid	0	2	0	
OILS, FUEL: 5	Residual fuel oil Nº 5	Combustible Liquid	0	2	0	
OILS, FUEL: 1-D	Diesel oil (light)	Combustible Liquid, III	0	2	0	
OILS, FUEL: 2-D	Diesel oil, medium	Combustible Liquid, III	0	2	0	
OILS, FUEL: Nº1	JP-1, Kerosene, Kerosine, Range oil	Combustible Liquid, III	0	2	0	
OILS, MISCELLANEOUS: LINSEED	Flaxseed oil, Raw linseed oil	NL	0	1	0	
OILS, MISCELLANEOUS: LUBRICATING	Crankcase oil, Motor oil, Transmission oil	NL	0	1	0	
OILS, MISCELLANEOUS: MINERAL	Liquid petrolatum, White oil	NL	0	1	0	
OILS, MISCELLANEOUS: RANGE	Kerosine, Kerosene, JP-1	Combustible Liquid	0	2	0	

			NFPA Hazard Classification			
Chemical Name	Synonyms	Hazard Classification	Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
OILS, MISCELLANEOUS: ROAD	Liquid asphalt, Petroleum asphalt, Slow curing asphalt	NL	0	1	0	
OILS, MISCELLANEOUS: SPRAY	Dormant oil, Foliage oil, Kerosene, heavy, Plant spray oil	Combustible Liquid	0	2	0	
OILS, MISCELLANEOUS: TRANSFORMER	Electrical insulating oil, Insulating oil, Petroleum insulating oil	NL	0	1	0	
OILS, MISCELLANEOUS: TURBINE	Steam turbine oil, Steam turbine lube oil	NL	0	1	0	
OLEIC ACID	cis-8-Heptadecylene-carboxylic acid, cis-9-Octane-cenoic acid, Red oil	NL	0	1	0	
OLEUM	Fuming Sulfuric Acid	Corrosive Material	3	0	2	~~W~~
OXALIC ACID	Ethanedioic Acid	Corrosive Material	2	1	0	
OXYGEN, LIQUEFIED	Liquid oxigen, LOX	Non-flammable Compressed Gas	3	0	0	oxy
PARATHION, LIQUID	O,O-Diethyl-(p-nitrophenyl) Phosphorothioate, Phosphorothioic Acid, Ethyl Parathion	Poisonous, Class B, I	4	1	2	
PENTABORANE	(9)-Pentaboron nonahydride	Flammable Liquid, I	3	3	2	
PENTACHLORO-PHENOL	Dowicide 7, Penta, Santophen 20	NL	3	0	0	
PENTANE	None	Flammable Liquid	1	4	0	
PERCHLORIC ACID	Dioxonium perchlorate solution, Perchloric acid solution	Oxidizer, I, II	3	0	3	oxy
PHENOL	Carbolic acid, Hydroxybenzene, Phenic acid, Phenyl hydroxide	Poisonous Liquid or Solid, Class B, II	3	2	0	
PHOSGENE	Carbonyl chloride, Chloroformyl chloride	Poisonous Gas or Liquid, Class A	4	0	0	
PHOSPHORIC ACID	Orthophosphoric acid	Corrosive Liquid, III	2	0	0	
PHOSPHORUS PENTASULFIDE	Phosphoric sulfide, Phosphorus persulfide, Thiophosphoric anhydride	Flammable Solid, II	3	1	2	~~W~~
PHOSPHORUS, RED	Amorphous phosphorus	Flammable Solid, III	0	1	1	
PHOSPHORUS TRICHLORIDE	None	Corrosive Material, II	3	0	2	~~W~~
PHOSPHORUS WHITE	Yellow phosphorus	Flammable Solid, I	3	3	1	
PHTHALIC ANHYDRIDE	1,2-Benzene-dicarboxylic acid anhydride, 1,3-Dioxophthalan, PAN, Phthalandione	NL, III	2	1	0	
PIPERAZINE	Piperazidine, Pyrazine hexahydride, Diethylene-diamine	NL, III	2	2	0	
POLYBUTENE	Butene resins, Polyisobutylene waxes	NL	0	1	0	
POTASSIUM CHLORATE	Chlorate of potash, Chlorate of potassium, Potcrate	Oxidizing Material, II	1	0	2	oxy
POTASSIUM CYANIDE	Cyanide	Poisonous Liquid or Solid, Class B, I	3	0	0	
POTASSIUM DICHLORO-*s*-TRIAZINETRIONE	Potassium dichloro-isocyanurate	Oxidizing Material, II	3	0	3	oxy
POTASSIUM DICHROMATE	Potassium bichromate, Bichrome	ORM-A	1	0	1	oxy

Chemical Name	Synonyms	Hazard Classification	NFPA Hazard Classification Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
POTASSIUM HYDROXIDE	Caustic potash, Lye	Corrosive Material, II	3	0	1	
POTASSIUM PERMANGANATE	None	Oxidizing Material, II	1	0	0	oxy
POTASSIUM PEROXIDE	Potassium superoxide	Oxidizing Material, Solid, I	3	0	2	₩
PROPANE	Dimethylmethane	Flammable Compressed Gas	1	4	0	
beta-PROPIOLACTONE	Betaprone, Hydracrylic acid, beta-lactone, 2-Oxetanone, Propanolide	Poisonous Liquid, Class B	0	2	0	
PROPIONALDEHYDE	Propyl aldehyde, Propaldehyde, Propanal, Propionic aldehyde	Flammable Liquid, II	2	3	1	
PROPIONIC ACID	Ethanecarboxylic acid, Methylacetic acid, Propanoic acid	Corrosive Material, III	2	2	0	
PROPIONIC ANHYDRIDE	Methylacetic anhydride, Propanoic anhydride, Propionyl oxide	Corrosive Liquid, III	2	2	2	₩
PROPYLENE	Methylethylene, Propene	Flammable Compressed Gas	1	4	1	
PROPYLENE OXIDE	Methyl oxirane, Propene oxide, 1,2-Epoxypropane	Flammable Liquid, I	2	4	2	
PROPYLENE TETRAMER	Dodecene (nonlinear), Tetrapropylene	Combustible Liquid, III	0	2	0	
PYRIDINE	None	Flammable Liquid, II	2	3	0	
PYROGALLIC ACID	1,2,3-Benzenetriol, Pyrogallol, 1,2,3-Trihydroxy-benzene	NL	1	1	0	
QUINOLINE	1-Benzazine, Chinoline, Leucol, Benzo(b)pyridine	NL, III	2	1	0	
RESORCINOL	1,3-Benzenediol, Dihydroxybenzol, m-Dihydroxy-benzene	NL, III	-	1	0	
SALICYLIC ACID	o-Hydroxybenzoic acid, Retarder W	NL	0	1	0	
SILVER NITRATE	Lunar caustic	Oxidizing Material, II	1	0	0	oxy
SODIUM	None	Flammable Solid, II	3	1	2	₩
SODIUM CHLORATE	Chlorate of soda	Oxidizing Material, II	1	0	2	oxy
SODIUM CYANIDE	Hydrocyanic acid, sodium salt	Poisonous Liquid or Solid, Class B, I	3	0	0	
SODIUM DICHLORO-s-TRIAZINETRIONE	Sodium Dichloroiso-cyanurate	Oxidizing Material, II	3	0	2	oxy
SODIUM DICHROMATE	Sodium Bichromate	ORM-A	1	0	1	oxy
SODIUM FLUORIDE	None	ORM-B, III	2	0	0	
SODIUM HYDROXIDE	Caustic soda	Corrosive Material, II	3	0	1	
SODIUM SULFIDE	None	Flammable Solid, II	2	1	0	
STEARIC ACID	1-Hepta-decanecarboxylic acid, Octadecanoic acid, Stearophanic acid	NL	1	1	0	
STYRENE	Phenethylene, Phenylethylene, Styrol, Styrolene	Flammable Liquid, III	2	3	2	
SULFUR DIOXIDE	None	Non-flammable Compressed Gas	3	0	0	
SULFURIC ACID	Battery acid, Chamber acid, Fertilizer acid, Oil of vitriol	Corrosive Material, II	3	0	2	₩

Chemical Name	Synonyms	Hazard Classification	NFPA Hazard Classification: Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
SULFURIC ACID, SPENT	None	Corrosive Material, II	3	0	2	
SULFUR (LIQUID)	Brimstone (liquid)	NL, III	2	0	1	
SULFUR MONOCHLORIDE	None	Corrosive Material	2	1	1	
TALLOW	Edible Tallow, Inedible Tallow, Tallow oil	NL	0	1	0	
TANNIC ACID	Tannin, Chineese Tannin, Gallotannic acid, Gallotannin, Glycerite	NL	0	1	0	
TETRAETHYLENE GLYCOL	Hi-Dry, Bis-[2-(2-hydroxy-ethoxy)ethyl] ether, 3,6,9-Trioxaundecan-1,11-diol	NL	1	1	0	
TETRAETHYLENE-PENTAMINE	1,1-Diamino-3,6,9-triazaundecane	NL	2	1	0	
TETRAETHYL LEAD	TEL, Lead tetraethyl	Poisonous Liquid or Solid Class B, I	3	2	3	
TETRAFLUORO-ETHYLENE, INHIBITED	Teflon monomer	Flammable Compressed Gas	3	4	3	
TETRAHYDRO-FURAN	Tetramethylene oxide, THF	Flammable Liquid, II	2	3	1	
TETRAHYDRO-NAPHTHALENE	1,2,3,4-Tetra-hydronaphthalene, Tetralin, Tetranap	Combustible Liquid	1	2	0	
TETRAMETHYL LEAD	Lead tetramethyl	Poisonous Liquid or Solid, Class B	3	3	3	
THORIUM NITRATE	Thorium nitrate tetrahydrate	Radioactive Material	1	0	0	oxy
TITANIUM TETRACHLORIDE	None	Corrosive Material, II	3	0	1	
TOLUENE	Methylbenzene, Methylbenzol, Toluol	Flammable Liquid, II	2	3	0	
TOLUENE 2,4-DIISOCYANATE	TDI, Hylene T, Mondur TDS, Nacconate 100	Poison, Class B, II	3	1	1	
o-TOLUIDINE	2-Amino-1-methylbenzene, 2-Aminotoluene, 2-Methylaniline, o-Methylaniline	Poison, II	3	2	0	
TRICHLOROSILANE	Silicochloroform, Trichloromono-silane	Flammable Liquid, I	3	4	1	
TRICHLORO-s-TRIAZINETRIONE	Trichloroimino-isocyanuric acid, Trichloro-s-triazine-2,4,6-(1H,3H,5H)-trione	Oxidizing Material	3	0	2	oxy
TRIETHANOLAMINE	Triethylolamine, Trihydroxy-triethylamine, Tris(hydroxy-ethyl)amine	NL	2	1	1	
TRI-ETHYLALUMINUM	ATE, Aluminum Triethyl, TEA	Flammable Liquid	3	3	3	W
TRIFLUORO-CHLOROETHYLENE	Chlorotrifluoro-ethylene, Kel F monomer, Plaskon monomer, Trifluorovinyl chloride, CTFE	Flammable Compressed Gas	-	4	0	
TRIISOBUTYL-ALUMINUM	Aluminum triisobutyl, TIBA, TIBAL	Flammable Liquid	3	3	3	W
TRIMETHYLAMINE	None	Flammable Compressed Gas	3	4	0	
TURPENTINE	Spirits of turpentine, Turps, Gum turpentine, Wood turpentine	Flammable Liquid, III	1	3	0	
URANYL NITRATE	Uranium nitrate	Radioactive Material	1	0	0	oxy
VINYL ACETATE	VAM, Vinyl A Monomer, Vy Ac	Flammable Liquid, II	2	3	2	
VINYL CHLORIDE	Chloroethylene, Chloroethene, Vinyl C Monomer, VCL, VCM	Flammable Compressed Gas	2	4	1	

Chemical Name	Synonyms	Hazard Classification	NFPA Hazard Classification: Health (Blue)	Flammability (Red)	Reactivity (Yellow)	Special (White)
VINYL FLUORIDE, INHIBITED	Fluoroethylene, Monofluoro-ethylene	Flammable Compressed Gas	1	4	2	
VINYLIDENE CHLORIDE, INHIBITED	1,1-Dichloroethylene unzym-Dichloroethulene	Flammable Liquid, I	2	4	2	
VINYL METHYL ETHER, INHIBITED	Methyl vinyl ether, Methoxyethylene	Flammable Compressed Gas	2	4	2	
VINYLTOLUENE	p-Methylstyrene	Combustible Liquid, III	2	2	1	
m-XYLENE	Xylol, 1,3-Dimethylbenzene	Flammable Liquid, II	2	3	0	
o-XYLENE	Xylol, 1,2-Dimethylbenzene	Flammable Liquid, II	2	3	0	
p-XYLENE	Xylol, 1,4-Dimethylbenzene	Flammable Liquid, II	2	3	0	
XYLENOL	Cresylic acid, 2,6-Dimethylphenol, 2,6-Xylenol, 2-Hydroxy-m-xylene	NL, II	2	1	0	
ZINC ACETATE	Acetic acid, zinc salt, Dicarbomethoxy-zinc, Zinc diacetate	NL, II	1	1	0	
ZINC CHROMATE	Buttercup yellow, Zinc chromate (VI)hydroxide, Zinc yellow	NL	1	0	0	
ZINC NITRATE	Zinc nitrate hexahydrate	Solid Oxidizing Material, II	1	0	0	oxy
ZIRCONIUM ACETATE	Zirconium acetate solution	NL	0	0	0	

2.4 LISTING OF FIRE, EXPLOSION AND CHEMICALLY REACTIVE CHEMICALS

The following is a list of chemicals and articles that are regulated by the U.S. Department of Transportation. The information has been obtained from 49 CFR, Parts 100-177 (*Hazardous Materials Table*). The articles and chemicals are grouped by the hazard class and division (as defined in Chapter 1).

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Hazard Class 1 - Division 1.1. Explosive Materials (Major hazard from these materials is mass explosion)	
Ammonium Nitrate, with more than 0.2 per cent combustible substances, including any organic substance calculated as carbon, to the exclusion or any other substance.	0222
Ammonium Perchlorate	0402
Ammonium picrate, dry or wetted with less than 10 per cent water, by mass	0004
Articles, explosive, n.o.s.	0354, 0462, 0463, 0464, 0465

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Articles, pyrotechnic for technical purposes	0428
Barium azide, dry or wetted with less than 50 per cent water, by mass	0224
Barium styphnate	0473
Black powder, compressed or Gunpowder, compressed or Black powder, in pellets or Gunpowder, in pellets	0028
Black powder or Gunpowder, granular or as a meal	0027
Bombs, photo-flash	0037, 0038
Bombs, with bursting charge	0034
Bombs with flammable liquid, with bursting charge	0399
Boosters with detonator	0225
Boosters without detonator	0042
Bursters, explosive	0043
Cartridges, flash	0049
Cartridges for weapons, blank	0326
Cartridges for weapons, with burstling charge	0005, 0006
Charges, burstling, plastic bonded	0457
Charges, demolition	0048
Charges, depth	0056
Charges explosive, commercial without detonator	0442
Charges propelling, for cannon	0279
Charges propelling, for rocket motors	0271, 0273
Charges, shaped, commercial, without detonator	0059
Charges, shaped, flexible, linear	0288
Charges, supplementary explosives	0060

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Components, explosive train, n.o.s.	0461
Cord, detonating, flexible	0065
Cord, detonating or Fuse, detonating metal clad	0290
Cyclotetramethylentetranitramine, desensitized or Octogen, desensitized or HMX, desensitized	0484
Cyclotetramethylentetranitramine, wetted or HMX, wetted or Octogen, wetted with not less than 15 percent water, by mass	0226
Cyclotrimethylenetrinitramine, desensitized or Cyclonite, desensitized or Hexogen, desensitized or RDX desensitized	0483
Cyclotrimethylenetrinitramine, wetted or cyclonote, wetted or Hexogen, wetted or RDX, wtted with not less than 15 per cent water, by mass	0072
Detonator assemblies, non-electric for blasting	0360
Detonators, electric, for blasting	0030
Detonators for ammunition	0073
Detonators, non- electric, for blasting	0029
Diazodinitrophenol, wetted with not less than 40 per cent water or mixture of alcohol and water, by mass	0074
Diethyleneglycol dinitrate, desensitized with not less than 25 percent non-volatile water insoluble phlegmatizer, by mass	0075
Dinitroglycoluril or Dingu	0489
Dinitrophenol, dry or wetted with less than 15 per cent water, by mass	1320
Dinitroresorcinol, dry or wetted with less than 15 per cent water, by mass	0078
Dipicryl sulfide, dry or wetted with less than 10 per cent water, by mass	0401
Explosive, blasting, type A	0081
Explosive, blasting, type B	0082
Explosive, blasting, type C	0083
Explosive, blasting, type D	0084
Explosive, blasting, type E	0241

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Explosive pest conterol devices	NA0006
Fireworks	0333
Flares, aerial	0420
Flares surface	0418
Flash powder	0094
Fracturing devices, explosive, without detonators for oil wells	0099
Fuzes, detonating	0106
Fuzes, detonating, with protective features	0408
Grenades, hand or rifle, with bursting charge	0284
Grenades, hand or rifle, with bursting charge	0292
Guanyl nitrosaminoguanylidene hydrazine (dry)	0113
Guanyl nitrosaminoguanyltetrazene, wetted or Tetrazene ,wetted with not less than 30 per cent water or mixture of alcohol and water, by mass	0114
Hexanitrodiphenylamine (Dipicrylamine; Hexyl)	0079
Hexanitrostilbene	0392
Hexatonal, cast	0393
Hexolite, dry or wetted with less than 15 per cent water, by mass	0118
Igniters	0325
Jet perforating guns, charged oil well, without detonator	0124
Lead mononitroresorcinate	NA0473
Lead styphnate, wetted or Lead trinitroresorcinate, wetted, with not less than 20 per cent water or mixture of alcohol and water, by mass	0130
Mercury fulminate, wetted with not less than 20 per cent water, or mixture of alcohol and water, by mass	0135
Mines with bursting charge	0136
Mines with bursting charge	0137
Nitro urea	0147

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
5-Nitrobenzotriazol	0385
Nitrocellulose, dry or wetted with less than 25 per cent water (or alcohol), by mass	0340
Nitrocellulose, unmodified or plasticized with not less than 18 per cent plasticizing substance, by mass	0341
Nitroglycerin, solution in alcohol, with more than 1 per cent but not more than 10 per cent nitroglycerin	0144
Nitroguanidine or Picrite, dry or wetted with less than 20 per cent water, by mass	0282
Nitrosoguanidine	NA0473
Nitrostarch, dry or wetted with less than 20 per cent water, by mass	0146
Nitrotriazolone or NTO	0490
Octolite or Octol, dry or wetted with less than 15 per cent water, by mass	0266
Pentaerythritetetranitrate or Pentaerythritol tetranitrate or PETN, wetted with not less than 25 per cent water, by mass or PETN, desensitized with not less than 15 per cent phlegmatizer by mass	0150
Pentaerythritetetranitrate or Pentaerythritol tetranitrate or PETN, with not less than 7 per cent wax by mass	0411
Pentolite, dry or wetted with less than 15 per cent water, by mass	0151
Powder cake, wetted or Powder paste, wetted with not less than 17 per cent alcohol by mass	0433
Powder, smokeless	0160
Primers, cap type	0377
Projectiles, with bursting charge	0167
Projectiles, with bursting charge	0168
Propellant, explosive	NA0474
Propellant, explosive, solid	NA0273
RDX and HMX mixtures, wetted with not less than 15 per cent water by mass or RDX and HMX mixtures, desensitized with not less than 10 per cent phlegmatizer by mass	0391

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Rocket motors	0280
Rockets, liquid fueled with bursting charge	0397
Rockets, with bursting charge	0180
Rockets, with bursting charge	0181
Signals, distress, ship	0194
Signals, railway track, explosive	0192
Signals, smoke	0196
Sounding devices, explosive	0296
Sounding devices, explosive	0374
Substances, explosive, n.o.s.	0357
Substances, explosive, n.o.s.	0473
Substances, explosive, n.o.s.	0474
Substances, explosive, n.o.s.	0475
Substances, explosive, n.o.s.	0476
Tetranitroaniline	0207
Torpedoes, liquid fuelled, with or without bursting charge	0449
Torpedoes with bursting charge	0329
Torpedoes with bursting charge	0330
Torpedoes with bursting charge	0451
Trinitro-meta-cresol	0216
Trinitroaniline or Picramide	0153
Trinitroanosole	0213
Trinitrobenzene, dry or wetted with less than 30 per cent water, by mass	0214
Trinitrobenzenesulfonic acid	0386
Trinitrobenzoic acid, dry or wetted with less than 30 per cent water, by mass	0215

Hazardous Materials Description and Proper Shipping Name	**UN Id. Number**
Trinitrochlorobenzene or Picryl chloride	0155
Trinitrofluorenone	0387
Trinitronaphthalene	0217
Trinitrophenetole	0218
Trinitrophenol or Picric acid, dry or wetted with less than 30 per cent water, by mass	0154
Trinitrophenylmethylnitramine or Tetryl ..	0208
Trinitroresorcinol or Styphnic acid, dry or wetted with less than 20 per cent water, or mixtute of alcohol and water, by mass	0219
Trinitroresorcinol, wetted or Styphnic acid, dry or wetted with not less than 20 per cent water, or mixtute of alcohol and water, by mass	0394
Trinitrotoluene and Trinitrobenzene mixtures or Trinitrotoluene or TNT and trinitrobenzene mixtures or TNT and hexanitrostilbene mixtures	0388
Trinitrotoluene mixtures containing trinitrobenzene and Hexanitrostilbene or TNT mixtures containing trinitrobenzene and hexanitrostilbene	0389
Trinitrotoluene or TNT, dry or wetted with less than 30 per cent water, by mass	0209
Tritonal	0390
Urea nitrate, dry or wetted with less than 20 per cent water, by mass	0220
Warheads, rocket with bursting charge	0286
Warheads, rocket with bursting charge	0369
Warheads, torpedo with bursting charge	0221
Hazard Class 1 - Division 1.2. Explosive Materials (Major hazard from these materials is dangerous projections)	
Ammunition, illuminating with or without burster, expelling charge or propelling charge	0254
Ammunition, incendiary, white phosphorus, with burster, expelling charge or propelling charge	0243
Ammunition, incendiary, white phosphorus with burster, expelling charge or propelling charge	0009

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Ammunition smoke, white phosphorus, with burster, expelling charge or propelling charge	0245
Ammunition, smoke with or without burster, expelling charge or propelling charge	0015
Ammunition, tear-producing with burster, expelling charge or propelling charge	0018
Ammunition, toxic with burster, expelling charge or propelling charge	0020
Articles, explosive, n.o.s.	0355
Articles, explosive, n.o.s.	0466
Articles, explosive, n.o.s.	0467
Articles, explosive, n.o.s.	0468
Articles, explosive, n.o.s.	0469
Articlec, pyrophoric	0380
Articles, pyrotechnic for technical purposes	0429
Bombs, photo-flash	0039
Bombs, with bursting charge	0035
Bombs, with bursting charge	0291
Bombs with flammable liquid, with bursting charge	0400
Boosters with detonator	0268
Boosters without detonator	0042
Cartridges for weapons, blank	0413
Cartridges for weapons, inert projectile or Cartridges, small arms	0328
Cartridges for weapons, with bursting charge	0007
Cartridges for weapons, with bursting charge	0321
Cartridges, power device	0381
Charges, bursting, plastics bonded	0458
Charges, explosive, commercial without detonator	0443

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Charges, propelling, for cannon	0414
Charges, propelling, for rocket motors	0415
Charges, propelling, for rocket motors, composite mixture	0416
Charges, shaped, commercial without detonator	0439
Components, explosive train, n.o.s.	0382
Contrivances, water-activated, with burster, expelling charge or propelling charge	0248
Cord detonating or Fuse detonating metal clad	0102
Detonators for ammunition	0364
Fireworks	0334
Flares, aerial	0421
Flares, surface	0419
Fuses, detonating	0107
Fuses, detonating, with protective features	0409
Grenades, hand or rifle, with bursting charge	0285
Grenades, hand or rifle, with bursting charge	0293
Grenades, practice, hand or rifle	0372
Igniters	0314
Mines with bursting charge	0138
Mines with bursting charge	0294
Projectiles, with burster or expelling charge	0346
Projectiles, with burster or expelling charge	0434
Projectiles, with bursting charge	0169
Projectiles, with bursting charge	0324
Rocket motors	0281
Rocket motors, liquid fueled	0395

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Rocket motors with hypergolic liquids with or without an expelling charge	0322
Rockets, line-throwing	0238
Rockets, fluid-fueled with bursting charge	0398
Rockets, with bursting charge	0182
Rockets, with bursting charge	0295
Rockets, with expelling charge	0436
Signal, smoke	0313
Sounding devices, explosive	0204
Sounding devices, explosive	0375
Substances, explosive n.o.s.	0358
Warheads, rocket with bursting charge	0287
Hazard Class 1 - Division 1.3. Explosive Materials (Major hazard from these materials is radiant heat or violent burning, or both, but there is no blast or projection hazard)	
Ammunition, illuminating with or without burster, expelling charge or propelling charge	0254
Ammunition, incendiary liquid or gel, with burster, expelling charge or propelling charge	0247
Ammunition, incendiary, white phosphorus, with burster, expelling charge or propelling charge	0244
Ammunition, incendiary with or without burster, expelling charge or propelling charge	0010
Ammunition, practice	0488
Ammunition, smoke, white phosphorus with burster, expelling charge, or propelling charge	0246
Ammunition, smoke, with or without burster, expelling charge, or propelling charge	0016
Ammunition, tear-producing with burster, expelling charge, or propelling charge	0019
Ammunition, toxic with burster, expelling charge, or propelling charge	0021

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Articles, explosive, n.o.s.	0356
Articles, explosive, n.o.s.	0470
Articles, pyrotechnic for technical purposes	0430
Bombs, photo-flash	0299
Cartridges, flash	0050
Cartridges for weapons, blank or Cartridges, small arms, blank	0327
Cartridges for weapons, inert projectile or Cartridges, small arms	0417
Cartridges, power device	0275
Cartridges, signal	0054
Cases, combustible, empty, without primer	0447
Charges, propelling, for cannon	0242
Charges, propelling, for rocket motors...	0272
Charges, propelling, for rocket motors, composite mixture	0274
Contrivances, water-activated, with burster, expelling charge or propelling charge	0249
Deflagrating metal salts or aromatic nitroderivatives, n.o.s.	0132
Dinitrobenzene	0406
Fireworks	0335
Flares, aerial	0093
Flares, surface	0092
Flash powder	0305
Fuse, instantaneous, non-detonating or Quickmatch	0101
Fuzes, igniting	0316
Grenades, practice, hand or rifle	0318
Igniters	0315

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Nitrocellulose, plastcized, with not less than 18 per cent plasticizing substance, by mass	0343
Nitrocellulose, wetted, with not less than 25 per cent alcohol, by mass	0342
Powder, smokeless	0161
Primers, tubular	0319
Projective, inert, with tracer	0424
Propellant explosive, liquid	NA0477
Propellant explosive, solid	NA0274
Rocket motors	0186
Rocket motors, liquid fueled	0396
Rocket motors with hypergolic liquids with or without an expelling charge	0250
Rockets, line-throwing	0240
Rockets, with expelling charge	0437
Rockets, with inert head	0183
Sodium picramate, dry or wetted with less than 20 % water, by mass	1349
Sodium salts of aromatic nitro-derivatives, n.o.s. explosive	0203
Substances, explosive, n.o.s.	0359, 0477, 0478
Hazard Class 1 - Division 1.4. Explosive Materials (These materials represent a small hazard with no mass explosion and no projection of fragments of appreciable size or range)	
Ammunition, incendiary with or without burster, expelling charge or propelling charge	0300
Ammunition, proof	0363
Ammunition, smoke with or without burster, expelling charge or propelling charge	0015

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Artcles, exlosive, n.o.s.	0350--0353, 0471, 0472
Articles, pyrotechnic for technical purposes	0431, 0432
Cartridges for weapons, blank or Cartridges, small arms, blank	0338, 0014
Cartridges for weapons, inert projectile or Cartridges, small arms	0339, 0012
Cartridges for weapons, with bursting charges	0348, 0412
Cartyridges, oil well	0278
Cartridges, power device	0276, 0323
Cartridges, signal	0312, 0405
Cases, cartridge, empty with primer	0055, 0379
Cases, combustible, empty, without primer	0446
Charges, bursting, plastics bonded	0459, 0460
Charges, explosive, commercial without detonator	0444, 0445
Charges, shaped, commercial without detonator	0440, 0441
Charges, shaped, flexible, linear	0237
Cord, detonating, flexible	0065
Cord, detonating, mild effect or Fuse, detonating, mild effect metal clad	0104
Cord, igniter	0066

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Cutters, cable, explosive	0070
Detonator assemblies, non-electric, for blasting	0361, 0267
Detonator assemblies, electric, for blasting	0456, 0455
Detonators for ammunition	0365, 0366
Explosive pest control devices	NA0412
Fireworks	0336, 0337
Flares, serial	0403, 0404
Fuse, igniter tubular metal clad	0103
Fuse, safety	0105
Fuzes, detonating	0257, 0367, 0410
Fuzes, igniting	0317, 0368
Grenades	NA0349, 0452
Jet perforating guns	NA0124
Lighters, fuse	0131
Primers, cap type	0044
Primers, tubular	0320, 0376
Projectiles, inert with tracer	0345, 0425
Projectiles with burster or expelling charge	0435
Projectiles with bursting charge	0344

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Rivets, explosive	0174
Rockets, line throwing	0453
Rockets with expelling charge	0438
Signal devices, hand	0191, 0373
Signals, smoke	0197
Substances, explosive, n.o.s.	0485, 0481, 0479, 0480
Tetrazo-1-acetic acid	0407
Warheads	0370, 0371
Hazard Class 1 - Division 1.5. Explosive Materials (These materials do not have significant explosive hazards or the effects of explosion are completely confined within the article itself)	
Explosive, blasting, type E or Agent blasting, Type E	0332
Substances, explosive, very insensitive, n.o.s.	0482
Hazard Class 2 - Dvision 2.1. Flammable Gas	
Acetylene, dissolved	1001
Aerosols, flammable	1950
Bromotrifluoroethylene	2419
Butane or Butane mixtures	1011
Butylene	1012
Carbon monoxide and hydrogen mixture	2600
Compressed or Liquified gases, flammable, n.o.s.	1954
Cyclopropane, liquefied	1027
Deuterium	1957

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Devices, small, hydrocarbon gas powered or hydrocarbon gas refills for small devices with release device	3150
Diborane mixtures	NA1911
Engine starting fluid, with flammable gas	1960
Ethane, compressed	1035
Ethane-propane mixture, refrigerated liquid	NA 1961
Ethane, refrigerated liquid	1961
Ethyl chloride	1037
Ethylacetylene, inhibited	2452
Ethylamine	1036
Ethylene, compressed	1962
Ethylene oxide and carbon monoxide mixtures with more than 9 % but not more than 87 % ethylene oxide	1041
Hydrocarbon gases, compressed, n.o.s., or Hydrocarbon gases mixtures, compressed, n.o.s.	1964
Hydrocarbon gases, liquefied, n.o.s. or Hydrocarbon gases mixtures, liquefied, n.o.s.	1965
Hydrogen and methane mixtures, compressed	1048
Hydrogen, compressed	1049
Hydrogen, refrigerated liquid (cryogenic liquid)	1966
Insecticide gases, flammable n.o.s.	1968
Isobutylene	1214
Methane, compressed gas or natural gas, compressed (with high methane conten)	1971
Methane, refrigerated liquid (cryogenic liquid) or natural gas, refrigerated liquid (cryogenic liquid - with high methane content)	1972
Methyl acetylene and propadiene mixtures, stabilized	1060
Methyl chloride	1063

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Methyl chloride and methylene chloride mixtures	1912
Methylamine, anhydrous	1061
Perfluoromethylvinyl ether	3153, 3154
Petroleum gases, liquefied or Liquefied petroleum gas	1075
Propane	1978
Silane	2203
Vinyl fluoride, inhibited	1860
Vinyl isobutyl ether, inhibited	1087
Hazard Class 3. Flammable Lquids	
Acetal	1088
Acetaldehyde	1089
Acetaldehyde Oxime	2332
Acetone	1090
Acetone Oils	1091
Acetyl Chloride	1717
Acetyl Methyl Carbonyl	2621
Acrolein Dimer, Stabilized	2607
Acrylonitrile, Inhibited	1093
Adhesives, Containing a flammable liquid.	1133
Aircraft hydraulic power unit fuel tank (containing a mixture of anhydrous hydrazine and monomethyl hydrazine) (M86 fuel)	3165
Alcoholic Beverages	3065
Alcohols, n.o.s	1987
Alcohols, toxic, n.o.s.	1986
Aldehydes, n.o.s.	1989

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Alkylamines, n.o.s., or Polyalkylamines, n.o.s. flammable, corrosive	2733
Allyl Acetate	2333
Allyl Bromide	1099
Allyl Chloride	1100
Allyl Ethyl Ether	2335
Allyl Formate	2336
Allyl Glycidyl Ether	2219
Allyl Iodide	1723
Amyl Acetates	1104
Amyl Alcohols	1105
Amyl Butyrates	2620
Amyl Chlorides	1107
Amyl Formates	1109
Amyl Mercaptans	1111
Amyl Methyl Ketone	1110
Amyl Nitrate	1112
Amyl Nitrites	1113
Amyl amines	1106
n-Amylene	1108
Anisole	2222
Asphalt, at or above its flashpoint	NA1999
Benzene	1114
Benzoic derivative pesticides, liquid flammable, toxic, n.o.s., flash point less than 23 °C.	2770
Benzotrifluoride	2338

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Bipyridilium pesticides, liquid, flammable, toxic, n.o.s., flash point less than 23 °C.	2782
Brake Fluid, Hydraulic	1118
1-Bromo-3-Methylbutane	2341
Bromobenzene	2514
2-Bromobutane	2339
2-Bromoethyl Ethyl Ether	2340
Bromomethylpropanes	2342
2-Bromopentane	2343
2-Bromopropane	2344
3-Bromopropyne	2345
Butanedione	2346
Butanols	1120
Butoxyl	2708
Butyl Acetates	1123
Butyl Benzenes	2709
n-Butyl Bromide	1126
n-Butyl Formate	1128
tert-Butyl Isocyanate	2484
n-Butyl Isocyanate	2485
Butyl Mercaptans	2347
n-Butyl Methacrylate	2227
Butyl Methyl Ether	2350
Butyl Nitrites	2351
Camphor Oil	1130

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Carbamate pesticides, liquid, flammable, toxic, n.o.s., flash point less than 23 °C.	2758
Carbon Disulfide	1131
Chlorobenzene	1134
Chlorobenzotrifluorides	2234
Chlorobutanes	1127
Chloromethyl Ethyl Ether	2354
Chloroprene, Inhibited	1991
2-Chloropropane	2356
2-Chloropropene	2456
Chlorosilanes, n.o.s., flash point less than 23 °C.	2985
Chlorotoluenes	2238
Coal Tar Distillates, flammable	1136
Coating Solution	1139
Compounds, Cleaning Liquid	NA1993
Compounds, tree or weed killing, liquid	NA1993
Copper based pesticides, liquid, flammable, toxic n.o.s., flash point less than 23 °C.	2776
Crotonylene	1144
Cycloheptane	2241
Cycloheptatriene	2603
Cycloheptene	2242
Cyclohexane	1145
Cyclohexanone	1915
Cyclohexene	2256
Cyclohexyl Acetate	2243

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Cyclohexyl Mercaptan	3054
Cyclooctadienes	2520
Cyclooctatetraene	2358
Cyclopentane	1146
Cyclopentanol	2244
Cyclopentanone	2245
Cyclopentene	2246
Decahydronaphthalene	1147
n-Decane	2247
Denatured Alcohol	NA1987 or NA 1986
1,2-Di-(Dimethylamino) Ethane	2372
Diacetone Alcohol	1148
Diallylamine	2359
Diallylether	2360
Dibromobenzene	2711
Dibutyl Ethers	1149
1,1-Dichloroethane	2362
Dichloroethylene	1150
Dichloropentanes	1152
Dichloropropene	2047
Dicyclopentadiene	2048
Diesel Fuel	NA1993
Diethoxymethane	2373
3,3-Diethoxypropene	2374

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Diethyl Carbonate	2366
Diethyl Ether or Ethyl Ether	1155
Diethyl Ketone	1156
Diethyl Sulfide	2375
Diethylamine	1154
Diethylaminoethanol	2686
Diethylbenzene	2049
2,3-Dihydropyran	2376
Diisobutyl Ketone	1157
Diisobutylamine	2361
Diisobutylene, Isomeric Compounds	2050
Diisopropyl Ether	1159
Diisopropylamine	1158
Diketene, Inhibited	2521
1,1-Dimethoxyethane	2377
1,2-Dimethoxyethane	2252
Dimethyl Carbonate	1161
Dimethyl Disulfide	2381
Dimethyl-N-Propylamine	2266
Dimethyl Sulfide	1164
Diethylamine Solution	1160
2-Dimethylaminoacetonitrile	2378
2,3-Dimethylbutane	2457
2,3-Dimethylbutylamine	2379
Dimethylcyclohexanes	2263

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Dimethyldichlorosilane	1162
Dimethyldiethoxysilane	2380
Dimethyldioxanes	2707
Dimethylethanolamine	2051
N,N-Dimethylformamide	2265
Dimethylhydrazine, Symmetrical	2382
Dioxane	1165
Dioxolane	1166
Dipentene	2052
Dipropyl Ether	2384
Dipropylamine	2383
Dipropylketone	2710
Dithiocarbamate pesticides, liquid, flammable, toxic n.o.s., flash point less than 23 °C.	2772
Divinyl Ether, Inhibited	1167
1,2-Epoxy-3-Ethoxypropane	2752
Ethanol or Ethyl Alcohol or Ethanol Solutions or Ethyl Alcohol Solutions	1170
Ethyl Acetate	1173
Ethyl Acrylate, Inhibited	1917
Ethyl Amyl Ketone	2271
Ethyl Borate	1176
Ethyl Butyl Ether	1179
Ethyl Butyrate	1180
Ethyl-2-Chloropropionate	2935
Ethyl Crotonate	1862
Ethyl Formate	1190

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Ethyl Isobutyrate	2385
Ethyl Isocyante	2481
Ethyl Lactate	1192
Ethyl Mercaptan	2363
Ethyl Methacrylate	2277
Ethyl Methyl Ketone or Methyl Ethyl Ketone	1193
Ethyl Nitrite Solutions	1194
Ethyl Orthoformate	2524
Ethyl Propionate	1195
Ethyl Propyl Ether	2615
Ethylamine, aqueous solution with not less than 50 % but not more than 70 % ethylamine.	2270
Ethylbenzene	1175
2-Ethylbutanol	2275
2-Ethylbutyl Acetate	1177
2-Ethylbutyraldehyde	1178
Ethylene Dichloride	1184
Ethylene Glycol Diethyl Ether	1153
Ethylene Glycol Monoethyl Ether	1171
Ethylene Glycol Monoethyl Ether Acetate	1172
Ethylene Glycol Monomethyl Ether	1188
Ethylene Glycoln Monomethyl Ether Acetate	1189
Ethylene Oxide and Propylene Oxide Mixtures, not more than 30 % ethylene oxide.	2983
1-Ethylpiperidine	2386
Ethyltrichlorosilane	1196

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Extracts, aromatic, liquid	1169
Extracts, flavoring, liquid	1197
Flammable Liquids, corrosive, n.o.s.	2924
Flammable Liquids, elevated temperature material, n.o.s.	NA9276
Flammable Liquids, n.o.s.	1993
Flammable Liquids, poisonous, n.o.s.	1992
Fluorobenzene	2387
Fluorotoluenes	2388
Formaldehyde, solutions, flammable	1198
Fuel, aviation, turbine engine	1863
Fuel Oil (No. 1,2,4,5, or 6)	NA1993
Furan	2389
Furfural	1199
Furfurylamine	2526
Fusel Oil	1201
Gas Drips, Hydrocarbon	1864
Gasohol (gasoline mixed with ethyl alcohol, max. 20 % alcohol)	NA1203
Gasoline	1203
Glycidaldehyde	2622
n-Heptaldehyde	3056
Heptanes	1206
n-Heptene	2278
Hexadienes	2458
Hexaldehyde	1207
Hexamethyleneimine	2493

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Hexanes	1208
Hexanols	2282
1-Hexene	2370
Hydrazine, anhydrous or Hydrazine aqueous solutions with more than 64 % hydrazine, by mass	2029
Ink, printer's, flammable	1210
2-Iodobutane	2390
Iodomethylpropanes	2391
Iodopropanes	2392
Isobutanol or Isobutyl Alcohol	1212
Isobutyl Acetate	1213
Isobutyl Acrylate	2527
Isobutyl Formate	2393
Isobutyl Isobutyrate	2528
Isobutyl Isocyanate	2486
Isobutyl Methacrylate	2283
Isobutyl Propionate	2394
Isobutylamine	1214
Isobutyraldehyde or Isobutyl Aldehyde	2045
Isobutyric Acid	2529
Isobutyric Anhydride	2530
Isobutyronitrile	2284
Isobutyryl Chloride	2395
Isocyanates, n.o.s. or Isocyanate Solutions, n.o.s. (Flashpoint less than 23 degrees C)	2478
Isoheptenes	2287

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Isohexenes	2288
Isooctenes	1216
Isopentenes	2371
Isoprene, Inhibited	1218
Isopropanol or Isopropyl alcohol	1219
Isopropenyl acetate	2403
Isopropenylbenzene	2303
Isopropyl Acetate	1220
Isopropyl Butyrate	2405
Isopropyl Chloroacetate	2947
Isopropyl Chloroformate	2407
Isopropyl-2-chloropropionate	2934
Isopropyl Isobutyrate	2406
Isopropyl Isocyanate	2483
Isopropyl Nitrate	1222
Isopropyl Propionate	2409
Isopropylamine	1221
Isopropylbenzene	1918
Kerosene	1223
Ketones, Liquid, n.o.s.	1224
Lighters for sigars, cigarettes etc., with lighter fluids	NA1226
Mercaptans, Liquid, n.o.s. or Mercaptan Mixtures, Liquid, n.o.s.	2778
Mercury based pesticides, liquid, flammable, toxic, n.o.s., flash point less than 23 degrees C	1228
Mesityl oxide	1229
Metal Alkyl, Solutions, n.o.s.	NA9195

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Methacrylaldehyde	2396
Methacrylonitrile, Inhibited	3079
Methallyl Alcohol	2614
Methanol or Methyl Alcohol	1230
4-Methoxy-4-methylpentan-2-one	2293
1-Methoxy-2-propanol	3092
Methoxymethyl Isocyanate	2605
Methyl Acetate	1231
Methyl Acrylate, Inhibited	1919
Methyl Allyl Chloride	2554
3-Methyl-1-butene	2561
2-Methyl-1-butene	2459
2-Methyl-2-butene	2460
Methyl tert-butyl ether	2398
Methyl butyrate	1237
Methyl-2-chloropropionate	2933
Methyl cyanide	1648
Methyl cyclohexane	2296
Methyl cyclohexanols, flash point not more than 60.5 degrees C	2617
Methyl cyclohexanone	2297
Methyl cyclopentane	2298
Methyl formate	1243
Methyl isobutyl carbinol	2053
Methyl isobutyl ketone	1245
Methyl isopropenyl ketone, inhibited	1246

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Methyl isothiocyanate	2277
Methyl isovalerate	2400
Methyl methacrylate monomer, inhibited	1247
Methyl orthosilicate	2606
Methyl propionate	1248
Methyl propyl ether	2612
Methyl propyl ketone	1249
Methyl vinyl ketone	1251
Methylal	1234
Methylamine, aqueous solution	1235
Methylamyl acetate	1223
3-Methylbutan-2-one	2397
n-Methylbutylamine	2945
2-Methylfuran	2301
5-Methylhexan-2-one	2302
Methylmorpholine	2535
Methylpentadienes	2461
2-Methylpentan-2-ol	2560
1-Methylpiperidine	2399
Methyltetrahydrofuran	2536
Methyltrichlorosilane	1250
alpha-Methylvaleraldehyde	2367
Morpholine	2054
Naphtha	2553
Naphtha, petroleum	1255

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Naphtha, solvent	1256
Natural gasoline	1257
Nitroethane	2842
Nitrocellulose, solution, flammable with not more than 12.6 per cent nitrogen, by mass, and not more than 55 per cent nitrocellulose	2059
Nitroethane	2842
Nitroglycerin, solution in alcohol, with more than 1% but not more than 5% nitroglycerin	3064
Nitroglycerin solution in alcohol, with not more than 5% nitroglycerin	1204
Nitromethane	1261
Nitropropanes	2608
Nonanes	1920
2,5 Norbornadiene (Dicycloheptadiene)	2251
Octadiene	2309
Octanes	1262
Octyl aldehydes, flammable	1191
Organochlorine pesticides liquid, flammable, toxic, n.o.s. flash point less than 23 degrees C	2762
Organophosphorus pesticides, liquid, flammable, toxic, n.o.s., flash point less than 23 degrees C	2784
Organotin pesticides, liquid, flammable, toxic, n.o.s., flash point less than 23 degrees C	2787
Paint including paint, lacquer, enamel, stain, shellac solutions, varnish, polish, liquid filter, and liquid lacquer base	1263
Paint related material including paint thinning, drying, removing, or reducing compound	1263
Paraldehyde	1264
Pentamethylheptane	2286

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Pentan-2,4-dione	2310
n-Pentanes or isopentane	1265
Perfumery products with flammable solvents	1266
Pesticides, liquid, flammable, toxic, n.o.s. (flashpoint less than 23 degrees C)	3021
Petroleum crude oil	1267
Petroleum distillates, n.o.s.	1268
Petroleum oil	1270
Petroleum spirit	1271
Phenoxy pesticides, liquid, flammable, toxic, n.o.s., flash point less than 23 degrees C	2766
Phenyl urea pesticides, liquid, flammable, toxic, n.o.s., flash point less than 23 degrees C	2768
Phthalimide derivative pesticides,liquid, flammable, toxic, n.o.s., flash point less than 23 degrees C	2774
Picolines	2313
Pine oil	1272
alpha-Pinene	2368
Piperidine	2401
Propanethiols	2402
n-Propanol or Propyl alcohol normal	1274
Propargyl alcohol	NA1986
Propionaldehyde	1275
Propionitrile	2404
Propionyl chloride	1815
n-Propyl acetate	1276
n-Propyl benzene	2365
Propyl chloride	1278

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Propyl formates	1281
n-Propyl isocyanates	2482
n-Propyl nitrate	1865
Propylamine	1277
Propylene dichloride	1279
Propylene oxide	1280
Propylene tetramer	2850
Propyleneimine, inhibited	1921
Pyridine	1282
Pyrrolidine	1922
Refrigerating machine	NA1993
Resin solution, flammable	1866
Rosin oil	1286
Rubber solution	1287
Shale oil	1288
Sodium methylate solution in alcohol...	1289
Styrene monomer, inhibited	2055
Substituted nitrophenol pesticides, liquid, flammable, toxic, n.o.s., flash point less than 23 degrees C	2780
Tars, liquid, including road asphalt and oils, bitumen and cut backs	1999
Terpene hydrocarbons, n.o.s.	2319
Terpinolene	2541
Tetraethyl silicate	1292
1,2,3,6-Tetrahydrobenzaldehyde	2498
Tetrahydrofuran	2056
Tetrahydrofurfurylamine	2943

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
1,2,3,6-Tetrahydropyridine	2410
Tetrahydrothiophene	2412
Tertamethylsilane	2749
Tetrapropylorthotitanate	2413
Thioacetic acid	2436
Thiophene	2414
Tinctures, medicinal	1293
Toluene	1294
Triallylamine	2610
Triacine pesticides, liquid, flammable, toxic, n.o.s., flash point less than 23 degrees C	2764
Triethyl phosphite	2323
Triethylamine	1296
Triisobutylene	2324
Triisocyanatoisocyanurate of isophoronediisocyanate, solution, 70 per cent, by mass	2906
Triisopropyl borate	2616
Trimethyl borate	2416
Trimethyl phosphite	2329
Trimethylamine, aqueous solutions not more than 50% trimethylamine by mass	1297
1,3,5-Trimethylbenzene	2325
Trimethylchlorosilane	1298
Tripropylamine	2260
Tripropylene	2057
Turpentine	1299
Turpentine substitute	1300

Hazardous Materials Description and Proper Shipping Name	**UN Id. Number**
Undecane	2330
Valeraldehyde	2058
Vinyl acetate, inhibited	1301
Vinyl butyrate, inhibited	2838
Vinyl ethyl ether, inhibited	1302
Vinyl isobutyl ether, inhibited	1304
Vinyl toluene, inhibited *mixed isomers*	2618
Vinylidene chloride, inhibited	1087
Vinyltrichlorosilane	1305
Wood preservatives, liquid	1306
Xylenes	1307
Zirconium suspended in a liquid	1308
Hazard Class 4 - Division 4.1. Flammable Solids (These include but are not limited to self-reactive materials which are materials that are liable to undergo at normal or elevated temperatures a strong exothermic decomposition caused by excessively high handling temperatures or by contaminattion, , and readily combustible materials which may cause a fire through friction)	
Aluminum powder, coated	1309
2,2'-Azodi-(2,4-dimethyl-4-methoxyvaleronitrile)	2955
2,2'-Azodi-(2,4 dimethylvaleronitrile)	2953
1,1'-Azodi-(hexahydrobenzonitrile)	2954
2,2', Azodi-(hexahydrobenzonitrile)	3030
Azoisobutyronitrile	2952
Barium azide, wetted by not less than 50 % water, by mass	1571
Benzene-1,3-disulfohydrazide, not more than 52 % as a paste	2971
Benzene sulfohydrazide	2970
4-(Benzyl(ethyl)amino)-3-ethoxybenzenediazonium zince chloride	3037

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
4-(Benzyl(methyl)amino)-3-ethoxybenzenediazonium zince chloride	
Borneol	1312
Calcium resinate	1313
Calcium resinate, fused	1314
Camphor, synthetic	2717
Celluloid	2000, 2002
3-Chloro-4-diethylaminobenzenediazonium zinc chloride	3033
Cobalt naphthenates, powder	2001
Cobalt resinate, precipitated	1318
Decaborane	1868
2-Diazo-1-naphthol-4-sulpho-chloride	3042
2-Diazo-1-naphthol-5-sulpho-chloride	3043
Dicyclohexylammonium nitrate	2687
4-Dimethylamino-6-2-(dimethylaminoethoxy) toluene-2-diazonium zinc chloride	3039
Dinitrophenolates, wetted with not less than 15 % water, by mass	1321
Dinitroesorcinol, wetted with not less than 15 % water, by mass	1322
N,N'-Dinitroso-N,N'-dimethyl terephthalamide, not more than 72 % as a paste	2973
N,N'-Dinitrospentamethylenetetramine, not more than 82 % with phlegmatizer	2972
Diphenyloxide-4,4' disulfohydrazide	2951
Dipicryl sulfide, wetted with not less than 10 % water, by mass	2852
4-Dipropylaminobenzenediazonium zinc chloride	3034
Ferrocerium	1323
Films, nitrocellulose base	1324
Flammable solids, corrosive, n.o.s.	2925

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Flammable solids, n.o.s.	1325
Flammable solids, poisonous, n.o.s.	2926
Hafnium powder	1326
Hexamine	1328
Isosorbide dinitrate mixtures	2907
Lead phosphite, dibasic	2989
Metal powders, flammable, n.o.s.	3089
Naphthalene, crude or refined	1334
Naphthalene, molten	2304
Nitrocellulose	2556, 2557, 2555
Nitroguanidine, wetted or Picrite, wetted with not less than 20 % water, by mass	1336
Nitronaphthalene	2538
Nitrostarch, wetted with not less than 20 % water, by mass	1337
Paraformaldehyde	2213
Phosphorous, amorphous	1338
Phosphorous heptasulfide, free from yellow or white phosphorous	1339
Phosphorous sesquisulfide, free from yellow or white phosphorous	1341
Phosphorous trisulfide, free from yellow or white phosphorous	1343
Picric acid, see Trinitrophenol, wet, with not less than 10 % water, by mass	NA1344
Self-reactive substances (aliphatic azocompounds, aromatic sulphohydrazides, N-nitroso compounds, diazonium salts), n.o.s.	3031, 3032
Silicon powder	1346
Silver picrate, wetted with not less than 30 per cent water, by mass	1347
Smokeless powder for small arms (100 pounds or less)	NA1325

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Sodium 2-diaszo-1-naphthol-4-sulphonate	3040
Sodium 2-diaszo-1-naphthol-5-sulphonate	3041
Sodium dinitro-orth-cresolate, wetted with not less than 15 per cent water, by mass	1348
Sodium picramate, wetted with not less than 20 per cent water, by mass	1349
Sulfur	1350
Sulfur, molten	2448
Titanium hydride	1871
Titanium sponge granules or Titanium sponge powders	2878
Toe puffs, nitrocellulose base	1353
Trinitrobenzene, wetted with not less than 30 per cent water, by mass	1354
Trinitrobenzoic acid, wetted with not less than 30 per cent water, by mass	1355
Trinitrophenol,wetted with not less than 30 per cent water, by mass	1344
Trinitrotoluene, wetted with not less than 30 per cent water, by mass	1356
Urea nitrate, wetted with not less than 20 per cent water, by mass	1357
Zinc resinate	2714
Zirconium, dry, coiled wire, finished metal sheets, strip (thinner than 254 microns but not thinner than 18 microns)	2858
Zirconium hydride	1437
Zirconium picramate, wetted with not less than 20 per cent water, by mass	1517
Zirconium powder, with not less than 25 per cent water (a visible axcess of water must be present) (a) mechanically produced, particle size less than 53 microns; (b) chemically produced, particle size less than 840 microns	1358
Hazard Class 4 - Division 4.2. Spontaneously Combustible Materials (These include pyrophoric materials and self-heating materials)	
Aluminum alkyl halides	3052
Aluminum alkyl hydrides	3076
Aluminum alkyls	3051

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Aluminum borohydride or aluminum borohydride in devices	2870
Barium alloys, pyrophoric	1854
Calcium dithionite or calcium hydrosulfite	1748
Calcium, pyrophoric or calcium alloys, pyrophoric	1855
Carbon , activated	1362
Carbon, animal or vegetable origin	1361
Celluloid, scrap	2002
Charcoal briquettes, shell, screenings, wood, etc.	NA1361
Copra	1363
Cotton waste, oily	1364
Cotton, wet	1365
Diethylzinc	1366
Dimethylzinc	1370
Ferrous metal borings, shavings, turnings or cuttings in a form liable to self-heating	2793
Fibers or fabrics, animal or vegetable, n.o.s. with animal or vegetable oil	1373
Fish meal, unstabilized or Fish scrap,unstabilized	1374
Iron oxide, spent, or Iron sponge, spent obtained from coal gas purification	1376
Lithium alkyls	2445
Magnesiun alkyls	3053
Magnesium diamide	2004
Magnesium diphenyl	2005
Maneb or Maneb preparations with not less than 60 per cent maneb	2210
Metal alkyl halides, n.o.s.	3049
Metal alkyl hydrides, n.o.s.	3050
Metal alkyls, n.o.s.	2003

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Metal catalyst, wetted with not less than 40 per cent water or other suitable liquid, by mass finely divided, activated or spent	1378
Paper, unsaturated oil treated incompletely dried (including carbon paper)	1379
Pentaborane	1380
9-Phosphabicyclononanes or Cyclooctadiene phosphines	2940
Phosphorus white, molten	2447
Phosphorus white or yellow dry or under water or in solution	1381
Plastics, nitrocellulose based, spontaneously combustible, n.o.s.	2006
Potassium dithionite or Potassium hydrosulfite	1929
Potassiumm sulfide, anhydrous or potassium sulfide with less than 30 per cent water or crystallization	1382
Pyrophoric liquid n.o.s.	2845
Pyrophoric metals, n.o.s. or pyrophoric alloys, n.o.s.	1383
Pyrophoric solids, n.o.s.	2846
Seed cake, containing vegetable oil solvent extractions and expelled seeds, containing not more than 10 % of oil and when the amount of moisture is higher than 11%, not more than 20% of oil and moisture combined	1386
Seed cake with more than 1.5 per cent oil and not more than 11 per cent moisture	1386
Seed cake with not more than 1.5 per cent oil and not more than 11 per cent moisture	2217
Self-heating substances, solid, corrosive, n.o.s.	3126
Self-heating substances, solid, n.o.s.	3088
Self-heating substances, solid, oxidizing, n.o.s.	3127
Self-heating substances, solid, poisonous, n.o.s.	3128
Sodium dithionite or Sodium hydrosulfite	1384
Sodium hydrosulfide with less than 25 per cent water of crystallization	2318
Sodium methylate	1431

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Sodium sulfide, anhydrous, or Sodium sulfide with less than 30 per cent water of crystallization	1385
Titanium powder, dry	2546
Titanium trichloride, pyrophoric or Titanium trichloride mixtures, pyrophoric	2441
Zirconium, dry, finished sheets, strip or coiled wire	2009
Zirconium powder, dry	2008
Zirconium scrap	1932
Hazard Class 4 - Division 4.3. Dangerous when Wet Materials	
Alkali metal amalgams	1389
Alkali metal amides	1390
Alkali metal dispersions, or Alkaline earth metal dispersions	1391
Alkaline earth metal alloys, n.o.s.	1393
Alkaline earth metal amalgams	1392
Aluminum carbide	1394
Aluminum ferrosilicon powder	1395
Aluminum hydride	2463
Aluminum phosphide	1397
Aluminum powder, uncoated	1396
Aluminum silicon powder, uncoated	1398
Boron trifluoride dimethyl etherate	2965
Calcium carbide	1402
Calcium cyamide with more than 0.1 per cent of calcium carbide	1403
Calcium hydride	1404
Calcium manganese silicon	2844
Calcium phosphide	1360
Calcium silicide	1405

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Cerium, turnings or gritty powder	3078
Cesium or Caesium	1407
Chlorosilanes, n.o.s., which in contact with water emit flammable gases	2988
Ferrosilicon, with 30 per cent or more but less than 90 per cent silicon	1408
Lithium	1415
Lithium aluminum hydride	1410
Lithium aluminum hydride, ethereal	1411
Litium borohydride	1413
Lithium ferrosilicon	2830
Lithium hydride	1414
Lithium hydride, fused solid	2805
Lithium nitride	2806
Lithiun silicon	1417
Magnesium aluminum phosphide	1419
Magnesium granules, coated particle size not less than 149 microns	2950
Magnesium hydride	2010
Magnesium phosphide	2011
Magnesium, powder or Magnesium alloys, powder	1418
Magnesium silicide	2624
Maneb stabilized or Maneb preparations, stabilized against self-heating	2968
Methyldichlorosilane	1242
Phosphorus pentasulfide, free from yellow and white phosphorus	1340
Potassium	2257
Potassium borohydride	1870
Potassium, metal alloys	1420

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Potassium phosphide	2012
Potassium sodium alloys	1422
Rubidium	1423
Sodium	1428
Sodium aluminum hydride	2835
Sodium borohydride	1426
Sodium hydride	1427
Sodium phosphide	1432
Stannic phosphide	1433
Strontium phosphide	2013
Substances which in contact with water emit flammable gases, liquid, corrosive, n.o.s.	3129
Substances which in contact with water emit flammable gases, liquid, n.o.s.	1348
Substances which in contact with water emit flammable gases, liquid, poisonous, n.o.s.	3130
Substances which in contact with water emit flammable gases, solid, corrosive, n.o.s.	3131
Substances which in contact with water emit flammable gases, solid, flammable, n.o.s.	3132
Substances which in contact with water emit flammable gases, solid, n.o.s.	3134
Substances which in contact with water emit flammable gases, solid, oxidizing, n.o.s.	3133
Substances which in contact with water emit flammable gases, solid, poisonous, n.o.s.	3134
Substances which in contact with water emit flammable gases, solid, self-heating, n.o.s.	3135
Trichlorosilane	1295
Zinc ashes	1435

Hazardous Materials Description and Proper Shipping Name	UN Id. Number
Zinc phosphide	1714
Zinc powder or Zinc dust	1436

3

Chemistry of Fire and Toxic Materials

3.1 INTRODUCTION

This chapter is organized into three main sections providing discussions on the chemistry of fire and explosion, and the chemistry of hazardous materials. The last section of this chapter provides the reader with an extensive glossary of technical terms dealing with chemical hazards and hazard materials handling.

3.2 CHEMISTRY OF FIRE

Discussions of the chemistry of fire are best started with a discussion of those materials which represent the most common flammable products, namely hydrocarbons. Hydrocarbons are compounds containing only hydrogen and carbon atoms. Since a hydrocarbon is a chemical combination of hydrogen and carbons, both of which are non-metals, hydrocarbons are convalently bonded. Hydrogen has only one electron in the outer ring and, therefore, will form only one bond, by donating one electron to the bond. Carbon, on the other hand, occupies a unique position in the Periodic Table, being halfway to stability with its four electrons in the outer ring. None of these electrons are paired, so carbon uses all of them to form covalent bonds. Carbon's unique structure makes it the basis of organic chemistry.

Carbon not only combines covalently with other non-metals, but also with itself. Oxygen also reacts with itself to form O_2, hydrogen reacts with itself to form H_2, nitrogen reacts with itself to form N_2, fluorine reacts with itself to form F_2, and chlorine reacts with itself to form Cl_2. Forming diatomic molecules, however, is the extent of the self-reaction of the elemental gases, while carbon has the ability to combine with itself almost indefinitely. Although the elemental gases form molecules when they combine with themselves, the carbon-to-carbon combination must include another element or elements, generally hydrogen. This combination of carbon with itself (plus hydrogen) forms a larger molecule with every carbon atom that is added to the chain. When the chain is strictly carbon-to-carbon with no branching, the resulting hydrocarbon is referred to as a straight-chain hydrocarbon. Where there are carbon atoms joined to carbon atoms to form side branches off the straight chain, the resulting compound is known as a branched hydrocarbon, or an isomer.

The carbon-to-hydrogen bond is always a single bond. While the resulting bond between carbon and hydrogen is always a single bond, carbon does have the capability to form double and triple bonds between itself and other carbon atoms, and/or any other atom that has the ability to form more than one bond. When a hydrocarbon contains only single bonds between carbon atoms, it is known as a saturated hydrocarbon; when there is at least one double or triple bond between two carbon atoms anywhere in the molecule, it is an unsaturated hydrocarbon. When determining the saturation or unsaturation of a hydrocarbon, only the carbon-to-carbon bonds are considered, since the carbon-to-hydrogen bond is always single. Hydrocarbons are among the most useful materials to mankind, but are also among the most dangerous in terms of their fire potential.

An analogous series of hydrocarbons, and one of the simplest, are the compounds known as the alkanes. In this series, the names of all the compounds end in -ane. The first compound in this series is methane. Methane's molecular formula is CH_4. Methane is a gas and is the principal ingredient in the mixture of gases known as natural gas. The next compound is this series is ethane, whose molecular formula is C_2H_6. It is also a gas present in natural gas, although in a much lower percentage than methane. The difference in the molecular formulas of methane and ethane is one carbon and two hydrogen atoms.

Propane is the next hydrocarbon in this series, and its molecular formula is C_3H_8 which is one carbon and two hydrogen atoms different from ethane. Propane is an easily liquified gas which is used as fuel.

The next hydrocarbon in the series is butane, another rather easily liquified gas used as a fuel. Together, butane and propane are known as the LP (liquified petroleum) gases. Butane's molecular formula is C_4H_{10}, which is CH_2 bigger than propane.

Hence, the series begins with a one-carbon-atom compound, methane, and proceeds to add one carbon atom to the chain for each succeeding compound. Since carbon will form four convalent bonds, it must also add two hydrogen atoms to satisfy those two unpaired electrons and allow carbon to satisfy the octet rule, thus achieving eight electrons in the outer ring. In every hydrocarbon, whether saturated or unsaturated, all atoms must reach stability. There are only two elements involved in a hydrocarbon, hydrogen and carbon; hydrogen must have two electrons in the outer ring, and carbon must have eight electrons in the outer ring. Since the carbon-hydrogen bond is always single, the rest of the bonds must be carbon-carbon, and these bonds must be single, double, or triple, depending on the compound.

Continuing in the alkane series (also called the paraffin series because the first solid hydrocarbon in the series is paraffin, or candle wax), the next compound is pentane. This name is derived from the Greek word penta, for five. As its name implies, it has five carbon atoms, and its molecular formula is C_5H_{12}. From pentane on, the Greek prefix for the numbers five, six, seven, eight, nine, ten, and so on are used to name the alkanes, the Greek prefix corresponding to the number of carbon atoms in the molecule. The first four members of the alkane series do not use the Greek prefix method of naming, simply because their common names are so universally accepted: thus the names methane, ethane, propane, and butane.

The next six alkanes are named pentane, hexane, heptane, octane, nonane, and decane. Their molecular formulas are C_5H_{12}, C_6H_{14}, C_7H_{16}, C_8H_{18}, C_9H_{20} and $C_{10}H_{22}$. The alkanes do not stop at the ten-carbon chain however. Since these first ten represent flammable gases and liquids and most of the derivatives of these compounds comprise the vast majority of hazardous materials encountered, we have no need to go any further in the series. The general formula for the alkanes is C_nH_{2n+2}. The letter n stands for the number of carbon atoms in the molecule. The number of hydrogen atoms then becomes two more than twice the number of carbon atoms. Since there is more than one analogous series of hydrocarbons, one must remember that each series is unique; the alkanes are defined as the analogous series of saturated hydrocarbons with the general formula C_nH_{2n+2}.

3.2.1 Isomers

Within each analogous series of hydrocarbons there exist isomers of the compounds within that series. An isomer is defined as a compound with the same molecular formula as another compound but with a different structural formula. In other words, if there is a different way in which the carbon atoms can align themselves in the molecule, a different compound with different properties will exist.

Beginning with the fourth alkane, butane, we find we can draw a structural formula of a compound with four atoms and ten hydrogen atoms in two ways; the first is as the normal butane exists and the second is as shown in Figure 1, with the name isobutane. With isobutane, no matter how you count the carbon atoms in the longest chain, you will always end with three. Notice that the structural formula is different - one carbon atom attached to the other carbon atoms - while in butane (also called normal butane), the largest number of carbon atoms another carbon atom can be attached to is two. This fact does make a difference in certain properties of compounds. The molecular formulas of butane and isobutane are the same and, therefore, so are the molecular weights. However, there is a 38-degree difference in melting points, 20-degree difference in boiling points, and the 310-degree difference in ignition temperatures. The structure of the molecule clearly plays part in the properties of the compounds.

With the five-carbon alkane, pentane, there are three ways to draw the structural formula of this compound with five carbon atoms and twelve hydrogen atoms. The isomers of normal pentane are isopentane and neopentane. The structural formulas of these compounds are shown in Figure 1, while typical properties are given in Table 1. Note the three identical molecular formulas and three identical molecular weights, but significantly different melting, boiling, and flash points and different ignition temperatures. These property differences are referred to as the "structural effect", i.e., differences in the properties of compounds exist for materials having the same molecular formulas but different structural arrangements. This particular structure effect is called the branching effect, and the isomers of all the straight-chain hydrocarbons are called branched hydrocarbons. There is another structural effect; it is produced simply by the length of the chain formed by consecutively attached carbon atoms.

In noting the increasing length of the carbon chain from methane through decane, the difference in each succeeding alkane is that "unit" made up of one carbon atom and two hydrogen atoms; that "unit" is not a chemical compound itself, but it has a molecular weight of fourteen. Therefore, each succeeding alkane in the analogous series weighs fourteen atomic mass units more than the one before it and fourteen less than the one after it. This weight effect is the reason for the increasing melting and boiling points, the increasing flash points, and the decreasing ignition temperatures. The increasing weights of the compounds also account for the changes from the gaseous state of the first four alkanes, to the liquid state of the next thirteen alkanes, and finally to the solid state of the alkanes, starting with the 17-carbon atom alkane, heptadecane.

Note that the larger a molecule (that is, the greater the molecular weight), the greater affinity each molecule will have for each other molecule, therefore, slowing down the molecular movement. The molecules, duly slowed from their frantic movement as gases, become liquids, and, as the molecules continue to get larger, they are further slowed from their still rapid movement as liquids and become solids.

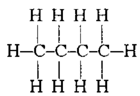
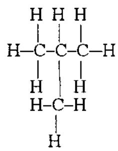
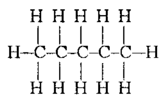
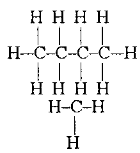
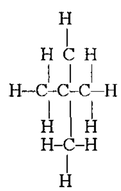
Compound	Molecular Formula	Structural Formula
Butane	C_4H_{10}	
Isobutane	C_4H_{10}	
Pentane	C_5H_{12}	
Isopentane	C_5H_{12}	
Neopentane	C_5H_{12}	

Figure 1. Illustrates the structural formulas for isomers of butane and pentane.

The straight-chain hydrocarbons represent just one group of straight-chain hydrocarbons, the saturated hydrocarbons known as the alkanes. There are other series of hydrocarbons that are unsaturated; one of those is important in the study of hazardous materials. Additionally, the first hydrocarbon in another series is the only hydrocarbon important in that series. Each of these hydrocarbon series are briefly described below.

3.2.2 Alkenes

The series of unsaturated hydrocarbons that contain just one double bond in the structural formula of each of its members is the analogous series known as the alkenes. Notice that the name of the analogous series is similar to the analogous series of saturated hydrocarbons known as the alkanes, but the structural formula is significantly different. Remembering that the definition of a saturated hydrocarbon is a hydrocarbon with nothing but single bonds in the structural formula and that an unsaturated hydrocarbon is a hydrogen-carbon with at least one multiple bond in the structural formula, then we would expect to find a multiple bond in the structural formulas of the alkenes. The names of all the hydrocarbons in this series end in -ene. The corresponding names for this series of hydrocarbons is similar to the alkanes, with the only difference being the above-mentioned ending. Thus, in the alkene series ethane becomes ethene, propane is propene, butane is butene; the five-carbon straight-chain hydrocarbon in the alkene series is pentene, as opposed to pentane in the alkane series, and so on.

Table 1. Typical Properties of Alkanes

Compound	Formula	Atomic Weight (°F)	Melting Point (°F)	Boiling Point (°F)	Flash Point (°F)	Ignition Temp. (°F)
Methane	CH_4	16	-296.5	-259	gas	999
Ethane	C_2H_6	30	-298	-127	gas	882
Propane	C_3H_8	44	-306	-44	gas	842
Butane	C_4H_{10}	58	-217	31	gas	550
Pentane	C_5H_{12}	72	-201.5	97	<-40	500
Hexane	C_6H_{14}	86	- 139.5	156	-7	437
Heptane	C_7H_{16}	100	-131.1	209	25	399
Octane	C_8H_{18}	114	-70.2	258	56	403
Nonane	C_9H_{20}	128	-64.5	303	88	401
Decane	$C_{10}H_{22}$	142	-21.5	345	115	410
Butane	C_4H_{10}	58	-217	31	gas	550
Isobutane	C_4H_{10}	58	-255	11	gas	860
Pentane	C_5H_{12}	72	-201.5	97	<-40	500
Isopentane	C_5H_{12}	72	-256	82	<-60	788
Neopentane	C_5H_{12}	72	2	49	<-20	842

Note that these compounds are covalently bonded compounds containing only hydrogen and carbon. The differences in their structural formulas are apparent; the alkanes have only single bonds in their structural formulas, while the alkenes have one (and only one) double bond in their structural formulas. There are different numbers of hydrogen atoms in the two analogous series. This difference is due to the octet rule that carbon must satisfy. Since one pair of carbon atoms shares a double bond, this fact reduces the number of electrons the carbons need (collectively) by two, so there are two fewer hydrogen atoms in the alkene than in the corresponding alkane.

In any hydrocarbon compound, carbon will form four covalent bonds. In saturated hydrocarbons the four bonds will all be single bonds. The definition of an unsaturated hydrocarbon, however, is a hydrocarbon with at least one multiple bond, and the alkenes are an analogous series of unsaturated hydrocarbons containing just one double bond (which is a multiple bond). The double bond must be formed with another carbon atom since hydrogen atoms can form only single bonds and, in a hydrocarbon compounds there are no other elements but hydrogen and carbon. In forming a double bond with another carbon atom and to satisfy the octet rule, the alkene must form fewer bonds with hydrogen, resulting in less hydrogen in the structural formula of each alkene than in the corresponding alkane. There are two fewer hydrogen atoms in each of the alkenes than in the alkane with the same number of carbon atoms. This is also shown by the general molecular formula of the alkenes, C_nH_{2n}, as opposed to the general molecular formula of the alkanes, which is C_nH_{2n+2}.

Note that there is no one-carbon alkene corresponding to methane, since hydrogen can never form more than one covalent bond, and there is no other carbon atom in the structural formula. Therefore, the first compound in the alkene series is ethene, while the corresponding two-carbon compound in the alkane series, ethane, is the second compound in the series, with methane the first.

Although the naming of the alkenes is the same as the alkanes, with only the ending changed from -ane to -ene, there is a problem with the names of the first three alkenes. The systematic names of hydrocarbons came a long while after the simplest (that is, the shortest chain) of the compounds in each series was known and named. In naming the alkanes, the system of using the Greek names for numbers as prefixes begins with pentane, rather than with methane. That situation occurred because methane, ethane, propane, and butane were known and named long before it was known that there was an almost infinite length to the chain that carbon could form and that a systematic naming procedure would be needed. Before the new system was adopted, the common names for the shortest-chain compounds had become so entrenched that those names survived unchanged. Therefore, not only are the first four compounds in the alkane series named differently from the rest of the series, the corresponding two-, three-, and four-carbon compounds are not generally known as ethene, propene, and butene. Their common names are ethylene, propylene, and butylene.

As noted earlier, more than one compound may have the same molecular formula (isomers), but a structural formula is unique to one compound. In addition, there are many chemicals which possess more than one chemical name, for the same reason mentioned above. The most common organic chemicals are those that have the shortest carbon chains. This fact is also true of their derivatives. The inclusion of a double bond in the structural formula has a profound effect on the properties of a compound. Table 2 illustrates those differences through the properties of alkenes. The presence of a double bond (and, indeed, a triple bond) between two carbon atoms in a hydrocarbon increases the chemical activity of the compound tremendously over its corresponding saturated hydrocarbon. The smaller the molecule (that is, the shorter the chain), the more pronounced this activity is. A case in point is the unsaturated hydrocarbon ethylene. Disregarding the present the differences in combustion properties between it and ethane, ethylene is so chemically active that, under the proper conditions, instead of burning, polymerization, which, if it is uncontrolled, is a much more violent reaction than combustion. This tendency to polymerize is due to the presence of the double bond. The tendency to polymerize decreases as the molecule gets bigger (the chain is longer). Only the first four or five of the straight-chain hydrocarbons are important in the study of hazardous materials. Few, if any, of the isomers of the alkenes are common.

There are other hydrocarbon compounds that contain multiple bonds, however, discussion here is limited to those compounds containing just one multiple bond in their molecules. This is because the compounds containing just one multiple bond are the most valuable commercially and, therefore, the most common. There is, however, a simple way to recognize when you are dealing with a compound that may contain two double bonds; that is a name in which the Greek prefix "di-" is used. As example would be the compound butadiene. Recognize from the first part of the name ("buta-") that there are four carbon atoms in the chain, and that there is a double bond present (the ending "-ene"), however, just before the -ene ending is the prefix "di-," meaning two. Therefore, recognize that you are dealing with a four-carbon hydrocarbon with two double bonds.

As in the alkanes, it is possible for carbon atoms to align themselves in different orders to form isomers. Not only is it possible for the carbon atoms to form branches which produce isomers, but it is also possible for the double bond to be situated between different carbon atoms in different compounds. This different position of the double bond also results in different structural formulas, which, of course, are isomers. Just as in the alkanes, isomers of the alkenes have different properties. The unsaturated hydrocarbons and their derivatives are more active chemically than the saturated hydrocarbons and their derivatives.

Table 2. Typical Properties of Alkenes

Compound	Formula	Molecular Weight	Melting Point (°F)	Boiling Point (°F)	Flash Point (°F)	Ignition Temp. (°F)
Ethylene	C_2H_4	28	-272.2	-155.0	gas	1,009
Propylene	C_3H_6	42	-301.4	-53.9	gas	927
1-Butene	C_4H_8	56	-300.0	21.7	gas	700
2-Butene	C_4H_8	56	-218.2	38.7	gas	615
1-Pentene	C_5H_{10}	70	-265.0	86.0	32	523
2-Pentene	C_5H_{10}	70	-292.0	98.6	32	NA
1-Hexene	C_6H_{12}	84	-219.6	146.4	-15	487
2-Hexene	C_6H_{12}	84	-230.8	154.4	-5	473
1-Heptene	C_7H_{14}	98	-119.2	199.9	28	500
1-Octene	C_8H_{16}	112	-152.3	250.3	70	446

NA= Not Applicable

3.2.3 Alkynes

Another analogous series of unsaturated hydrocarbons that contain just one multiple bond, but, instead of being a double bond, it is a triple bond is the alkynes. The names of all the compounds end in -yne. The only compound in this series that is at all common happens to be an extremely hazardous material. It is a highly unstable (to heat, shock, and pressure), highly flammable gas that is the first compound in the series. This two-carbon unsaturated hydrocarbon with a triple bond between its two carbon atoms is called ethyne, and indeed this is its proper name. It is, however, known by its common name, acetylene. The -ene ending could be confusing, so one must memorize the fact that acetylene is an alkyne rather than an alkene. Its molecular formula is C_2H_2. The fact that it contains this triple bond makes it extremely active chemically, that is what is meant by its instability to heat, shock, and pressure. It takes energy to start a chemical reaction, and heat, shock, and pressure are forms of energy. The fact that the triple bond contains so much energy tied up in the structure means that it will release this energy, which is the input of some slight amount of external energy. When this input energy strikes the molecule of acetylene, the triple bond breaks, releasing the internal energy of the bonds. This produces either great amounts of heat or an explosion, depending on the way in which the external energy was applied.

There are no other alkynes that are of commercial importance, and so acetylene will be the only member of this series that is considered in fire discussions. There are other alkynes, however, along with hydrocarbons that might have one double bond and a triple bond present in the molecule.

3.2.4 Straight-Chain Hydrocarbon Nomenclature

The system for naming the straight-chain hydrocarbons is based on an agreed-upon method of retaining the first three or four common names, then using Greek prefixes that indicate the number of carbon atoms in the chain. For isomers, the same system is used, always using the name of the compound that is attached to the chain and the name of the chain.

Recall the first analogous series of hydrocarbons the alkanes, a series of saturated hydrocarbons, all ending in -ane. For these hydrocarbons and other hydrocarbons to react, a place on the hydrocarbon chain must exist for the reaction to take place. Since all the bonds from carbon to hydrogen are already used, an "opening" on one of the carbon atoms must exist for it to be able to react with something else. This "opening" occurs when one of the hydrogen atoms is removed from its bond with a carbon atom, thus causing that carbon to revert back to a condition of instability, with seven electrons in its outer ring, or, as we now state, with one unpaired electron. This one unpaired electron (or half of a covalent bond, or "dangling" bond) wants to react with something, and it will, as soon as another particle which is ready to react is brought near. This chain of carbon atoms (from one carbon to another to another, and so on) with a hydrogen atom missing is a particle that was once a compound, and its name is a radical.

Radicals are created by energy being applied to them in a chemical reaction or in a fire. Remember that a hydrocarbon compound with at least one hydrogen atom removed is no longer a compound, but a chemical particle known as a radical. Radicals have names of their own; they are derived from the name of the alkane. When a hydrogen atom is removed from the alkane hydrocarbon, the name is changed from -ane to -yl. Therefore, when a hydrogen is removed from the compound methane, the methyl radical is formed. When a hydrogen atom is removed from the compound ethane, the ethyl radical is formed. In the same manner, the propyl radical comes from propane, the butyl radical comes from butane, and so on. Similarily, isobutane will produce the isobutyl radical, and isopentane will produce the isopentyl radical. A list of hydrocarbons and the radicals produced from them when a hydrogen is removed is shown is Table 3. Note that there are only a few radicals from compounds other than the alkanes which are important.

Radicals are referred to as hydrocarbon "backbones". As an example, isobutane is more properly named methyl propane. Another isomer with a different proper name is isopentane, more properly called methyl butane. Neopentane is also named 2,2-dimethyl propane.

Table 3. A Listing of Common Radicals

Methane	CH_4	Methyl	$-CH_3$
Ethane	C_2H_6	Ethyl	$-C_2H_5$
Propane	C_3H_8	n-Propyl	$-C_3H_7$
		Isopropyl	$-C_3H_7$
Butane	C_4H_{10}	n-Butyl	$-C_4H_9$
Isobutane	C_4H_{10}	Isobutyl	$-C_4H_9$
		sec-Butyl	$-C_4H_9$
		tert-Butyl	$-C_4H_9$
Ethylene	C_2H_4	Vinyl	$-C_2H_3$
Benzene	C_6H_6	Phenyl	$-C_6H_5$

The following is a list of rules for proper nomenclature of the isomers and their derivatives.
1. Find the longest continuous chain and name it as if it were an alkane.
2. Name the side branches in the same manner.
3. Identify the number of the carbon atom on the longest chain to which the branch is attached by counting from the end of the chain nearest to the branch.
4. If it is possible that there could be any confusion as to which carbon atom is meant, put the number in front of the name of the compound, followed by a dash.
5. If there is more than one branch, you must use the numbers to identify the carbon atom to which they are attached.
6. If the branches are identical, use the prefixes di- for two, tri- for three, tetra- for four, and so on.

In this manner, the four isomers of hexane are named 2-methyl pentane, 3-methyl pentane, 2,2,-dimethyl butane, and 2,3-dimethyl butane.

3.2.5 Aromatic Hydrocarbons

The above discussions have concentrated on hydrocarbons, both saturated and unsaturated, with the unsaturated hydrocarbons containing only one multiple bond. The unsaturated hydrocarbons are the alkenes with one double bond and the alkynes with one triple bond. There are other straight-chain hydrocarbons that are unsaturated containing more than one multiple bond, some with more than one double bond, and some with a mixture of double bonds and triple bonds. The combinations and permutations are endless, but there are only a few of the highly unstable materials.

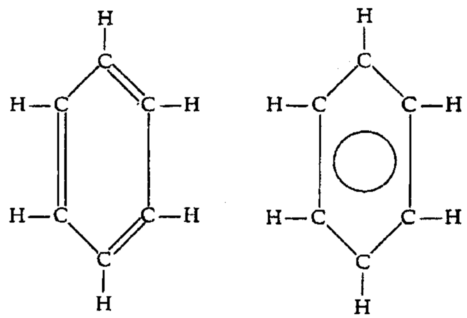
From a commercial standpoint, there is a large body of hydrocarbons that is very important and hence these are of relevance to first responders to a hazardous-materials incidents. These hydrocarbons are different in that they are not straight-chain hydrocarbons but have a structural formula that can only be called cyclical. The most common and most important hydrocarbon in this group is benzene. It is the first and simplest of the six-carbon cyclical hydrocarbons referred to as aromatic hydrocarbons.

Benzene's molecular formula is C_6H_6, but it does not behave like hexane, hexene, or any of their isomers. One would expect it to be similar to these other six-carbon hydrocarbons in its properties. Table 4 provides a comparison between benzene, hexane and 1-hexene. The table shows that there are major differences between benzene and the straight-chain hydrocarbons of the same carbon content. Hexene's ignition temperature is very near to hexane's. The flash point difference is not great, however, there are significant differences in melting points. The explanation for these differences is structure; which in the case of benzene is a cyclical form with alternating double bonds.

Table 4. Comparison Between Properties of Benzene and of Straight-Chain Hydrocarbons

Compound	Formula	Melting Point (°F)	Boiling Point (°F)	Flash Point (°F)	Ignition Temp. (°F)	Molecular weight
Hexane	C_6H_{14}	-139.5	156.0	-7	500	86
1-Hexene	C_6H_{12}	-219.6	146.4	<-20	487	84
Benzene	C_6H_6	41.9	176.2	12	1,044	78

The alternating double bonds are illustrated in Figure 2A. Initially, it was believed that the alternating double bonds impart very different properties to benzene, however, and the fact is that they do not. The only possible way for the benzene molecule to exist is illustrated in Figure 2B, in which a circle is drawn within the hexagonal structural to show that the electrons that should form a series of alternating double bonds are really spread among all six carbon atoms. It is the only structure possible that would explain the unique properties of benzene. This structural formula suggests resonance; that is, the possibility that the electrons represented by the circle are alternating



(A) **(B)**

Figure 2. Illustrates the structure of benzene: (A) conventional illustration of double bonds, (B) illustration implying resonance.

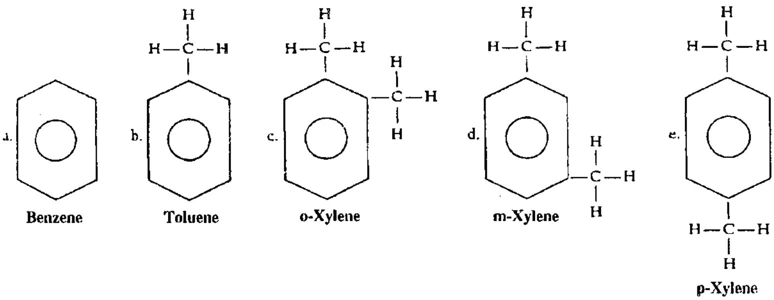


Figure 3. Illustrates the structures of benzene and some of its common derivatives.

back and forth between and among the six carbon atoms. This particular hexagonal structure is found throughout nature in many forms, almost always in a more complicated way, usually connected to many other "benzene rings" to form many exotic compounds. Of importance to the immediate discussions are benzene and a few of its derivatives. Benzene's derivatives include toluene and xylene, whose structural formulas are illustrated in Figure 3 along with that of benzene. Some typical properties are given in Table 5, which illustrates the differences caused by molecular weight and structural formulas. There are other cyclical hydrocarbons, but they do not have the structural formulas of the aromatics, unless they are benzene-based. These cyclical hydrocarbons may have three, four, five, or seven carbons in the cyclical structure, in addition to the six-carbon ring of the aromatics. None of them has the stability or the chemical properties of the aromatics.

Table 5. A Comparison of Benzene and Some of its Derivatives

Compound	Formula	Melting Point (°F)	Boiling Point (°F)	Flash Point (°F)	Ignition Temperature (°F)	Molecular Weight
Benzene	C_6H_6	41.9	176.2	12	1,044	78
Toluene	C_7H_8	-138.1	231.3	40	997	92
o-xylene	C_8H_{10}	-13.0	291.2	90	867	106
m-xylene	C_8H_{10}	-53.3	281.9	81	982	106
p-xylene	C_8H_{10}	-55.8	281.3	81	984	106

The aromatic hydrocarbons are used mainly as solvents and as feedstock chemicals for chemical processes that produce other valuable chemicals. With regard to cyclical hydrocarbons, the aromatic hydrocarbons are the only compounds discussed. These compounds all have the six-carbon benzene ring as a base, but there are also three-, four-, five-, and seven-carbon rings. These materials will be considered as we examine their occurrence as hazardous materials. After the alkanes, the aromatics are the next most common chemicals shipped and used in commerce. The short-chain olefins (alkenes) such as ethylene and propylene may be shipped in larger quantities because of their use as monomers, but for sheer numbers of different compounds, the aromatics will surpass even the alkanes in number, although not in volume.

3.2.6 Hydrocarbon Derivatives

A hydrocarbon derivative is a compound with a hydrocarbon backbone and a functional group attached to it chemically. A hydrocarbon backbone is defined as a molecular fragment that began as a hydrocarbon compound and has had at least one hydrogen atom removed from the molecule. Such a fragment is also known as a radical. A functional group is defined as an atom or a group of atoms, bound together, which impart specific chemical properties to a molecule; also referred to as radicals. A hydrocarbon derivative then is essentially a compound made up of two specific parts; the first part comes from a hydrocarbon, and the second may have many different origins (which includes coming from a hydrocarbon), depending on the chemical makeup of the functional group. The hydrocarbon backbone may come from an alkane, an alkene, an alkyne (indeed, any saturated or unsaturated hydrocarbon), or from an aromatic hydrocarbon or other cyclical hydrocarbon. Any hydrocarbon compound may form the hydrocarbon backbone portion of the hydrocarbon derivative, as long as it has been converted to a radical, by removal of one or more hydrogens, in preparation for the reaction. The functional group may have many origins, with chemists using as reactants any chemical compound that will produce the desired functional group. The functional groups include the halogens (fluorine, chlorine, bromine, and iodine), the hydroxyl radical, the carbonyl group, oxygen, the carboxyl group, the peroxide radical, the amine radical, and even other hydrocarbon radicals. When these functional groups are chemically attached to hydrocarbon backbones, they form compounds called hydrocarbon derivatives, and each functional group imparts a separate set of chemical and physical properties to the molecule formed by this chemical attachment.

Just as the alkanes and alkenes had general formulas, the carbon derivatives all have general formulas. The hydrocarbon backbone provides a portion of the general formula, and the functional group provides the other part. In each case, the hydrocarbon derivative is represented by the formula R-, and the hydrocarbon backbone has its own specific formula. The term "substituted hydrocarbon" is another name for hydrocarbon derivative, because the functional group is substituted for one or more hydrogen atoms in the chemical reaction.

3.2.7 Halogenated Hydrocarbons

A halogenated hydrocarbon is defined as a derivative of a hydrocarbon in which a hydrogen atom is replaced by a halogen atom. Since all of the halogens react similarly, and the number of hydrocarbons (including all saturated hydrocarbons, unsaturated hydrocarbons, aromatic hydrocarbons, other cyclical hydrocarbons, and all the isomers of these hydrocarbons) is large, the number of halogenated hydrocarbons can also be very large. The most common hydrocarbon derivatives are those of the first four alkanes and the first three alkenes (and, of course, the isomers of these hydrocarbons). There are some aromatic hydrocarbon derivatives, but, again, they are of the simplest structure. Whatever the hydrocarbon backbone is, it is represented in the general formula by its formula, which is R-. Therefore, the halogenated hydrocarbons will have formulas such as R-F, R-Cl, R-Br, and R-I for the respective substitution of fluorine, chlorine, bromine, and iodine on to the hydrocarbon backbone. As a rule, the general formula can be written R-X, with the R as the hydrocarbon backbone, the X standing for the halide (any of the halogens), and the "-" the covalent bond between the hydrocarbon backbone and the halogen. R-X is read as "alkyl halide".

Radicals of the alkanes are referred to as alkyl radicals. There are two other important radicals; they are the vinyl radical, which is produced when a hydrogen atom is removed from ethylene, and the phenyl radical, which results when a hydrogen atom is removed from benzene. The term halogenated means that a halogen atom has been substituted for a hydrogen atom in a hydrocarbon molecule. The most common halogenated hydrocarbons are the chlorinated hydrocarbons. The simplest chlorinated hydrocarbon is methyl chloride, whose molecular formula is CH_3Cl. The structural formula for methyl chloride shows that one chlorine atom is substituted for one hydrogen atom. Methyl chloride has many uses, such as a herbicide, as a topical anesthetic, extractant, and low-temperature solvent, and as a catalyst carrier in low-temperature polymerization. It is a colorless gas that is easily liquified and is flammable; it is also toxic in high concentrations. Methyl chloride is the common name for this compound, while its proper name is chloromethane. Proper names are determined by the longest carbon chain in the molecule, and the corresponding hydrocarbon's name is used as the last name of the compound. Any substituted groups are named first, and a number is used to designate the carbon atom that the functional group is attached to, if applicable.

It is possible to substitute more than one chlorine atom for a hydrogen atom on a hydrocarbon molecule; such substitution is done only when the resulting compound is commercially valuable or is valuable in another chemical process. An example is methylene chloride (the common name for dichloromethane), which is made by substituting two chlorine atoms for two hydrogen atoms on the methane molecule. Its molecular formula is CH_2Cl_2. Methylene chloride is a colorless, volatile liquid with a sharp, ether-like odor. It is listed as a non-flammable liquid, but it will ignite at 1,224°F; it is narcotic at high concentrations. It is most commonly used as a stripper of paints and other finishes. It is also a good degreaser and solvent extractor and is used in some plastics processing applications.

Substituting a third chlorine on the methane molecule results in the compound whose proper name is trichloromethane (tri- for three; chloro- for chlorine; and methane, the hydrocarbon's name for the one-carbon chain). It is more commonly known as chloroform. Its molecular formula is $CHCl_3$. Chloroform is a heavy, colorless, volatile liquid with a sweet taste and characteristic odor. It is classified as non-flammable, but it will burn if exposed to high temperatures for long periods of time. It is narcotic by inhalation and toxic in high concentrations. It is an insecticide and a fumigant and is very useful in the manufacture of refrigerants.

The total chlorination of methane results in a compound whose proper name is tetrachloromethane (tetra- for four), but its common name is carbon tetrachloride (or carbon tet). This is a fire-extinguishing agent that is no longer used since it has been classified as a carcinogen. It is still present, though, and its uses include refrigerants, metal degreasing, and chlorination of organic compounds. Its molecular formula is CCl_4. It is possible to form analogues of methyl chloride, (methyl fluoride, methyl bromide, methyl iodide), methylene chloride (substitute fluoride, bromide, and iodide in this name also), chloroform (fluoroform, bromoform, and iodoform), and carbon tetrachloride (tetrafluoride, tetrabromide, and tetraiodide). Each of these halogenated hydrocarbons has some commercial value.

What was true for one hydrocarbon compound is true for most hydrocarbon compounds, particularly straight-chain hydrocarbons; that is, you may substitute a functional group at each of the bonds where a hydrogen atom is now connected to the carbon atom. Where four hydrogen atoms exist in methane, there are six hydrogen atoms in ethane; you recall that the difference in make-up from one compound to the next in an analogous series is the "unit" made up of one carbon and two hydrogens. Therefore, it is possible to substitute six functional groups on to the ethane molecule. You should also be aware that the functional groups that would be substituted for the hydrogens need not be the same, that is, you may substitute chlorine at one bond, fluorine at another, the hydroxyl radical at a third, an amine radical at a fourth, and so on.

Substituting one chlorine atom for a hydrogen atom in ethane produces ethyl chloride, a colorless, easily liquifiable gas with an ether-like odor and a burning taste, which is highly flammable and moderately toxic in high concentrations. It is used to make tetraethyl lead and other organic chemicals. Ethyl chloride is an excellent solvent and analytical reagent, as well as an anesthetic. Its molecular formula is C_2H_5Cl.

Although we are using chlorine as the functional group, it may be any of the other halogens. In addition, we are giving the common names, while the proper names may be used on the labels and shipping papers. Ethyl chloride's proper name is chloroethane.

Substituting another chlorine produces ethylene dichloride (proper name 1,2-dichloroethane). In this case, an isomer is possible, which would be the chlorinated hydrocarbon where both chlorines attached themselves to the same carbon atom, whereby 1,1-dichloroethane is formed. These compounds have slightly different properties and different demands in the marketplace. As further chlorination of ethane occurs, we would have to use the proper name to designate which compound is being made. One of the analogues of ethylene dichloride is ethylene dibromide, a toxic material that is most efficient and popular as a grain fumigant, but it is known to be a carcinogen in test animals.

There are many uses for the halogenated hydrocarbons. Many of them are flammable; most are combustible. Some halogenated hydrocarbons are classified as neither, and a few are excellent fire-extinguishing agents (the Halons ®), but they will all decompose into smaller, more harmful molecular fragments when exposed to high temperatures for long periods of time.

3.2.8 Alcohols

The compounds formed when a hydroxyl group (-OH) is substituted for a hydrogen are called alcohols. They have the general formula R-OH. The hydroxyl radical looks exactly like the hydroxide ion, but it is not an ion. Where the hydroxide ion fits the definition of a complex ion - a chemical combination of two or more atoms that have collectively lost or (as in this case) gained one or more electrons - the hydroxide radical is a molecular fragment produced by separating the -OH from another compound, and it has no electrical charge. It does have an unpaired electron waiting to pair up with another particle having its own unpaired electron. The alcohols, as a group, are flammable liquids in the short-chain range, combustible liquids as the chain grows longer, and finally solids that will burn if exposed to high temperatures, as the chain continues to become longer. As in the case of the halogenated hydrocarbons, the most useful alcohol compounds are of the short-carbon-chain variety. Just as in the case of the halogenated hydrocarbons, the simplest alcohol is made from the simplest hydrocarbon, methane. Its name is methyl alcohol and its molecular formula is CH_3OH.

Nature produces a tremendous amount of methyl alcohol, simply by the fermentation of wood, grass, and other materials made to some degree of cellulose. In fact, methyl alcohol is known as wood alcohol, along with names such as wood spirits and methanol (its proper name; the proper names of all alcohols end in -ol). Methyl alcohol is a colorless liquid with a characteristic alcohol odor. It has a flash point of 54°F, and is highly toxic. It has too many commercial uses to list here, but among them are as a denaturant for ethyl alcohol (the addition of the toxic chemical methyl alcohol to ethyl alcohol in order to form denatured alcohol), antifreezes, gasoline additives, and solvents. No further substitution of hydroxyl radicals is performed on methyl alcohol.

The most widely known alcohol is ethyl alcohol, simply because it is the alcohol in alcoholic drinks. It is also known as grain alcohol, or by its proper name, ethanol. Ethyl alcohol is a colorless, volatile liquid with a characteristic odor and a pungent taste. It has a flash point of 55°F, is classified as a depressant drug, and is toxic when ingested in large quantities. Its molecular formula is C_2H_5OH. In addition to its presence in alcoholic beverages, ethyl alcohol has many industrial and medical uses, such as a solvent in many manufacturing processes, as antifreeze, antiseptics, and cosmetics.

The substitution of one hydroxyl radical for a hydrogen atom in propane produces propyl alcohol, or propanol, which has several uses. Its molecular formula is C_3H_7OH. Propyl alcohol has a flash point of 77°F and, like all the alcohols, burns with a pale blue flame. More commonly known is the isomer of propyl alcohol, isopropyl alcohol. Since it is an isomer, it has the same molecular formula as propyl alcohol but a different structural formula. Isopropyl alcohol has a flash point of 53°F. Its ignition temperature is 850°F, while propyl alcohol's ignition temperature is 700°F, another effect of the different structure. Isopropyl alcohol, or 2-propanol (its proper name) is used in the manufacture of many different chemicals, but is best known as rubbing alcohol.

The above-mentioned alcohols are by far the most common. Butyl alcohol is not as commonly used as the first four in the series, but it is used. Secondary butyl alcohol and tertiary butyl alcohol, so named because of the type of carbon atom in the molecule to which the hydroxyl radical is attached, must be mentioned because they are flammable liquids, while isobutyl alcohol has a flash point of 100°F. All of the alcohols of the first four carbon atoms in the alkanes, therefore, are extremely hazardous because of their combustion characteristics.

Whenever a hydrocarbon backbone has two hydroxyl radicals attached to it, it becomes a special type of alcohol known as a glycol. The simplest of the glycols, and the most important, is ethylene glycol, whose molecular formula $C_2H_4(OH)_2$. The molecular formula can also be written CH_2OHCH_2OH and may be printed as such on some labels. Ethylene glycol is a colorless, thick liquid with a sweet taste, is toxic by ingestion and by inhalation, and among its many uses is a permanent antifreeze and coolant for automobiles. It is a combustible liquid with a flash point of 240°F.

The only other glycol that is fairly common is propylene glycol which has a molecular formula of $C_3H_6(OH)_2$. It is a combustible liquid with a flash point of 210°F, and its major use is in organic synthesis, particularly of polyester resins and cellophane.

The last group of substituted hydrocarbons produced by adding hydroxyl radicals to the hydrocarbon backbone are the compounds made when three hydroxyl radicals are substituted; these are known as glycerols. The name of the simplest of this type of compound is just glycerol. Its molecular formula is $C_3H_5(OH)_3$. Glycerol is a colorless, thick, syrupy liquid with a sweet taste, and has a flash point of 320°F, and is used to make such diverse products as candy and explosives, plus many more. Other glycerols are made, but most of them are not classified as hazardous materials.

3.2.9 Ethers

The ethers are a group of compounds with the general formula R-O-R'. The R, of course, stands for any hydrocarbon backbone, and the R' also stands for any hydrocarbon backbone, but the designation R' is used to indicate that the second hydrocarbon backbone may be different from the first. In other words, both the hydrocarbon backbones in the formula may be the same, but the "'" is used to indicate that it may also be different. R-O-R as the general formula for the ethers is also correct. The fact that there are two hydrocarbon backbones on either side of an oxygen atom means that there will be two hydrocarbon names used.

The simplest of the ethers would be ether that has the simplest hydrocarbon backbones attached; those backbones are the radicals of the simplest hydrocarbon, methane. Therefore, the simplest of the ethers is dimethyl ether, whose formula is CH_3OCH_3. Dimethyl is used because there are two methyl radicals, and "di-" is the prefix for two. This compound could also be called methyl methyl ether, or just plain methyl ether, but it is better known as dimethyl ether. It is an easily liquified gas that is extremely flammable, has a relatively low ignition temperature of 66°F, and is used as a solvent, a refrigerant, a propellant for sprays, and a polymerization stabilizer.

The next simplest ether is the ether with the simplest alkane as one of the hydrocarbon backbones and the next alkane, which is methyl ethyl ether. Its molecular formula is $CH_3OC_2H_5$. It is a colorless gas with the characteristic ether odor. It has a flash point of 31°F, and an ignition temperature of only 374°F. This property, of course, makes it an extreme fire and explosion hazard.

The next simplest ether is actually the one most commonly referredto as "ether". It is diethyl ether, whose molecular formula is $C_2H_5OC_2H_5$, sometimes written as $(C_2H_5)_2O$. This ether is the compound that was widely used as an anesthetic in many hospitals. One of the hazards of all ethers, and particularly diethyl ether because of its widespread use, is that once ethers have been exposed to air, they possess the unique capability of adding an oxygen atom to their structure and converting to a dangerously unstable and explosive organic peroxide. The peroxide-forming hazard aside, diethyl etherhas a flash point of -56°F and ignition temperature of 356 °F; it is a colorless, volatile liquid with the characteristic ether odor. In addition to its use as an anesthetic, it is useful in the synthesis of many other chemicals, but it is an extremely hazardous material.

Another important ether is vinyl ether, a colorless liquid with the characteristic ether odor. Its molecular formula is $C_2H_3OC_2H_3$. Vinyl ether has a flash point of -22°F and an ignition temperature of 680°F. It is highly toxic by inhalation and is used in medicine and in the polymerization of certain plastics.

3.2.10 Ketones

The ketones are a group of compounds with the general formula R-C-R'. The -C- functional group is known as the carbonyl group or carbonyl radical; it appears in many different classes of hydrocarbon derivatives. There are only a few important ketones, and they are all extremely hazardous.

The first is the simplest, again with two methyl radicals, one on either side of the carbonyl group. Its molecular formula is CH_3COCH_3. Its proper name is propanone (propa- because of the relationship to the three-carbon alkane, propane, and -one because it is a ketone); it could logically be called dimethyl ketone, but it is universally known by its common name, acetone. Acetone is a colorless, volatile liquid with a sweet odor, has a flash point of15° F and an ignition temperature of 1,000° F, is narcotic in high concentrations, and could be fatal by inhalation or ingestion. It is widely used in manufacturing many chemicals and is extremely popular as a solvent.

The next most common ketone is methyl ethyl ketone, commonly referred to as MEK. Its molecular formula is $CH_3COC_2H_5$. MEK has a flash point of 24°F and an ignition temperature of 960°F. It is a colorless liquid with a characteristic ketone odor. It is as widely used as acetone and is almost as hazardous.

3.2.11 Aldehydes

The aldehydes are a group of compounds with the general formula R-CHO. The aldehyde functional group is always written -CHO, even though this does not represent the aldehyde's structural formula. It is written in this way so that the aldehydes will not be confused with R-OH, the general formula of the alcohols.

The simplest of the aldehydes is formaldehyde, whose molecular formula is HCHO. The second hydrocarbon backbone of the ketone is replaced by a hydrogen atom. Formaldehyde is a gas that is extremely soluble in water; it is often sold commercially as a 50 percent solution of the gas in water. The gas itself is flammable, has an ignition temperature of 806°F and a strong, pungent odor, and is toxic by inhalation. Inhalation at low concentrations over long periods of time has produced illness in many people. Beside its use as an embalming fluid, formaldehyde is used in the production of many plastics and in the production of numerous other chemicals.

The next aldehyde is acetaldehyde, a colorless liquid with a pungent taste and a fruity odor. Its molecular formula is CH_3CHO. It has a flash point of -40°F, an ignition temperature of 340°F, and is toxic by inhalation. Acetaldehyde is used in the manufacture of many other chemicals. Other important aldehydes are propionaldehyde, butyraldehyde, and acrolein.

3.2.12 Peroxides

The peroxides are a group of compounds with the general formula R-O-O-R'. All peroxides are hazardous materials, but the organic peroxides may be the most hazardous of all.

3.2.13 Esters

The esters are a group of compounds with the general formula R-C-O-O-R'. They are not generally classified as hazardous materials, except for the acrylates, which are monomers and highly flammable. Few of the rest of the class are flammable. There are some esters that are hazardous.

3.2.14 Amines

The amines are a group of compounds with the general formula R-NH_2, and all the common amines are hazardous. As a class the amines pose more than one hazard, being flammable, toxic, and, in some cases, corrosive. The amines are an analogous series of compounds and follow the naming pattern of the alkyl halides and the alcohols; that is, the simplest amine is methyl amine, with the molecular formula of CH_3NH_2. Methyl amine is a colorless gas with an ammonia-like odor and an ignition temperature of 806°F. It is a tissue irritant and toxic, and it is used as an intermediate in the manufacture of many chemicals.

Ethyl amine is next in the series, followed by propyl amine, isopropyl amine, butyl amine and its isomers, and so on.

3.2.15 Theory of Flammability and Pyrolysis

Fire, or combustion is a chemical reaction, and specifically it is an oxidation reaction. Oxidation is defined as the chemical combination of oxygen with any substance. In other words, whenever oxygen (and some other materials) combines chemically with a substance, that substance is said to have been oxidized. Rust is an example of oxidized iron. In this case, the chemical reaction is very slow. The very rapid oxidation of a substance is called combustion, or fire.

There are three basic theories that are used to describe the reaction known as fire. They are: the fire triangle, the tetrahedron of fire, and the life cycle of fire. Of the three, the first is the oldest and best known, the second is accepted as more fully explaining the chemistry of fire, while the third is a more detailed version of the fire triangle. Each is briefly described below.

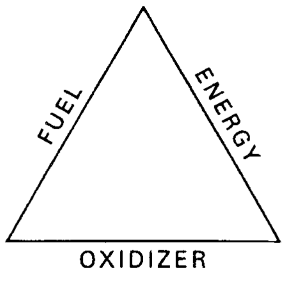


Figure 4. Illustrates the fire triangle theory.

The first of these theories, the fire triangle, is quite simplistic and provides a basic understanding of the three entities that are necessary for a fire. This theory states that there are three things necessary to have a fire: fuel, oxygen (or an oxidizer), and heat (or energy). It likens these three things to the three sides of a triangle, stating that as long as the triangle is not complete, that is, the legs are not touching each other to form the closed or completed triangle, combustion cannot take place. Figure 4 illustrates the fire triangle.

The theory, as stated, is still correct. Without fuel to burn, there can be no fire. If there is no oxygen present, there can be no fire (technically, this is not correct, but we can make the fire triangle theory technically correct by changing the oxygen leg to an oxidizer leg). Finally, without heat, there can be no fire. This last statement must also be brought up to date. The fact is that heat is just one form of energy; it is really energy that is necessary to start a fire. This difference is mentioned because there are some instances where light or some other form of energy may be what is needed to start the combustion reaction. It is best to change the "heat" leg of the fire triangle to the "energy" leg. Therefore, our "updated" fire triangle now has three sides representing fuel, oxidizer, and energy.

A fuel may be defined as anything that will burn. It is important for you to grasp this definition, because most firefighters consider only flammable gases and liquids as fuels. Many others include wood, and coal as fuels, because we all recognize that they will burn, but we also tend to forget the metals, which under many circumstances are more hazardous than almost any other type of fuel. Fuels may be categorized into the following classes:

1. Elements (which include the metals, and some non-metals such as carbon, sulphur, and phosphorus)
2. Hydrocarbons
3. Carbohydrates (including mixtures that are made up partially of cellulose, like wood and paper)
4. Many covalently bonded gases (including carbon monoxide, ammonia, and hydrogen cyanide)
5. All other organic compounds

This list of materials that burn is quite long, and one must not forget that the list includes not only the pure substances such as the elements and compounds that make up the list, but mixtures of those elements and compounds. Examples of mixtures would include natural gas, which is a mixture of methane (principally), ethane, and a few other compounds, and gasoline, which is a mixture of the first six liquid alkanes (pentane, hexane, heptane, octane, nonane, and decane), plus a few other compounds. Wood (another mixture), and wood-related products, like paper, are excellent fuels, as are many polymers such as rubber, plastics, wool, silk, and the above-mentioned cellulose, which makes wood and paper the excellent fuels that they are.

The second leg of the fire triangle is oxygen, or the oxidizer leg. We changed this because oxygen, although it is the most common oxidizing agent encountered, is not the only oxidizer. Another problem with calling this second leg the oxygen leg is that most firefighters consider only oxygen from the atmosphere when they think of oxygen, and do not consider other sources. Since the greatest source of oxygen is the atmosphere, however, this has to be considered the source that must be eliminated as one of the ways to control a fire. Whatever the source, note that oxygen does not burn.

The third leg of the fire triangle is what was once called the heat leg but we have updated to call it the energy leg, so as to consider all forms capable of providing the source of energy needed to start the combustion process. This energy can be provided in one or more of several ways. The energy can be generated chemically by the combustion of some other fuel, or it can be generated by some other exothermic chemical reaction. Exothermic is defined as the emission or liberation of heat (or energy). This is the opposite of endothermic, which is defined as the taking-in or absorption of heat (or energy).

Energy may also be generated by mechanical action; that is, the application of physical force by one body upon another. Examples of this are the energy created by the friction of one matter upon another or the compression of a gas.The force of friction in one case may produce energy that manifests itself as heat, while friction in the other case may result in a discharge of static electricity. Static electricity is created whenever molecules move over and past other molecules. This happens whether the moving molecules are in the form of a gas, a liquid, or a solid. (This is the reason why leaking natural gas under high pressure will ignite. This is also the reason why two containers must be bonded - connected by an electrical conductor - when you are pouring flammable liquids from one container to another. In any case, the amount of energy present and/or released could be more than enough to start the combustion reaction.)

A third method of generation of energy is electrical - much like the discharge of static electricity. This method may manifest itself as heat, as produced in an electrical heater, as arcing in an electrical motor or in a "short" circuit, or as the tremendous amount of energy released as lightning.

The fourth method of generation of energy is nuclear. Nuclear energy may be generated by the fission (splitting) of the atoms of certain elements and by the fusion (or joining together) of the nuclei of certain elements.

Once the energy - in many cases, heat - is generated, it must be transmitted to the fuel (the "touching" of the fuel and energy legs). This process is accomplished in three ways: conduction (the transfer of heat through a medium, such as a pan on a stove's heating element), convection (the transfer of heat with a medium, such as the heated air in a hot-air furnace), and radiation (the transfer of heat which is not dependent on any medium).

These three entities (fuel, oxidizer, an energy) make up the three legs of the fire triangle. It is a physical fact, a law of nature that cannot be repealed, that when fuel, oxidizers, and energy are brought together in the proper amounts, a fire will occur. If the three are brought together slowly, and over a long period of time, the oxidation will occur slowly, as in the rusting of iron. If the three are of a particular combination, the resulting oxidation reaction might even be an explosion. Whatever form the final release of energy takes, the thing that cannot be changed is that the chemical reaction will occur.

The second popular explanation of fire is the tetrahedron theory which is illustrated in Figure 5. This theory encompasses the three concepts in the fire triangle theory but adds a fourth "side" to the triangle, making it a pyramid, or tetrahedron; this fourth side is called the "chain reaction of burning". This theory states that when energy is applied to a fuel like a hydrocarbon, some of the carbon-to-carbon bonds break, leaving an unpaired electron attached to one of the molecular fragments caused by the cleavage of the bond, thus creating a free radical. This molecular fragment with the unpaired electron, or "dangling" bond, is highly reactive and will therefore seek out some other material to react with in order to satisfy the octet rule. The same energy source that provided the necessary energy to break the carbon-to-carbon bond may have also broken some carbon-to-hydrogen bonds, creating more free radicals, and also broken some oxygen-to-oxygen bonds, creating oxide radicals. This mass breaking of bonds creates the free radicals in a particular space, and in a number large enough to be near each other, so as to facilitate the recombining of these free radicals with whatever other radicals or functional groups may be nearby. The breaking of these bonds releases the energy stored in them, so that this subsequent release of energy becomes the energy source for still more bond breakage, which in turn releases more energy. Thus the fire "feeds" upon itself by continuously creating and releasing more and more energy (the chain reaction), until one of several things happens: either the fuel is consumed, the oxygen is depleted, the energy is absorbed by something other than the fuel, or this chain reaction is broken. Thus a fire usually begins as a very small amount of bond breakage by a relatively small energy (ignition) source and builds itself up higher and higher, until it becomes a raging inferno, limited only by the fuel present (a fuel-regulated fire) or the influx of oxygen (an oxygen-regulated fire). The earlier in the process that the reaction can be interrupted, the easier the extinguishment of the fire will be. This theory claims that the propagation of all hydrocarbon fires (or fires involving hydrocarbon derivatives) depends upon the formation of the hydroxyl (-OH) radical, which is found in great quantities in all such fires.

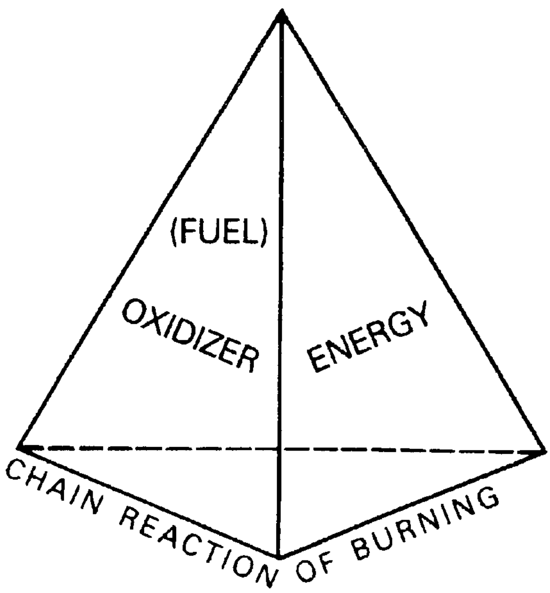


Figure 5. Illustrates the theory of the fire tetrahedron.

The third theory of fire is the life cycle theory, which is illustrated in Figure 6. According to this theory, the combustion process can be categorized by six steps, rather than the three of the fire triangle or the four of the tetrahedron of fire theory. Three of the steps in this theory are the same as the only three steps in the fire triangle theory. In the life cycle of fire theory, the first step is the input heat, which is defined as the amount of heat required to produce the evolution of vapors from the solid or liquid. The input heat will also be the ignition source and must be high enough to reach the ignition temperature of the fuel; it must be continuing and self-generating and must heat enough of the fuel to produce the vapors necessary to form an ignitable mixture with the air near the source of the fuel. The second part of the life cycle of fire theory is the fuel, essentially the same as the fuel in the tetrahedron of fire and the fire triangle. It was assumed without so stating in the fire triangle theory, and is true in all three theories, that the fuel must be in the proper form to burn; that is, it must have vaporized, or, in the case of a metal, almost the entire piece must be raised to the proper temperature before it will begin to burn. The third part is oxygen in which the classical explanation of this theory only concerns itself with atmospheric oxygen, because the theory centers around the diffusion flame, which is the flame produced by a spontaneous mixture (as opposed to a pre-mixed mixture) of fuel gases or vapors and air. This theory concerns itself with air-regulated fires, so airflow is crucial to the theory; this is why only atmospheric oxygen is discussed. Ignoring oxygen and the halogens that are generated from oxidizing agents should be viewed as a flaw in this theory. The fourth part of the theory is proportioning, or the occurrence of intermolecular collisions between oxygen and the hydrocarbon molecule (the "touching" together of the oxidizer leg and the fuel leg of the fire triangle). The speed of the molecules and the number of collisions depend on the heat of the mixture of oxygen and fuel; the hotter the mixture, the higher the speed. A rule of thumb is used in chemistry that states the speed of any chemical reaction doubles for roughly every 18°F (10°C.) rise in temperature. The fifth step is mixing; that is, the ratio of fuel to oxygen must be right before ignition can occur (flammable range). Proper mixing after heat has been applied to the fuel to produce the vapors needed to burn is the reason for the "backdraft" explosion that occurs when a fresh supply of air is admitted to a room where a fire has been smoldering. The sixth step is ignition continuity, which is provided by the heat being radiated from the flame back to the surface of the fuel; this heat must be high enough to act as the input heat for the continuing cycle of fire. In a fire, chemical energy is converted to heat; if this heat is converted at a rate faster than the rate of heat loss from the fire, the heat of the fire increases; therefore, the reaction will proceed faster, producing more heat faster than it can be carried away from the fire, thus increasing the rate of reaction even more. When the rate of conversion of chemical energy falls below the rate of dissipation, the fire goes out. That is to say, the sixth step, ignition continuity, is also the first step of the next cycle, the input heat. If the rate of generation of heat is such that there is not enough energy to raise or maintain the heat of the reaction, the cycle will be broken, and the fire will go out. The life cycle of fire theory adds the concepts of flash point and ignition point (heat input) and flammable range (mixing). These terms are discussed at greater length later in this chapter.

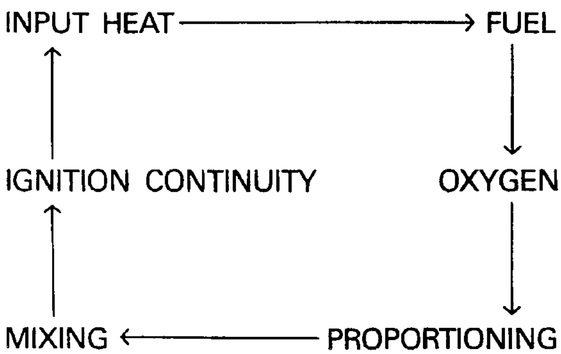


Figure 6. Illustrates the life cycle theory of fire.

3.2.16 Classifying Petroleum Liquids with Respect to Fire Characteristics

Hydrocarbons are derivatives from petroleum or crude, but within the context of our immediate discussions, we shall use the terms petroleum liquids and hydrocarbon liquids as being interchangeable. From a fire standpoint, there are only two categories of petroleum liquids, namely *flammable liquids* and *combustible liquids*. Both categories of materials will burn; however, it is into which of these two categories that a liquid belongs that determines its relative fire hazard. Of the two categories, it is the flammables that are considered to be more hazardous, principally because they release ignitable vapors at lower temperatures (a concept consistent with the life cycle theory of fire).

Fire hazard is viewed from the standpoint of safety, to which in the United States, the Occupational Safety and Health Standard (OSH) is often used as the basis for classification of flammables versus a combustible material. Additionally, the U.S. Department of Transportation also has very specific definitions regarding classification of fire hazards based on safe transport of materials. For initial discussions we will adhere to the OSHA definitions, and later refer to distinctions in U.S. federal definitions which are legal standards.

For flammable liquids, the OSHA standard defines a flammable material based upon the liquid's flash point temperature. Any liquid having a flash point below 100°F is classified as being flammable. The definition for flammable liquids given by the National Fire protection Association (NFPA) includes the additional criteria that the liquid's vapor cannot exceed 40 psi at a liquid temperature of 100°F. From a practical standpoint, these criteria refer simply to the fact that any material with a flash point temperature of 100°F or less is capable of releasing vapors at a rate sufficient to be ignitable, and hence represents the greatest danger from a fire standpoint due to the possibility of spontaneous combustion. It is important to note that there are many materials that are capable of vaporizing at extremely low temperatures. A common example is gasoline whose flash point is -40°F.

The combustible liquid category are thus those liquids whose flash points are above 100°F. The category for petroleum liquids covers a range from the 100°F flash point of kerosene to the flash point of 450°F of some motor oils. Although these materials are less hazardous than flammable liquids, they still represent fire hazards and under certain conditions are as dangerous as flammables. Some typical examples of the two categories of fire hazards for petroleum liquids are given in Table 6.

The term flash point is sometimes confusing and its definition should be carefully considered. The term basically refers to the temperature that a liquid must be at before it will provide the fuel in vapor form necessary for the condition of spontaneous combustion to occur. Perhaps more accurate a definition is that it refers to the lowest temperature a liquid may be and still have the ability to liberate flammable vapor at a sufficient rate that, when mixed with the proper amounts of air, the air-fuel mixture will flash in the presence of a source of energy or ignition source. This provides a more pragmatic viewpoint on how fires occur. In essence, when a material liberates vapor, this vapor represents fuel. When it combines with oxygen in air in the proper amounts, we now have a flammable mixture, and hence all that is needed to complete the fire triangle is a source of energy. In essence then, it is the vapor (air-fuel mixture) that burns, and not the material itself. It, therefore, stands to reason that, assuming sufficient amounts of air to be present, the greater the volume of released vapor, the larger and more intense will be the fire.

Table 6. Common Examples of Flammable and Combustible Petroleum Liquids

Flammables	Flash Point, °F	Combustible	Flash Point, °F
Gasoline	-40	Kerosene	100
Ethers	-30	Fuel oils	100-140
Acetone	-4	Diesel oil	130
Methanol	52	Lubricating oil	300
Crude Oil and Naphtha	20-90	Asphalt	400

Another term that is often given attention to is the fire point. The fire point temperature refers to the temperature which the liquid must be at before released vapor is in sufficient quantity to continue to burn. With the flash point temperature, the amounts of vapor being released at the exact flash point temperature will not sustain the fire and, after flashing across the liquid surface, the flame extinguishes. For many materials the fire point is only a few degrees above the flash point, but regardless, the flash point is perhaps the more universally accepted basis of classifying a fire hazard largely because a flash fire will generally be sufficient to ignite combustible materials. Both the terms flash point and fire point (or also known as the ignition point) are discussed in greater detail later in this chapter.

3.2.17 Fire Extinguishment

Fire is an exothermic (heat-liberating) reaction. There must be a continuous feedback of energy (heat) to keep the reaction going. Also, heat is dissipated from the fire by one or more of the methods of transferring heat: conduction, convection, and radiation. Heat energy is also fed back to the fire by radiation from the flame, and this source of heat keeps the fire going. If we could devise a way to interrupt that feedback of heat to the fuel, the continuity of the fire would be broken, and the fire would go out. Hence, a fire-extinguishing agent is needed that siphons heat energy away from the fire, reduces the temperature of the material burning, and cools the surroundings below the ignition temperature of the fuel, so that there would not be a re-ignition of flammable vapors once the fire was extinguished.

Water is the most common extinguishing agent that performs this task. Water has many disadvantages, however. Some of the drawbacks to the use of water as an extinguishing agent include its propensity to conduct electricity (which, of course, is deadly if the water is applied incorrectly), its low viscosity (which allows it to run off a wall instead of sticking there), and a high surface tension (which prevents it from penetrating tightly arranged materials). Water also allows heat to be radiated through it, freezes at a relatively high temperature, splashes about, and displaces many flammable liquids, causing them to spread rapidly, while burning all the time. This list of problems also includes the fact that water itself will violently react with many of the hazardous materials it is supposed to control.

In addition to the fact that water is relatively inexpensive and is usually available in large quantities, there are two specific properties of water that make it invaluable. Those properties are its latent heat of vaporization and its specific heat. The latent heat of vaporization of a substance is defined as the amount of heat a material must absorb when it changes from a liquid to a vapor or gas. The specific heat of a substance is defined as the ratio between the amount of heat necessary to raise the temperature of a substance and the amount of heat necessary to raise the same weight of water by the same number of degrees.

The specific heat of water is important because it is so high in relation to the specific heat of other materials; this fact means that it takes more energy to raise the temperature of water than just about any other material. Therefore, the temperature of the materials to which water has been applied will drop faster than the temperature of water will rise. The specific heat may be reported as the number of calories needed to raise the temperature of one gram of the material 1°C, or the number of British Thermal Units (BTUs) needed to raise one pound of the material, 1°F. Therefore, when water is applied to a fire, it begins absorbing heat from the fire, thereby cooling the fire down while the water heats up. For every BTU absorbed, the temperature of the water will rise 1°F per pound of water involved. The important thing to remember here is that the rise in temperature of the water is caused by heat energy absorbed from the fire. The water is siphoning the heat away from the burning material. The temperature of the water will continue to rise, as long as the fire is producing heat, until it reaches its boiling point of 212°F. At this time the latent heat of vaporization of water comes into play. At 212°F the water is still a liquid and will remain a liquid unless more energy is received from the fire. At this time, there is a phase change from liquid to vapor, with no increase in temperature; that is, wateras a liquid at 212°F converts to water vapor at 212°F. It is at this phase change that the latent heat of vaporization of water does its work, for while water will absorb 1 BTU per pound for every increase of 1°F, up to 212°F, at 212°F when the phase change occurs, 970 BTUs are absorbed per pound. That sudden, rapid, and massive withdrawal of heat energy from the fire at this time is what gives water its tremendous fire-extinguishing capabilities, which are so valuable as to overcome the previously mentioned disadvantages. Heat is withdrawn from the burning material so rapidly, and in such large quantities, that the temperature of the burning fuel drops dramatically, usually well below its ignition temperature. When this happens, of course, the fire goes out. The latent heat of vaporization also explains why steam at 212°F is hotter than boiling water at 212°F. The live steam has 970 BTU's of energy more than the boiling water.

This latent heat of vaporization also explains why materials wet with water are difficult, and sometimes impossible, to ignite. If a combustible substance has absorbed enough water to be considered wet, or just damp, this water will act as a barrier to ignition by its evaporation as it is heated. As heat is applied to the wet substance, the water begins to evaporate (go through the phase change from a liquid to a vapor). To make this phase change, the water must absorb 1 BTU for every pound of water present for every 1°F it rises until it reaches 212°F, whereupon it must absorb 970 BTUs for every pound of water present. Before any combustible material that has been wet with water can burn, the water (which has preferentially been absorbing the applied heat and thus keeping the combustible material itself from heating to its ignition temperature) must be driven off. If in the process of driving off the water enough heat energy from the potential ignition source has been used up so that there is not enough left (for example a burnt-out match) to raise the combustible to its ignition temperature, there will be no fire.

Water, of course, does not work with all materials. There is a special class of materials that are water reactive, and hence water becomes an unacceptable extinguishing agent. For these class of materials another approach to eliminating the fire is taken. Specifically, we must remove the oxidizer leg from the fire triangle; i.e. cut off the supply of oxygen which fuels the air to fuel mixture.

3.2.18 Flammability Properties

The following discussions are limited to petroleum liquids. From a fire standpoint, the two main categories of petroleum liquids are flammable and combustible, and are determined mainly by the liquid's flash point. Both categories of liquids will burn but it is into which of these two categories the liquid belongs that determines its relative fire hazard. As already noted, flammable liquids are generally considered the more hazardous of the two categories mainly because they release ignitable vapors.

Following OSHA definitions, a flammable material is any liquid having a flash point below 100°F. The NFPA expands this definition by including the stipulation that the vapor cannot exceed 40 psi (pounds per square inch) at a liquid temperature of 100°F, with the theory being that such liquids are capable of releasing vapor at a rate sufficient to be ignitable. Since this aspect of the definition relating to vapor pressure has little fire-ground application it is often ignored. However, it is important to note that if the heat from a fire raises the liquid temperature to a temperature above the liquid's flash point, it will automatically increase the vapor pressure inside a closed container. Any other source of sufficient heat will produce the same result.

Within the combustible liquid category are those materials with a flash point above 100°F. Combustible liquids are considered less hazardous than flammable liquids because of their higher flash points. However, this statement can be misleading since there are circumstances when it is not a valid assumption. It is possible for certain combustible liquids to be at their flash point when a hot summer sun has been striking their metal container for some time. Additionally, during the transportation of some combustible products, the product is either preheated or a heat source is maintained to make the product more fluid than it would be at atmospheric temperatures. One reason this is done is to facilitate transportation or pumping; i.e. to aid with the movement of a material that is very viscous, such as asphalt or tar. Also, some materials classed as combustible solids will be heated to their melting point. Naphthalene is one example of this treatment. Naphthalene might be heated to a temperature above its melting point, which is about 176°F. Despite its fairly high ignition temperature (almost 980°F), it would not be unreasonable to surmise that a spill of liquid naphthalene could present a serious fire hazard. Fortunately, with naphthalene, quick action with adequate amounts of water applied as spray streams should cool and solidify it, thus greatly minimizing the fire risk.

It is important to note that a combustible liquid at or above its flash point will behave in the same manner that a flammable liquid would in a similar emergency. As an example No.2 fuel oil when heated to a temperature of 150°F can be expected to act or react in the same way gasoline would at 50°F. In most instances, however, to reach this elevated temperature will require the introduction of an external heat source. Some common examples of combustible petroleum liquids are given in Table 7.

Table 7. Examples of Petroleum Liquids That Are Combustible

Product	Flash Point (°F)
Kerosene	100+
Fuel Oils	100 - 140
Diesel Oil	130
Lubricating Oil	300
Asphalt	400

It is important to note that the extinguishing techniques, controlling actions, or fire-prevention activities implemented can differ greatly depending upon which of the two categories the liquid falls in. To have the ability to categorize a liquid correctly when it is not so identified, it is only necessary to know its flash point. By definition, the flash point of a liquid determines whether a liquid is flammable or combustible.

The categories of liquids are further subdivided into classes according to the flash point plus the boiling point of certain liquids. These divisions are summarized in Table 8, which shows that flammable liquids fall into Class 1, and combustible liquids into Classes 2 and 3. The products that are at the low end (100°F) of the Class 2 combustible-liquid group might be thought of as borderline cases. These could act very much like flammable liquids if atmospheric temperatures were in the same range. It is not a common industry practice to identify either stationary or portable (mobile) liquid containers by the class of liquid it contains. The usual practice is to label either "flammable" or "combustible" and include the required U.S. Department of Transportation placard.

Table 8. Classes of Flammable and Combustible Liquids

Class	Flash Point (°F)	Boiling Point (°F)
1	Below 100	—
1A	Below 73	Below 100
1B	Below 73	At or above 100
1C	73-99	—
2	100-139	—
3	140 or above	Below 100
3A	140-199	At or above 100
3B	200 or above	—

Basically, the flash point is the temperature a liquid must be at before it will provide the fuel vapor required for a fire to ignite. A more technical definition for flash point is: The lowest temperature a liquid may be at and still have the capability of liberating flammable vapors at a sufficient rate that, when united with the proper amounts of air, the air-fuel mixture will flash if a source of ignition is presented. The amounts of vapor being released at the exact flash-point temperature will not sustain the fire and, after flashing across the liquid surface, the flame will go out. It must be remembered that at the flash-point temperature, the liquid is releasing vapors and, as with other ordinary burnable materials, it is the vapors that burn. The burning process for both ordinary combustible solids and liquids requires the material to be vaporized. It may also be in the form of a very fine mist, which will be instantly vaporized if a source of heat is introduced. It is not the actual solid or the liquid that is burning, but the vapors being emitted from it. For this reason, when we speak of a fuel we are referring to the liberated vapor. It is an accepted phenomenon, assuming sufficient amounts of air to be present, that the greater the volume of released vapor, the larger the fire will be.

The technical literature sometimes refers to the "fire point", which in most instances is just a few degrees above the flash point temperature, and is the temperature the liquid must be before the released vapor is in sufficient quantity to continue to burn, once ignited. However, because a flash fire will normally ignite any Class "A" combustible present in the path of the flash, it is reasonable to accept the flash point as being the critical liquid temperature in assessing a fire hazard. Any of the other combustibles ignited by the flash fire, that is, wood, paper, cloth, etc., once burning, could then provide the additional heat necessary to bring the liquid to its fire point.

A crucial objective upon arrival of the first responding fire forces is to determine if the liquid present is a product that is vaporizing at the time or, if it is not, and what condition may be present that is capable of providing the required heat to cause the liquid to reach its flash point. This information would have a direct influence on the selection of control and/or extinguishing activities. An emergency involving a petroleum liquid, which is equal to or above flash point, means that a fuel source consisting of flammable vapors will be present. This, in turn, means the responding fire-fighting forces will be faced with either a highly hazardous vapor cloud condition or with a fire if ignition has occurred before arriving at the scene. Conversely, if it is a liquid at a temperature below its flash point, then fuel would not be immediately available to burn.

As explained earlier by the theories of fire, a source of air or more specifically, oxygen must be present. A reduction in the amount of available air to below ideal quantities causes the fire to diminish. Moreover, reduce the fuel quantity available and the fire will also diminish in size. Almost all extinguishing techniques developed are methods of denying the fire one or both of these requirements. By cooling a material below its flash point, vapor production is halted, thus removing the fuel from the fire. When utilizing a smothering-type extinguishing agent, the principle involved consists of altering the air-fuel mixture. When the vapor is no longer in its explosive range, the fire dies, either due to insufficient fuel or a lack of oxygen. The flash point tells us the conditions under which we can expect the fuel vapor to be created, but it is the explosive range which tells us that a certain mixture of fuel vapor and air is required for the vapor to become ignitable. The terms flammable limit and combustible limit are also used to describe the explosive range. These three terms have identical meanings and can be used interchangeably. In chapter 5 the reader can find a compilation of published data that lists the explosive ranges for the various flammable liquids and gases. This information is reported as the lower explosive limits (LEL) and the upper explosive limits (UEL). The values that are reported for the LEL and UEL are given as a percentage of the total volume of the air-fuel mixture. The area between the LEL and the UEL is what is known as the explosive range. The figures given for the amount of fuel vapor required to place a substance within its explosive range are shown as a percentage of the total air-fuel mixture. To compute how much air is required to achieve this mixture, subtract the listed percentage from 100 percent: the remainder will be the amount of air needed. Even though it is only the oxygen contained in the air that the fire consumes, flammable ranges are shown as air-fuel ratios because it is the air that is so readily available. Any air-fuel mixture in which the vapor is above the UEL, or any air-fuel mixture in which the vapor is below the LEL, will not burn. Using gasoline as an example, the explosive range can be computed as follows:

	LEL(%)	UEL (%)
Gasoline vapor	1.5	7.6
Air	98.5	92.4
Total volume	100	100

This example helps to illustrate that large volumes of air are required to burn gasoline vapors. The explosive ranges for the different grades of gasoline, or even those of most other petroleum liquids, are such that average explosive-range figures that are suitable for use by the fire fighter would be the LEL at 1 percent and the UEL at about 7 percent. The vapor content of a contaminated atmosphere may be determined through the use of a combustible gas-detecting instrument, referred to as an explosimeter.

If a fire involving a petroleum liquid does occur, an extinguishing technique that may be appropriate is the altering of the air-fuel mixture. One technique utilized will necessitate the use of an extinguishing agent such as a foam with the capability of restricting the air from uniting with the vapor. Another technique is to prevent the liquid from having the ability to generate vapor. Usually this is a cooling action and is accomplished with water spray streams. In both cases, extinguishment is accomplished as a result of altering the air-fuel mixture to a point below the LEL for the specific liquid.

We will now devote attention to the so-called ignition temperature. Consider the emergency situation where there is a spill of gasoline. We may immediately conclude that two of the requirements for a fire exist. First, the gasoline, which would be at a temperature above its flash point, will be releasing flammable vapors; thus a source of fuel will be present. Moreover, there is ample air available to unite with the fuel thus there is the potential for the mixture to be in its explosive range. The only remaining requirement needed to have a fire is a source of heat at or above the ignition temperature of gasoline. Technically speaking, all flammable vapors have an exact minimum temperature that has the capability of igniting the specific air-vapor mixture in question. This characteristic is referred to as the ignition temperature and could range from as low as 300°F for the vapor from certain naphthas to over 900°F for asphaltic material vapor. Gasoline vapor is about halfway between - at 600°F. A rule of thumb for the ignition temperature of petroleum-liquid vapors is 500°F. This figure may appear low for several of the hydrocarbon vapors, but it is higher than that of most ordinary combustibles, and is close enough to the actual ignition temperatures of the products most frequently present at emergency scenes to give a suitable margin of safety.

In emergency situations, it is best to take conservative approaches by assuming that all heat sources are of a temperature above the ignition temperature of whatever liquid may be present. This approach is not an overreaction when it is realized that almost all the normally encountered spark or heat sources are well above the ignition temperature of whatever petroleum liquid might be present. Among the more common sources of ignition would be smoking materials of any kind (cigarettes, cigars, etc.), motor vehicles, and equipment powered by internal combustion engines: also electrically operated tools or equipment, as well as open-flame devices such as torches and flares. The removal of any and all potential ignition sources from the area must be instituted immediately and methodically. The operation of any motor vehicle, including diesel-powered vehicles, must not be permitted within the immediate vicinity of either a leak or spill of a flammable liquid. The probability of a spark from one of the many possible sources on a motor vehicle is always present. Also, under no circumstances should motor vehicles be allowed to drive through a spill of a petroleum product.

Ignition sources are not necessarily an external source of heat; it could be the temperature of the liquid itself. Refineries and chemical plants frequently operate processing equipment that contains a liquid above its respective ignition temperature. Under normal operating conditions, when the involved liquid is totally contained within the equipment, no problems are presented because the container or piping is completely filled with either liquid or vapor. If full and totally enclosed, it means there can be no air present; thus an explosive or ignitable mixture cannot be formed. If the enclosed liquid which in certain stages of its processing may be above the required ignition temperature should be released to the atmosphere, there is a possibility that a vapor-air mixture could be formed and hence, ignition could occur. This type of ignition is referred to as auto-ignition. Auto-ignition is defined as the self-ignition of the vapors emitted by a liquid heated above its ignition temperature and that, when escaping into the atmosphere, enter into their explosive range. Some typical ignition temperatures for various petroleum liquids are 600°F for gasoline, 550°F for naphtha and petroleum ethers, 410°F for kerosine, and 725°F for methanol.

From the above discussions, the important elements that are responsible for a fire are:

- Fuel in the form of a vapor that is emitted when a liquid is at or above its flash point temperature.
- Air that must combine with the vapor in the correct amounts to place the mixture in the explosive range.
- Heat, which must be at least as hot as the ignition temperature, must then be introduced.

In addition to fuel, oxygen, and energy, the tetrahedron of fire theory identifies the chemical chain reaction of the flame as a requirement for a fire to sustain itself. The fourth side of the tetrahedron is the chain reaction, however, from a practical standpoint it does not appear to have a significant influence on normal fire-control practices. It is known that when using a dry chemical, extinguishment is achieved by the interruption of the chain reaction propagating the flame rather than by a smothering action, however this knowledge doesn't really alter the practical application of this technique to fire fighting.

Petroleum liquids have certain characteristics that can exert an influence on the behavior of the liquid and/or vapor that is causing the problem. For this reason, these features may have a bearing on the choice of control practices or extinguishing agents under consideration. These characteristics include the weight of the vapor, the weight of the liquid, and whether the liquid will mix readily with water. The specific properties of importance are vapor density, specific gravity, and water solubility. Before discussing these important physical properties, let's first examine the data in Table 9 which lists the flammability limits of some common gases and liquids. Two general conclusions can be drawn. First, the lower the material's LEL, obviously the more hazardous. Also note that there are some materials that have wide explosive ranges. This aspect is also significant from a fire standpoint. As an example, comparing hydrogen sulfide to benzene, although the LEL for H_2S is more than 3 times greater, its explosive range is 7 times wider. This would suggest that H_2S is an extremely hazardous material even though its LEL is relatively high. In fact, H_2S fires are generally so dangerous that the usual practice is to contain and allow burning to go to completion rather than to fight the fire.

Table 9. Limits of Flammability of Gases and Vapors, % in Air

Gas or Vapor	LEL	UEL
Hydrogen	4.00	75.0
Carbon monoxide	12.50	74.0
Ammonia	15.50	26.60
Hydrogen sulfide	4.30	45.50
Carbon disulfide	1.25	44.0
Methane	5.30	14.0
Ethane	3.00	12.5
Propane	2.20	9.5
Butane	1.90	8.5
Iso-butane	1.80	8.4
Pentane	1.50	7.80
Iso-pentane	1.40	7.6

Table 9 Continued

Gas or Vapor	LEL	UEL
Hexane	1.20	7.5
Heptane	1.20	6.7
Octane	1.00	3.20
Nonane	0.83	2.90
Decane	0.67	2.60
Dodecane	0.60	...
Tetradecane	0.50	...
Ethylene	3.1	32.0
Propylene	2.4	10.3
Butadiene	2.00	11.50
Butylene	1.98	9.65
Amylene	1.65	7.70
Acetylene	2.50	81.00
Allylene	1.74	...
Benzene	1.4	7.1
Toluene	1.27	6.75
Styrene	1.10	6.10
o-Xylene	1.00	6.00
Naphthalene	0.90	...
Anthracene	0.63	...
Cyclo-propane	2.40	10.4
Cyclo-hexene	1.22	4.81
Cyclo-hexane	1.30	8.0
Methyl cyclo-hexane	1.20	...
Gasoline-regular	1.40	7.50
Gasoline-73 octane	1.50	7.40
Gasoline-92 octane	1.50	7.60
Gasoline-100 octane	1.45	7.50
Naphtha	1.10	6.00

3.2.19 Estimating Lower Flammable Limits

The following discussion provides a plant caculation method for lower explosion limit concentrations for flare stacks or leaking valves that could ignite.

Explosivity limits for various pure components are given in Table 9. The limits of flammability (a concentration, C) for a mixture of gases can be computed from the following expression:

$$\frac{1}{C_L} = \frac{y_1}{C_{L1}} + \frac{y_2}{C_{L2}} + \dots + \frac{y_n}{C_n} \tag{1}$$

where: C_L = Lower explosive limit concentration of the mixture in air
y_1 = Mole fraction (or volume fraction) of component 1 in the mixture

y_n = Mole fraction of the nth component
C_{L1} = Lower explosive limit concentration of component 1 in air
C_n = Lower explosive limit of the nth component.

Equation 1 is accurate for mixtures of paraffinic gases or for mixtures of H_2, CO and CH_4. It is only approximate for mixtures of H_2 and C_2H_4, H_2 and C_2H_2, H_2S and CH_4 or CH_4 and $C_2H_2Cl_2$. It is even less accurate for mixtures of flammable gases with steam or inerts. Nevertheless, for the accuracy required here, this simple equation should be tried first in all cases. When dealing with a mixture of flammable gases and inerts, the simplest way to approximate C_L is to use the above equation with C_L taken to be equal for the inert components. This step treats the inerts as a simple diluent in an ideal mixture. It would give only a rough approximation for mixtures such as H_2 and H_2O vapor, where a component which is inert in the cold mixture nevertheless enters into the reactions taking place in the flame. In such cases, if a rough approximation of C_L is not good enough, then more accurate methods described below should be used.

Application of this procedure to inadvertently ignited safety valve discharges can involve a special problem. Certain combinations of pressure ratio and length of safety valve riser can result in choked flow, with a pressure discontinuity at the exit. The pressure of the jet then adjusts to atmospheric pressure in a system of shock waves or expansion waves over a distance of a few pipe diameters. These waves can affect the local mixing of the jet with the crosswind. Since the calculation procedure incorporates correlations for subsonic jets, it cannot be expected to be entirely accurate in this case. Nevertheless, since the wave system occupies a very small portion of the flow field influenced by the jet, the procedure can still be counted on to provide a useful approximation of the gross flame length and flame shape when the actual discharge velocity and diameter are used in the calculation.

Credit for additional height of the flame center for multiple valve installations may be taken by clustering the safety valve discharge pipes to the atmosphere. The following procedure should be used for determining equivalent diameter and exit velocity to be used in the flame center calculation. Diameter and velocity are based on the total actual area of the clustered vents.

For Equal Diameter Vents -

$$D_{jequ.} = \left[4 * (\textit{sum of vent areas}) / \pi\right]^{0.50} = d * n$$

$V_{jequ.}$ = actual velocity of any one vent.

For Unequal Diameter Vents :

$$D_{jequ.} = \left[4 * (\textit{sum of vent areas}) / \pi\right]^{0.50} = \sqrt{d_1^2 + d_2^2 + \dots + d_n^2}$$

$$U_{jequ} = \text{Total Gas Rate / Total Vent Area} = \frac{1.273 * 10^{-3} * Q}{(D_{jequ.})^2}$$

In the above expressions, the terms are defined as follows:

d, d_1, d_2, d_n = Diameter of individual vents, in meters
D_{jequ} = Equivalent vent diameter to be used in flame calculation, in meters
n = Number of vents in cluster ($n > 3$)
Q = Total gas rate of all valves, in dm^3/s at one atmosphere and the release temperature
$U_{jequ.}$ = Equivalent vent exit velocity to be used in flame calc., in m/s

Let's now turn attention back to the flammability limit itself. When small increments of a combustible gas are successively mixed with air, a concentration is finally attained in which a flame will propagate if a source of ignition is present. This is referred to as the Lower Flammable Limit (or lower explosion limit, LEL or LFL) of the gas in air. As further increments of the gas are added, a higher concentration of flammable gas in air will finally be attained in which a flame will fail to propagate. The concentration of gas and air just as this point is reached is referred to as the Upper Flammable Limit (UFL or upper explosion limit, UEL) of the gas in air.

Safety requires that only the most reliable experimentally determined flammable limit data be considered in purging calculations.

Below atmospheric pressure there is no effect on the limits of flammability of natural gas-air mixtures and most other gas-air mixtures. Below about 25 mm absolute pressure, carbon monoxide-air mixtures are not flammable.

From atmospheric pressure, up to 2170 kPa, the lower limit of flammability is not affected, but the upper limit rises as the pressure on the mixture is increased. This widens the limits of flammability as the pressure increases, as shown in Table 10. Above 2170 kPa the lower limit will be reduced.

It is necessary, in approaching most problems to obtain the limits of flammability of the particular gas mixture in question. Few industrial fuel gases are composed of pure gases or vapors, but are mixtures in most cases of many different gases. If the equipment and time are available, a number of mixtures of the fuel gas-air mixtures may be prepared and their flammabilities tested by ignition but it is much easier to determine the flammability limits of complex gas mixtures by calculation. Experience has shown that the results obtained are sufficiently dependable.

Table 10. Effect of Increase in Pressure on Raising the Upper Flammability Limit

Gage Pressure, kPa		0	500	1000	1500	2000	2500
Methane and Natural Gas	Approx.	15	17	20	25	31	42
Coke Oven Gas	Approx.	31	35	44	57	72	-
Multipliers*		1	1.2	1.5	2.0	2.6	3.7

* For estimating the upper limit of gases other then those given when the limits at 0 gage pressure are known, apply the multipliers indicated in the table to the present range in flammability, adding the new range to the lower limit at 0 gage pressure to find the new upper limit.

A calculation of the flammability limits of complex gas mixtures is carried out by the application of the mixture rule. Stated simply, the mixture rule is that if two limit mixtures of different gases are added together, the resulting mixture also will be a limit mixture. The mathematical statement of this law is as follows:

$$C_L = \frac{1}{\sum (y_1/C_{L2} + y_2/C_{L2} + y_3/C_{L3} + \cdots + y_n/C_n)} \qquad (2)$$

where y_1, y_2, y_3, etc., are the proportions of each combustible gas present in the original mixture, free from air and inerts so that $y_1 + y_2 + y_3, + \ldots y_n = 100$, and C_{L1}, C_{L2}, $C_{L3} \ldots C_{Ln}$, etc., are the lower limits of flammability of the mixture. A similar procedure would be applied to determine the upper limit of flammability.

An example of the application of this law is given for natural gas having the following composition:

Gas	% By Volume	%Gas in Air Lower Limit
Methane	80.0	5.00
Ethane	15.0	3.10
Propane	4.0	2.10
Butane	1.0	1.86

$$\text{Lower Limit} = \frac{100}{\frac{80.0}{5.00} + \frac{15.0}{3.10} + \frac{1.0}{1.86}} = 4.30\% \text{ Gas in Air}$$

Any oxygen contained in a mixture may be considered as though it were a part of the air required for the combustion, and the analysis of the flammable mixture should be converted to an air-free basis before the flammable limits are calculated.

When mixtures contain appreciable amounts of nitrogen and carbon dioxide, calculation of the flammability limits becomes more complicated and requires the use of an extension of the mixture rule. In this modified method, the inert gases are taken into consideration by assuming that the original mixture is composed of a number of submixtures of inert gas-combustible gas, the flammability limits of which have been experimentally determined in a similar manner as have the limits for the pure gases as given in Table 9. Figures 7, 8, and 9 provide the flammability limits of mixtures of some common gases present in fuels with CO_2, N_2 and H_2O.

An illustration of the application of this modified mixture rule is given in Table 11. In this example, a producer gas has the composition shown at the top of the table. The CO_2 and N_2 may be apportioned with the different combustibles in any of several ways, two of which are represented by calculations A and B in Table 11.

In these examples, the inerts CO_2 and N_2 are combined with the combustibles H_2 and CO and the small amount of CH_4 is taken alone. Next, the ratio of inert to combustible is obtained for each group and the flammable limits for each such mixture are obtained from Figure 9. The mixture rule formula is now applied, using the data as just obtained, and the limits are calculated as shown in Table 10.

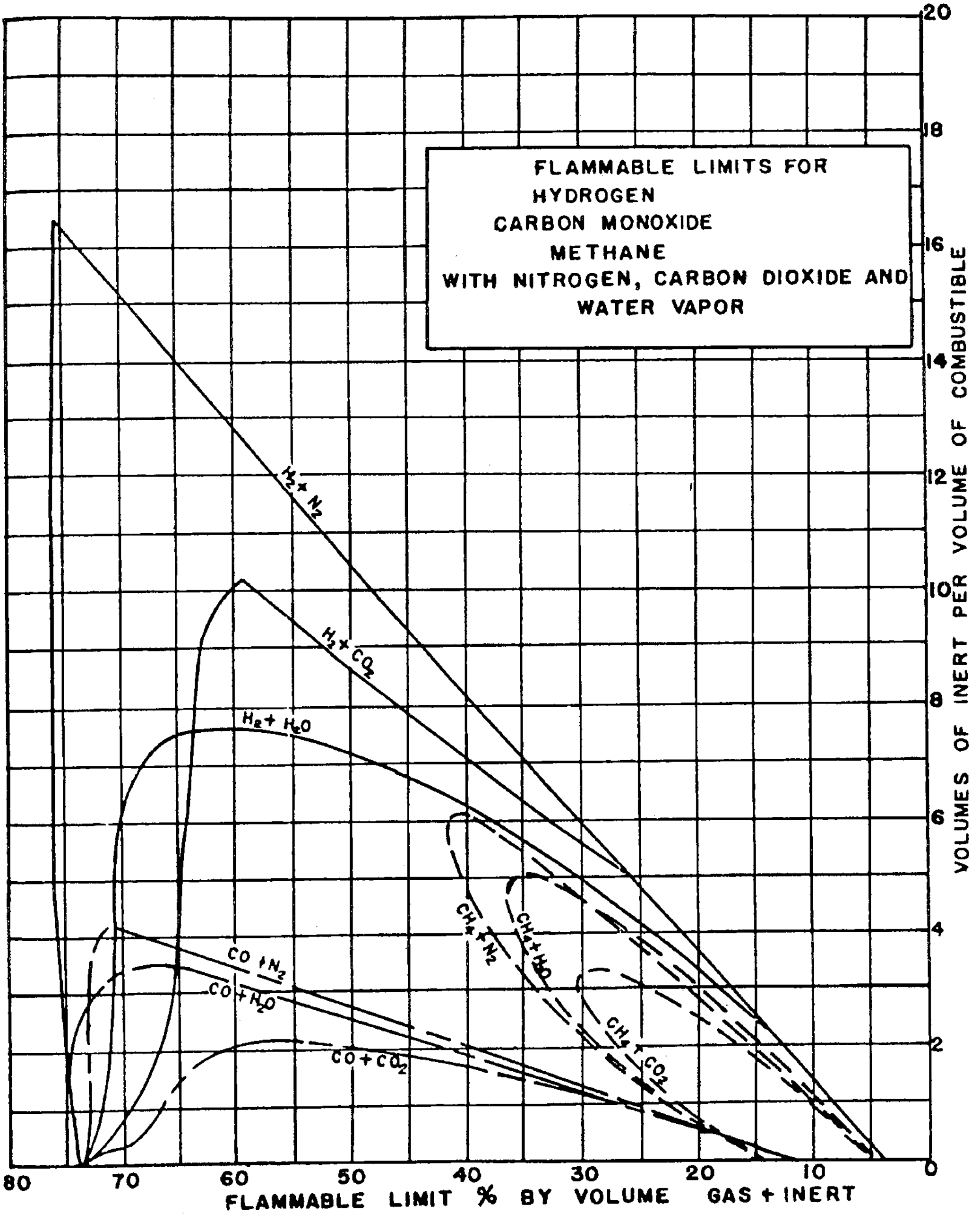


Figure 7. Flammable limits for hydrogen, carbon monoxide, methane, with nitrogen, carbon dioxide and water vapor.

The summary at the bottom of Table 10 indicates the relative agreement between the calculated data and that experimentally determined for this particular producer gas. It is suggested that the difference between calculated and determined data in this case may be due more to inaccuracies in the analysis of the producer gas (particularly for methane) than to the fault of the mixture rule formula. This points up the fact that reliable gas analyses also are a necessary part of the calculated flammability limit data.

3.2.20 Vapor Density

Vapor density is a measure of the relative weight of vapor compared to the weight of air. Published data on the characteristics of petroleum products usually include the vapor density. The value of unity has been arbitrarily assigned as the weight of air. Hence any vapor that is reported to have a density of greater than 1 is heavier than air, and any vapor with a density of less than 1 is lighter than air. Vapors weighing more than 1 will usually flow like water, and those weighing less will drift readily off into the surrounding atmosphere. Even heavier-than-air flammable petroleum-liquid vapor can be carried along with very slight air currents. It may spread long distances before becoming so diluted with enough air as to place it below the lower explosive limit (LEL), at which time it would become incapable of being ignited. There are catastrophic incidences that have occurred whereby ignitable air-vapor mixtures have been detected as far as one-half mile from the vapor source. For this reason, while responding to a spill or leak, we must consider environmental and topographical features of the surroundings, such as wind direction, the slope of the ground, any natural or artificial barriers that may channel the liquid or vapors. It is critical in a non-fire incident such as a spill or leak to determine the type of petroleum liquid present and its source. Information about the material's vapor density enables us to make reasonable predictions as to the possible behavior of the emitting vapor. These factors may influence the route of approach, the positioning of firefighting apparatus and personnel, the need for and the route of evacuation, and the boundaries of the potential problem area. It is essential that no apparatus or other motor vehicles or personnel be located in the path that a vapor cloud will most likely follow.

As a rule of thumb one should approach a hydrocarbon spill (non-fire situation) under the assumption that the liquid is vaporizing (the vapors will be invisible) and that the liberated vapors are heavier than air unless proven otherwise. The expected conduct of a heavier-than-air vapor is for it to drop and spread at or below ground level much as a liquid would. The big difference is that a liquid will be visible and its boundaries well defined. One can expect that the invisible heavier-than-air vapor will settle and collect in low spots such as ditches, basements, sewers, etc. As the vapor travels, it will be mixing with the air, thus some portions of the cloud may be too rich to burn, other sections too lean, and still others well within the explosive range. Some typical vapor densities for petroleum products are 3 to 4 for gasoline, 2.5 for naphtha, and 1.1 for methanol. For comparison, the vapor density for hydrogen gas is 0.1.

3.2.21 Specific Gravity

The property of specific gravity indicates a petroleum liquid's weight relative to the weight of an equal volume of water. The specific gravity of water is assigned the value of unity as a reference point. Hence, other liquids are evaluated relative to water; those lighter than water have a value less than unity, whereas those that are heavier have a value that is greater than unity. In general, petroleum products are lighter than water; as a result, they can be expected to float on and spread

THE CALCULATION OF FLAMMABLE LIMITS

Gas Analysis Gas Composition		Combinations Chosen	Total	Ratio Inert/Combustible	Flammable Limits (Fig. 1) Lower	Upper
H_2	12.4%	12.4 H_2 + 6.2 CO_2	18.6%	0.50	6.0	71.5
CO	27.3	27.3 CO + 53.4 N_2	80.7%	1.96	39.8	73.0
CH_4	0.7	0.7 CH_4	0.7%	0.00	·5.0	15.0
CO_2	6.2					
O_2	0.0					
N_2	53.4					

CALCULATION A

$$\text{Lower Limit} = \frac{100}{\frac{18.6}{6.0} + \frac{80.7}{39.8} + \frac{0.7}{5.0}} = 19.0$$

$$\text{Upper Limit} = \frac{100}{\frac{18.6}{71.5} + \frac{80.7}{73.0} + \frac{0.7}{15.0}} = 70.8$$

Gas Analysis	Combinations	Ratio	Lower	Upper
	12.4 H_2 + 53.4 N_2 - 65.8	4.31	22.0	76.0
	27.3 CO + 6.2 CO_2 - 33.5	0.23	15.0	71.0
	0.7 CH_4 - 0.7	0.7	5.0	15.0

CALCULATION B

$$\text{Lower Limit} = \frac{100}{\frac{65.8}{22.0} + \frac{33.5}{15.0} + \frac{0.7}{5.0}} = 18.7$$

$$\text{Upper Limit} = \frac{100}{\frac{65.8}{76.0} + \frac{33.5}{71.0} + \frac{0.7}{15.0}} = 71.9$$

Summary	Lower Limit		Upper Limit	
Determined	20.7	use 18.7	73.7	use 73.7
Calculation A	19.0		70.8	
Calculation B	18.7		71.9	

Table 10. The Calculation of Flammable Limits

over the water's surface. The exceptions to this are thick, viscous materials such as road tars and heavy "bunker" fuel.

With their low specific gravity, most petroleum liquids, if spilled onto a pool of water, have a tendency to spread quickly across the water's surface. Unless the fluid contacts an obstacle, the oil will continue to spread until it is of microscopic thickness. For this reason, a relatively small amount of oil floating on water is capable of covering a large area of the surface.In a spill situation, knowledge of the liquid's specific gravity can help determine which one of several tactics will be implemented to mitigate the spread of contamination or to eliminate a fire hazard. Knowing the specific gravity will help determine the following:

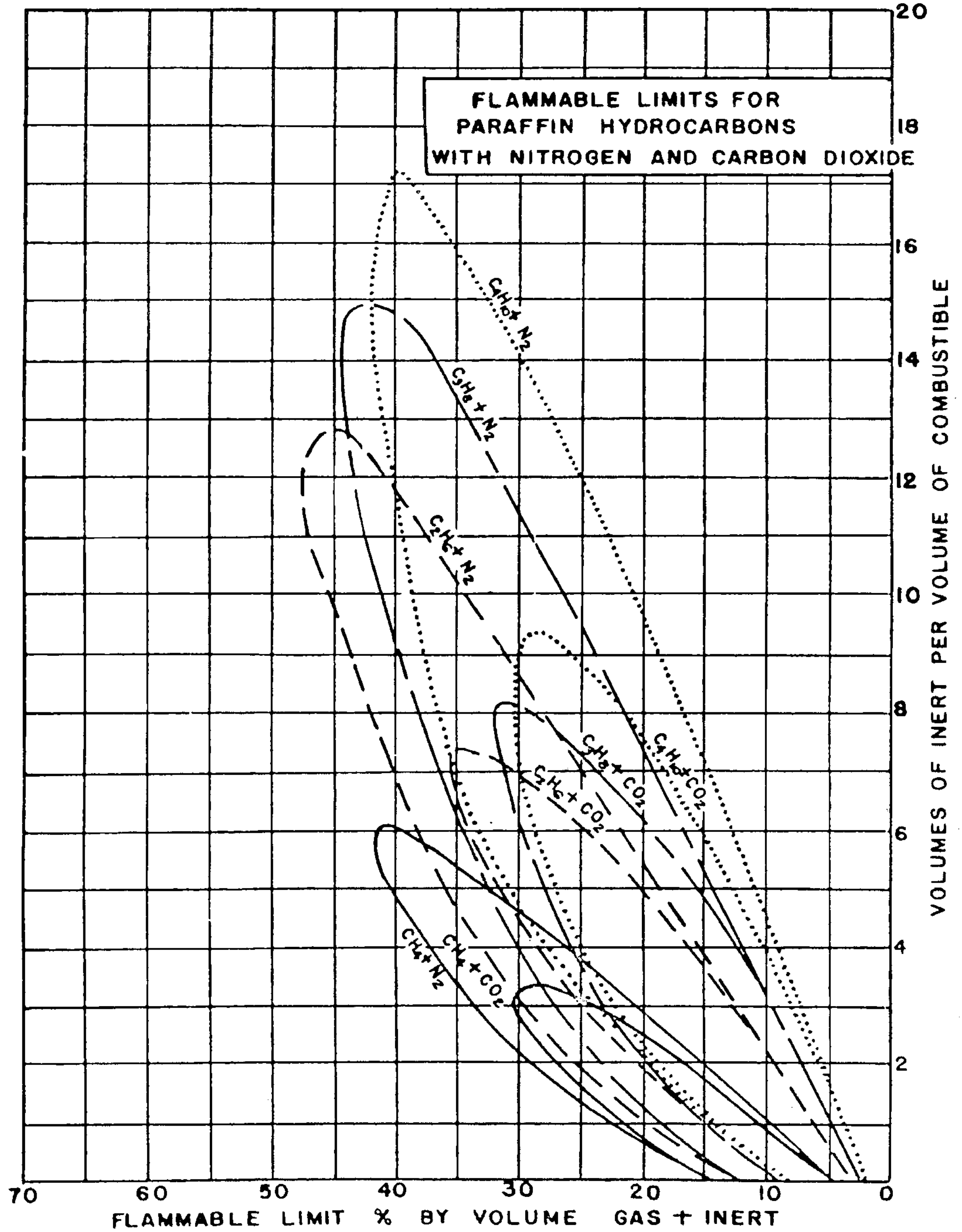


Figure 8. Flammable limits for paraffin hydrocarbons, with nitrogen and carbon dioxide.

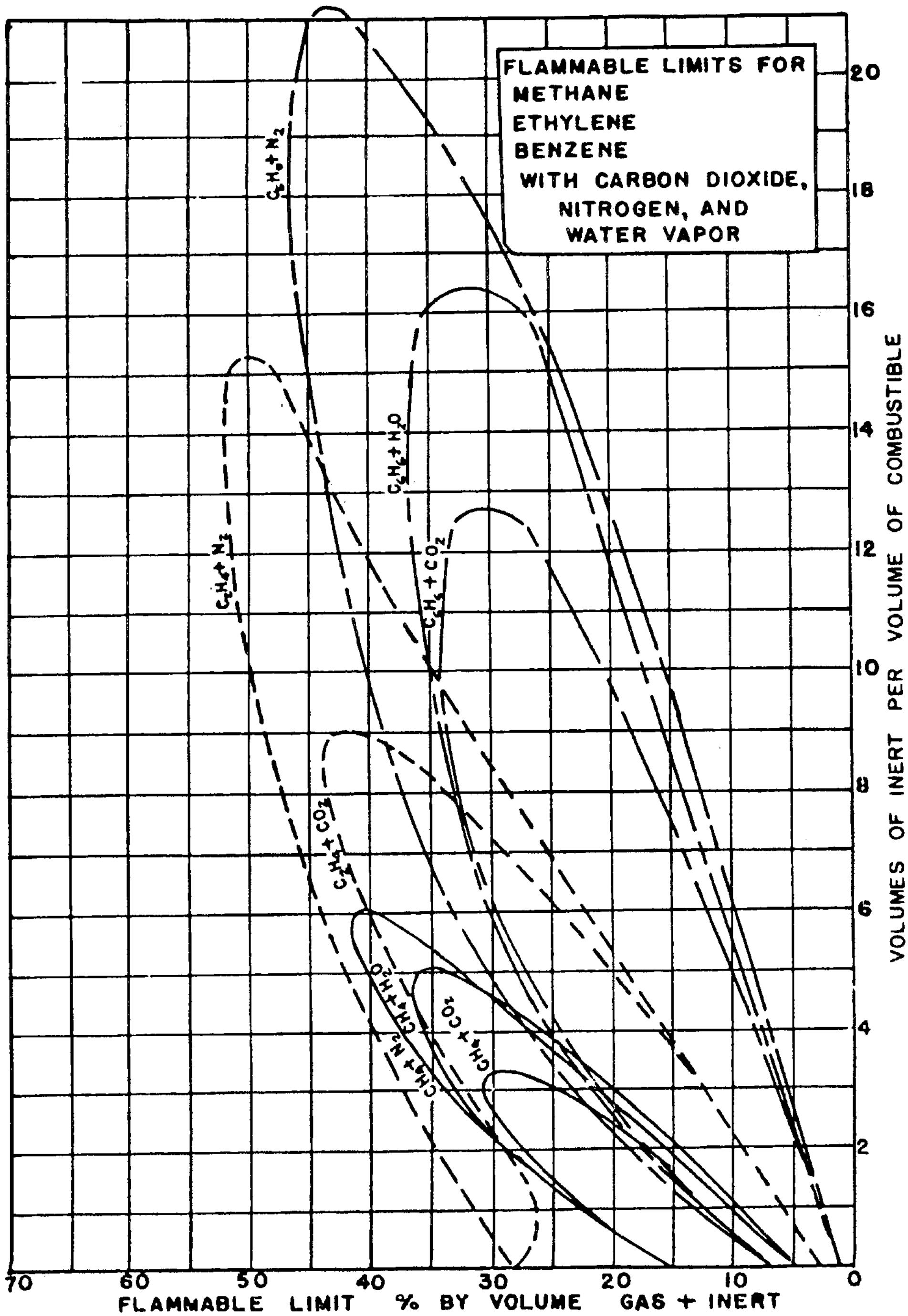


Figure 9. Flammable limits for methane, ethylene, benzene, with nitrogen, carbon dioxide and water vapor.

- If it will be possible to use only water, or must we apply a different agent for purposes of smothering the fire.
- How great the probability is that the burning liquid could result in the involvement of exposures because of it floating on any water that is applied.
- Can the displacement of the fuel by water be considered an effective technique to control a leak from a container.

Some specific gravities of common petroleum liquids are 1 to 1.1 for asphalt, 0.8 for gasoline, and 0.6 for naphtha.

3.2.22 Water Solubility

Another important property of petroleum liquids is water solubility, which may be described as the ability of a liquid to mix with water. Since most petroleum products are lighter than water, and even if they are well mixed with water, they will separate into a layer of water and a layer of the hydrocarbon. Exceptions to this are polar solvents such as methanol and other alcohols. These types of materials will readily mix with water and can even become diluted by it.

Information on solubility is important in an emergency situation because a petroleum fire will require the application of a regular-type foam or an alcohol-resistant-type foam for extinguishment or for vapor-suppression purposes. For use on a water-soluble liquid, a good-quality alcohol-resistant foam is generally applied.

3.2.23 Responding to Fires

In an emergency situation involving a flammable petroleum liquid, the product can be expected to behave as follows:

- When accidentally released from its container it almost always results in a fire response.
- If a fire does occur, flammable liquids prove to be virtually impossible to extinguish by cooling with water.
- If the liquid is contained, the confined space will consist of a vapor-rich mixture.
- After extinguishment, there is still the strong possibility for a reflash owing to the continued production of vapor.

It is important to remember that during an emergency the escaping flammable liquids are low-flash products and, as a result, are releasing vapor at the usual atmospheric temperatures. These materials are, therefore, very susceptible to ignition. Because of this, they are generally encountered as an event requiring fire-control procedures. Also, for the same reasons, and the frequent need for large quantities of chemical extinguishing agents, they can present difficult extinguishment problems. The fact that the temperature at which many flammable liquids release vapor is well below the temperature of the water that is being used for fire-control purposes means that extinguishment by the cooling method is not feasible. This does not mean water cannot be used. In fact, the use of water serves an important function in spite of its limitations. However, to obtain extinguishment other tactics utilizing a different agent and techniques are needed. Exactly what agent and what technique will be dictated by the size of the fire, the type of storage container or processing equipment involved, and the fire-fighting resources that are available. When dealing with a low flash point flammable liquid, the probability of a reflash occurring after initial extinguishment is achieved is a high probability.

The probability of an ignitable air-fuel mixture existing inside a closed storage container of a flammable liquid is normally low. Flammable liquids have the capacity of generating vapor below the commonly encountered atmospheric temperatures; thus, the space between the tank top and the liquid surface will most usually contain a vapor-rich atmosphere (i.e., conditions will be above the UEL). As the vapor being liberated drives the air from the container, the vapor-rich mixture being above the UEL cannot be ignited; moreover, if a fire should occur outside the tank or vessel, it will not propagate a flame back into the tank. The major exceptions would be those instances where the product had a flash point temperature about the same as the prevailing atmospheric temperature. Another example would be when a tank containing a low vapor pressure product with a flash point in the same range as the prevailing atmospheric temperature is suddenly cooled. A thunderstorm accompanied by a downpour of rain could cause the tank to breathe in air if the liquid is cooled below the temperature at which it is capable of emitting vapor (the boiling point).

In contrast to flammable liquids, an emergency situation that involves a combustible liquid will have a much different behavior. The expected behavior of a combustible product would be for:

- the liquid to present no significant vapor problem,
- a fire to be readily extinguished by cooling the liquid with water,
- the atmosphere above the liquid level to be below the LEL of any confined product.

Most combustible liquids do not present a vapor problem if accidentally released into the atmosphere. The probability of a fire, therefore, is considerably less than it would be if the spill was of a flammable material. If, however, the combustible liquid is at a temperature higher than its flash point, then it can be expected to behave in the identical manner a flammable liquid. One major difference between the two in a fire situation is that the potential exists for cooling the combustible liquid below its flash point by the proper application of water (generally applied in the form of water spray). In the event the liquid is burning, and if the fire forces are successful in achieving the required reduction in liquid temperature, then vapor production will cease and the fire will be extinguished because of a lack of vapor fuel. Unless this reduction in liquid temperature can be brought about, the fire will necessitate the same control considerations a low-flash liquid fire would.

With a fire in a storage tank containing a combustible liquid, normally the application of a foam blanket is the only practical method to achieve extinguishment. This is normally done when the entire exposed surface is burning and is necessitated by the fact that the sheer size of the fire makes it very difficult to apply water spray in the amounts and at the locations needed. Also, the volume of oil that has become heated is such that the large quantities of water needed to cool the liquid would introduce the possibility of overflowing the tank. Another problem is that the water requirements for both protecting exposures and attempting extinguishment might be far greater than what is available. These factors alone would cause the emergency forces to treat all refined product tank fires alike and, regardless of the flash point of the liquid, initiate the required steps to apply a foam blanket to the liquid surface. In addition there is always concern for any reaction the water may cause when contacting an oil or hydrocarbon heated above the boiling point of water (212°F). In general, because a spill is generally shallow, spilled or splashed combustible liquids do not present the type of problems that a large storage tank does. It is reasonable to expect to be able to extinguish shallow pools or surface spills with water spray.

In the case of a storage tank with a combustible product, the atmosphere inside the container will normally consist of air. On occasion, there will be detectable odors such as that associated with fuel oil. These odors, which are a good indicator of the presence of a combustible product, are not considered fuel vapor. During a fire situation, flame impingement or radiant heat on a container could cause the liquid to become heated to the temperature at which it would emit vapors. Should this occur, and the vapors being generated then start to mix with the air already in the tank, at some instant the space in the container would then contain a mixture that was within the explosive range of the product; if ignition occurred, a forceful internal explosion could result.

The case of crude oil is somewhat unique compared to fires with refined petroleum products. Burning crude oil has the capability of developing a "heat wave". Crude oil has a composition of different fractions of petroleum products. In a manner similar to a refinery operation which distills, or heats crude oil to separate it into the various usable products - such as gasoline and asphalt, a fire accomplishes the same effect. As crude oil burns it releases the fractions that have lower flash points first, and these are burned. The heavier fractions sink down into the heated oil. This movement of light fractions up to the fire and heavier, heated fractions down into the crude produces the phenomenon known as a heat wave. Crude oil has the same basic characteristics as other flammable liquids. There are different grades of crude oil produced from various geographic locations throughout the world, with some crudes having more heavy-asphalttype material than others. Some have greater quantities of sulfur (creating the problem of poisonous hydrogen sulfide gas generation during a fire) and still others more light, gaseous fractions; however, a common characteristic among them is that all will have varying amounts of impurities and some entrained water.

When liquids of this type burn, creating a heat wave which is comprised of the higher boiling point components plus whatever impurities may be present in the product, radiant heat from the flame heats the liquid surface, the light products boil-off, thus creating the vapor that is burning. The remaining hot, heavier materials transfer their heat down into the oil. As it is formed, this heat wave, or layer of heated crude oil components, can reach temperatures as high as 600°F and spread downward at a rate of from 12 to 18 inches per hour faster than the burn-off rate of the crude oil. This would mean that with a crude oil burn-off of 1 foot per hour, at the end of two hours the heat wave would be somewhere between 24 and 36 inches thick. Once this heat wave is created, the chances of extinguishing a crude-oil tank fire, unless it is of small size, are poor, and any water or foam applied could result in a "slopover" of burning oil.

As noted earlier, crude oil normal contains some entrained water and/or an emulsion layer of water and oil. In addition, crude-oil storage tanks will have some accumulations of water on the uneven tank bottoms. In a fire, when a heat wave is formed and comes in contact with any water, a steam explosion will occur, thus agitating the hot oil above it with great force. The evolution of the steam explosion can be attributed to the reaction of water to high temperatures. When water is heated to its boiling point of 212°F, water vapor or steam is generated. Steam that is produced expands approximately 1700 times in volume over the volume of the water that boils away. If a heat wave of a temperature well above 212°F contacts any water entrained in the oil, or some of the bottom water, which is usually in larger quantities, the instantaneous generation of steam will act like a piston, causing the oil to be flung upward with considerable violence and force. This reaction is so strong that it causes the oil to overflow the tank shell. This sudden eruption is known as a boilover. When the hot oil and steam reaction takes place, the oil is made frothy, which in turn further increases its volume. The reaction resulting from the heat wave contacting entrained water can be expected to be of lesser activity than from contact with bottom water. The reason for this difference is that the quantities of water converted to steam in a given spot are usually less.

Another phenomenon associated with a crude oil fire is slopover. Basically, the same principles that are responsible for a boilover are the cause of a slopover. The fundamental difference is that in a slopover the reaction is from water that has entered the tank since the start of the fire. Usually this introduction is the result of firefighting activities. A slopover will occur at some point after the heat wave has been formed. Either the water from the hose streams or, after the bubbles collapse, the water in the foam will sink into the oil, contacting the heat wave, where it is converted to steam, and the agitation of the liquid surface spills some amount of oil over the tank rim.

The proper extinguishing agents suitable for petroleumliquid emergencies must be capable of performing the identical functions as those agents used in the combating of structural-type fires. There will be times when circumstances dictate the use of a cooling agent, whereas at other times it will be a smothering agent, and on some occasions, both agents will be necessary. There are a variety of agents capable of accomplishing each of these objectives, as well as being appropriate to combat Class B-type fires. Agents suitable for use on Class B-type fires include halon, carbon dioxide (CO_2), dry chemicals, foam, and aqueous film forming foam. A brief description of the major types of fire fighting agents is given below.

Water - Regardless whether it is a spill or a fire, or whether it involves a flammable or a combustible liquid, water is almost invariably required. Water can be used for the dissipation of vapors, for the cooling of exposed equipment, for the protection of personnel, for control purposes, and, for actual extinguishment. For the cooling down of exposed equipment such as pipelines, pumps, or valves, it is recommended that water be applied at the minimum flow rate of 1 gallon per minute per 10 square feet of exposed surface area. Some general guidelines to consider when applying water are as follows:

- All areas of any piping, containers, etc., that are exposed to the fire's heat or flame should be kept wetted during the course of the fire.
- The use of water streams to push and move the burning liquid away from exposed equipment is recommended provided that it can be done safely.
- The rate of flow from any hose stream should not be less than 100 gal/min regardless of its purpose.
- The use of spray streams is recommended whenever possible.
- Back-up lines for lines in active service should be provided and they should be at least of the same capacity as the attack line.
- Any equipment being protected is cool enough if water applied to it no longer turns to steam.

With storage tanks or processing equipment exposed to fire or radiant heat, the cooling of any metal above the liquid level inside the vessel is critical. Metal surfaces that have a constant film of water flowing over them will not reach a surface temperature above the boiling point of water. This temperature is well below that which would subject the metal to loss of integrity because of softening.

Water flows employed to cool exposed vertical storage tanks can be calculated using as a requirement one hose line (flowing 200 gal/min) per 10 feet of tank diameter. Assuming an average tank height of 50 feet, this would give a water flow capability in excess of the recommended rate. On the fire ground, wind conditions, personnel deficiencies (fatigue, lack of experience or training, etc.), stream feathering, and so forth have historically resulted in not all the water that is flowing actually doing its intended function. The rule of thumb of one line flowing a minimum of 200 gal/min for each 10 feet of tank diameter provides a suitable safety margin to overcome the loss of water not reaching its target. This flow is only required on the side or sides of the tank being heated; therefore, if a 100-foot-diameter tank is receiving heat on just one-half of its circumference, it would require five hose streams of 200 gal/min, each applied to the heated area for cooling purposes. It must be anticipated that these minimum flows will need to be maintained for a time period of at least 60 minutes. Tank truck incidents in which the fire burned for several hours are not unusual. It should be appreciated that a relatively minor fire on a tank truck or rail car could require in excess of 20,000 gallons of water for control and/or extinguishment. It is imperative that as early into the event as possible, an accurate assessment of water flow requirements should be made and flow rates adjusted accordingly. First responders must be constantly alert for any indication of an increase in the internal pressure of a container. Such an increase or any visible outward distortion of the tank shell would be an indication that additional water flows are required. These warning signs, which would be an indication of increased internal pressures, could justify the immediate use of unmanned monitors or hoseholders, larger size nozzles, and the pulling back of all personnel to a safe location.

In preparing emergency response plans for petroleum liquid spills or fires, it should be taken into consideration that the required water rates could be needed for long periods of time. Built into the plans must be provisions for an uninterrupted supply at a suitable volume. The rates stipulated in the foregoing do not include amounts of water that may be needed for the protection of fire-fighting personnel who are involved in activities such as rescue work or valve closing and block off operations. If these or other water-consuming activities are required, additional water must be provided. Of equal importance to the amount of water being used is that water be used in the right place. In general, the application of water should have as its objective one or more of the following goals:

- The cooling of the shell of any container that is being subjected to high heat levels. This is most effectively accomplished by applying the water to the uppermost portions of the container and allowing it to cascade down the sides.
- The cooling of any piece of closed-in equipment containing a liquid or gas and exposed to high heat levels. This is most effectively accomplished by applying the water spray over the entire area being heated.
- The protection of any part of a container, piping, or item of processing equipment receiving direct flame contact. This is most effectively accomplished with a very narrow spray pattern or even a straight stream directed at the point of flame contact.
- The cooling of steel supports of any container or pipe rack that may be subjected to high heat levels. This is most effectively accomplished by the application of narrow spray streams to the highest part of the support being heated and permitting the water to run down the vertical length of the support.

Foam - The application of a foam blanket is the only means available to the fire forces for the extinguishment of large petroleum storage tank fires. The foam blanket extinguishes by preventing vapor, rising from the liquid surface, from uniting with the surrounding air and forming a flammable mixture. Although the water in a foam does provide some incidental cooling action, this is considered of more importance for cooling heated metal parts, thus reducing the possibility of re-ignition, than as an extinguishing factor. A good-quality foam blanket of several inches in thickness has also been proved effective as a vapor suppressant on low flash-point liquids. Foam may also be used to suppress vapor, hence the layer of foam will be instrumental both in preventing ignition and reducing the contamination of the surrounding atmosphere. Since foam is still water, even if in a different form from that usually used, it may conduct electricity: consequently, its use on live electrical equipment is not recommended.

There are basically two methods of foam application to fires. The first involves the application of chemical foam, which is generated from the reaction of a powder with water. This type of foam has been replaced largely by a technique that involves the formation of foam bubbles when a foaming agent and water are expanded by the mechanical introduction of air. This type, which is not a chemical reaction, is referred to as mechanical foam. Another name for the same material is air-foam. There are a variety of foam concentrates designed to fit different hazards. These include regular protein-based foams, fluoroprotein foams, aqueous film forming types, alcohol-resistant types, as well as foams that are compatible with dry chemical powders and those that will not freeze at below-zero temperatures. Of the many types, the most suitable for general all-around petroleum the use would be either a good-quality fluoroprotein or a good-quality aqueous film forming foam (AFFF). Foam liquids are also available in a wide range of concentrates, from 1 percent to 10 percent. The 3 percent and 6 percent protein and fluoroprotein types are usually employed as low-expansion agents with an expansion ratio of about 8 to 1. That is, for each 100 gallons of foam solution (water/concentrate mix) to which air is properly introduced, it will then develop approximately 800 gallons of finished foam. Foam concentrates of other than 3 percent or 6 percent generally are either high-expansion (as high as 1,000 to 1) or alcohol-resistant types.

In foam applications, the manufacturer will provide a percentage rating of a concentrate, which identifies the quantity of concentrate required to be added to water to achieve a correct solution mixture. For each 100 gallons of solution flowing, a concentrate rated as 3 percent would mean 3 gallons of concentrate per 97 gallons of water, whereas a 6 percent concentrate would mix with 94 gallons of water. This readily explains why only half as much space is required to store or transport the amount of 3 percent concentrate needed to generate a given quantity of foam than would be needed for a 6 percent concentrate to make the same volume of foam.

Once the application of foam is initiated, it must be applied as gently as possible in order to develop a good vapor-tight blanket on the liquid surface. Any agitation of the foam blanket or of the burning liquid surface will serve to prolong the operation and to waste foam supplies. Water streams cannot be directed into the foam blanket or across the foam streams because the water will dilute and break down the foam. To be assured that all metal surfaces are cool enough and a good, thick (4 inches or more) blanket of foam has been applied, continue application for a minimum of five minutes after all visible fire is extinguished.

As noted earlier, one of the agents considered suitable for the extinguishment of petroleum-liquid fires is aqueous film forming foam. This is a liquid concentrate that contains a fluorocarbon surfactant to help float and spread the film across the petroleum-liquid surface and is commonly referred to as "A Triple F". AFFF concentrates of 1, 3, or 6 percent are available, all with about an eight to one expansion ratio. This material is one of the mechanical-type foaming agents. The same kind of air-aspirating nozzles and proportioners that are used for protein-based foams are usable with AFFF concentrates. The primary advantage of AFFF over other foaming agents is its ability to form a thin aqueous film that travels ahead of the usual foam bubbles. This film has the ability to flow rapidly across the burning liquid surface, thus extinguishing the fire by excluding the air as it moves across the surface. The regular foam bubbles formed and flowing behind the film have good securing qualities, which serve to prevent reflashing from occurring. As with all types of foams, care must be exercised that the foam blanket, once formed, is not disturbed. Water streams should not be directed into the foam blanket or onto the same target a foam stream is aimed at. Water will dilute the foam below the needed concentration and, simultaneously, the force of the stream will destroy the foam's blanketing effect. The blanket must be maintained until all flames are extinguished, all heated metal surfaces cooled, and other sources of ignition removed from the vicinity.

Alcohol-Resistant Foams - Foams that are suitable for water-soluble polar solvents are formulated to produce a bubble that is stable in those fuels and tends to mix and unite with water. Fuels of this type dissolve the water contained in regular foam very rapidly resulting in the collapse of the bubbles. The breakdown is so fast and complete with regular protein or fluoroprotein based foams that unless the rate at which the foam is being applied is well above the recommended rate, the blanket will not form at all. Alcohol-type foam concentrates are most commonly available at strengths of 3 percent, 6 percent, or 10 percent. Because of the possibility of breakdown, regular foams are not considered suitable for polar solvent-type fires. The exception would be a fire in a container of fairly small diameter or a shallow spill, either of which would allow for the possibility of applying foam at sufficient rates to the point of overwhelming the fire.

High-Expansion Foams - High-expansion foam includes foaming agents with the expansion ratio between the solution and the foam bubbles of from 20 to 1 to as high as 1,000 to 1. This agent has been found suitable when combating certain types of Class A and Class B fires. Originally developed to help fight fires inside mines, it is most effective when used in confined areas. Extinguishment is accomplished both by the smothering action of the foam blanket and the cooling action obtained from the water as the bubbles break down. Light, fluffy bubbles break apart and are easily dispersed by even relatively moderate wind currents. Bubbles formed at ratios greater than about 400 to 1 are most likely to be adversely affected by regular air movement as well as the thermal updrafts created by the fire. In an effort to overcome the susceptibility of the bubbles to wind currents, medium expansion foams have been introduced, which have expansion ratios ranging from about 20:1 to 200:1. High-expansion foam concentrates require special foam generators both for proportioning the liquid with water, and aspirating the mixture. Many high-expansion foam-dispensing devices have a discharge range of only a few feet; thus, they must be operated fairly close to the area being blanketed.

Other Extinguishing Agents - Other extinguishing agents that are suitable for use on fires involving petroleum liquids include dry chemical powders, carbon dioxide gas, and halon gases. Each of these agents, while being capable of extinguishing Class B fires, usually is available in either hand-held extinguishers or the larger wheeled or trailer-mounted portable units.

In some petroleum refineries or chemical plants, an on-site fire brigade that is equipped with an apparatus capable of dispensing large volumes of dry chemical, or a vehicle with a large-capacity carbon dioxide (CO_2) cylinder is common practice.

3.3 CHEMISTRY OF HAZARDOUS MATERIALS

The reader should note that there are a number of important terms that should be noted when dealing with hazardous materials. These terms include important properties of general classes of chemicals and of a few commonly used industrial chemicals. This section will attempt to familiarize the reader with the main points. This section is not intended for practicing industrial chemists, nor is it intended as anything other than a refresher for those with strong backgrounds in chemistry. It is intended to provide a brief introduction to chemistry for the safety manager who must, as a part of his responsibilities, deal with hazardous materials issues.

3.3.1 Chemical Properties

All chemicals, including hazardous ones, are commonly described in terms of their physical, chemical, and biological properties. To use this information fully, it is necessary to understand the meaning and importance of the various individual properties, and also to have some grasp of the significance of the various numerical values within the context of chemicals at large. These properties can then be used along with other information to predict the likely behavior of hazardous chemicals, and to recognize and avoid potentially dangerous situations. The first step is to define and comment on several of the more critical properties that are useful in the handling of hazardous materials. Some basic terminology are listed in Table 11.

Physical State at 20°C — the physical nature of the chemical (solid, liquid, or gas) at 20°C (i.e., room temperature). Changing the temperature may alter the physical state, depending on the magnitude and direction of the change relative to the melting and boiling points of the chemical.

Table 11. List of Commonly Measured Physical/Chemical Properties

Color	BOD_5
Odor	ThOD
Physical state at 20°C	Fire point
Molecular weight (MW)	Auto-ignition temperature
Chemical formula	Flashpoint
Melting point (MP)	Explosive limits
Boiling point (BP)	Heat content
Vapor pressure (VP)	Threshold limit value (TLV)
Density	Specific gravity (SG)
Vapor density (VD)	Solubility (water;
Octanol/water partition	other solvents)
coefficient (K_{ow})	

Boiling Point (BP) — the temperature at which a liquid changes to gas under standard atmospheric pressure (760 mm mercury). The BP of water is 100°C, while the BPs of ethyl alcohol and n-hexane are 78.4°C and 68.7°C, respectively. Lowering the atmospheric pressure (e.g., by applying a vacuum) will lower the BP; conversely, higher pressures result in elevated boiling points.

Melting Point (MP) — the temperature at which a solid changes to a liquid. The melting point is not particularly sensitive to atmospheric pressure, but it is responsive to dissolved salts which depress the melting point. Thus, in winter, it is usual to salt sidewalks to keep water from freezing.

Vapor Pressure (VP) — the pressure exerted by the vapor in equilibrium with its liquid at a given temperature. Vapor pressure is a measure of the relative volatility of chemicals. Liquids with high vapor pressures generally represent a greater fire hazard than those with lower vapor pressures. For a given liquid the vapor pressure increases with increasing temperature. Consequently, drummed materials with high vapor pressures in particular should not be stored in direct sunlight, as overheating of the materials and resultant increases in vapor pressures could result in "pregnant" drums with failed or weakened seams. When used with solubility data, vapor pressure values can be used to predict the rate of evaporation of dissolved solvents from water. At 20°C, water, ethanol, and benzene exert vapor pressures of 17.5, 43.9, and 74 mm of mercury, respectively.

Vapor Density (VD) — the mass per unit volume of a given vapor/gas relative to that of air. Thus, acetaldehyde with a vapor density of 1.5 is heavier than air and will accumulate in low spots, while acetylene with a vapor density of 0.9 is lighter than air and will rise and disperse. Heavy vapors present a particular hazard because of the way they accumulate: if toxic they may poison workers; if nontoxic they may displace air and cause suffocation by oxygen deficiency; if flammable, once presented with an ignition source, they represent a fire or explosion hazard. Gases heavier than air include carbon dioxide, chlorine, hydrogen sulfide, and sulfur dioxide.

Density — the mass per unit volume of any substance, including liquids. The density of a liquid determines whether a spilled material that is insoluble in or immiscible with water will sink or float on water. Knowledge of this behavior is essential in checking whether to use water to suppress a fire involving the material.

Specific Gravity (SG) — the ratio of the density of a liquid as compared with that of water. Insoluble materials will sink or float in water depending on the SG. Materials heavier than water have SGs >1, and materials lighter than water have SGs <1. Thus, lead, mercury, and carbon tetrachloride with SGs of 11.3, 13.6, and 1.6, respectively, will sink, whereas gasoline with a SG of 0.66 to 0.69, will float on water. This is an important property to know when a material has spilled, particularly in a water body.

Solubility — the amount of a given substance (the solute) that dissolves in a unit volume of a liquid (the solvent). This property is of importance in the handling and recovery of spilled hazardous materials. Water-insoluble chemicals are much easier to recover from water than spills of water-soluble chemicals. Acetone, which is miscible/soluble in water in all proportions, is not readily recoverable from water. In contrast, benzene, which is lighter than water and insoluble as well, can be readily trapped with a skimmer. For organic compounds, solubility tends to decrease with increasing molecular weight and chlorine content.

Flashpoint — the lowest temperature of a liquid at which it gives off enough vapor to form an ignitable mixture with air near the surface of the liquid within the vessel used. Two tests are used—Open Cup and Closed Cup. Generally, the Open Cup method results in flashpoints 5° to 10° higher than the Closed Cup method. Flashpoint <140°F (Closed Cup) is the criterion used by EPA to decide whether a chemical is hazardous by ignitability. DOT defines materials with flashpoints of <100°F as flammable materials, and between 100° and 200°F as combustible.

Fire Point — the temperature at which a liquid gives off enough vapor to continue to burn when ignited.

Auto-Ignition Temperature — the temperature at which ignition occurs without an ignition source and the material continues to burn without further heat input.

Flammable or Explosive Limits — the upper and lower vapor concentrations at which a mixture will burn or explode. The lower explosive limit of p-xylene is 1.1 percent by volume in air, whereas the upper explosive limit is 7.0 percent in air. A mixture of p-xylene vapor and air having a concentration of <1.1 percent in air is too lean in p-xylene vapor to burn. Conversely, a mixture containing more than 7.0 percent is too rich in p-xylene to burn. By subtraction (7.0 - 1.1), p-xylene is said to have a flammable range of 5.9. Materials having low explosive limits and wide flammable ranges are extremely dangerous.

Heat Content — the heat released by complete combustion of a unit weight of material. Methane has a heat content of about 21,500 Btu/lb while benzene contains about 17,250 Btu/lb.

Octanol/Water Partition Coefficient (K_{ow}) — the equilibrium ratio of the concentrations of material partitioned between octanol and water. This coefficient is considered to be an index of the potential of a chemical to be bioaccumulated. Higher values of K_{ow}, are associated with greater bioaccumulative potential.

Biochemical Oxygen Demand at Five Days (BOD_5) — the quantity of oxygen required by microbes for the oxidative breakdown of a given waste material during a 5-day test period. BOD_5 is usually taken as an index of the ultimate oxygen demand (i.e., oxygen required when sufficient time is allowed to achieve maximum microbial decomposition). BOD_5 is used to predict the impact of a spill or release of material on the oxygen content of a body of water.

Theoretical Oxygen Demand (ThOD) — the cumulative amount of oxygen needed to completely oxidize a given material. The ThOD is the upper limit for BOD_5 values, although it is seldom achieved. A comparison of the BOD_5 and ThOD values for a given chemical provides an indication of the biodegradability of that chemical.

Threshold Limit Value (TLV) — the exposure level under which most people can work for eight hours a day, day after day, with no harmful effects. A table of these values and accompanying precautions for most common industrial materials is published annually by the American Conference of Governmental Industrial Hygienists (ACGIH). TLV values for specific chemicals can be found in this handbook.

pK_a — the negative logarithm of the equilibrium constant for acids or bases. This parameter is an indicator of the strength of an acid or base. Strong acids, such as H_2SO_4, and HCl, have low pK_a's (i.e., ~1.0) while strong bases such as KOH and NaOH, have pK_a's close to 14.0. Weak acids and weak bases fall in the intermediate range.

3.3.2 Key Concepts and Definitions

Concentrations — Chemists and engineers seldom work with pure solutions of materials. In fact, more often than not we work with very minute amounts of materials dispersed in environmental media. A knowledge of units of concentration is required. Units of concentration in common usage for aqueous solutions include parts per million (ppm) and with increasing analytical capability and environmental awareness, parts per billion (ppb), and even parts per trillion (ppt), milligrams per liter (equivalent to ppm for dilute aqueous solutions), moles per liter or molar solutions (a weight of substance equivalent to the gram-molecular or gram atomic weight in a liter of solution), equivalents per liter (commonly used for acids and bases; a one equivalent per liter solution is stated to be a one normal solution), and finally percent by weight or volume. For vapors and gases, mists, and particulates in air, common units of concentration are ppm, micrograms per m^3, and percent by volume.

Solubility Product — The solubility product constant commonly referred to as the solubility product provides a convenient method of predicting the solubility of a material in water at equilibrium. Copper hydroxide, for example, dissolves according to the following equilibrium:

$$Cu(OH)_2\,(s) \leftrightarrows Cu^{2+} + 2OH^- \tag{3}$$

The resultant solubility product is represented in the following manner:

$$[Cu^{2+}][OH^-]^2 = K_{sp} \tag{4}$$

Note that the brackets, [ ], refer to the concentration of the species. K_{sp} is the solubility product constant; hence $[Cu^{2+}]$ and $[OH^-]^2$ are equal to the molar concentrations of copper and hydroxyl ions, respectively. The K_{sp} is commonly used in determining suitable precipitation reactions for removal of ionic species from solution. In the same example, the pH for removal of copper to any specified concentration can be determined by substituting the molar concentration into the following equation:

$$[OH^-]\,[H^+] = \sqrt{\frac{Ksp}{[Cu^{2+}]}} \tag{5}$$

and then applying the derived values in turn to these other equations:

$$[OH^-]\,[H^+] = 10^{14} \text{ and } pH = -\log\,[H^+] \tag{6}$$

Use of the K_{sp} for precipitation information is often complicated by a number of interfering factors including complexation of metallic ions, high ionic strength solutions, and high solids contents. This principle is applicable solely to ionic compounds, i.e., primarily inorganic compounds.

Adsorption — An important physico-chemical phenomenon used in treatment of hazardous wastes or in predicting the behavior of hazardous materials in natural systems is adsorption. Adsorption is the concentration or accumulation of substances at a surface or interface between media. Hazardous materials are often removed from water or air by adsorption onto activated carbon. Adsorption of organic hazardous materials onto soils or sediments is an important factor affecting their mobility in the environment. Adsorption may be predicted by use of a number of equations most commonly relating the concentration of a chemical at the surface or interface to the concentration in air or in solution, at equilibrium. These equations may be solved graphically using laboratory data to plot "isotherms." The most common application of adsorption is for the removal of organic compounds from water by activated carbon.

Volatilization — Volatilization is a physico-chemical phenomenon of particular interest to environmental managers as well as safety managers. It is the tendency of a material to transfer from a liquid phase (either pure or dissolved as in aqueous systems) to a gaseous phase (commonly air). The volatilization, or evaporation as it is more commonly called, is controlled by a number of factors, the most important of which are the vapor pressure of the material, temperature (vapor pressure increases with temperature), and air/material interfacial surface area, and the action of active mass transfer agents such as wind.

The processes of dissolution/precipitation (for inorganics), dissolution/phase separation (for organics), adsorption, and volatilization control the distribution of a spilled material in the environment. Conversely, knowledgeable manipulation of these same processes can be used to advantage in either cleaning up or mitigating the effects of spilled material. Thus, for example, groundwater contaminated with volatile organics of limited aqueous solubility can be decontaminated by air stripping of these compounds which can then be concentrated by adsorption on activated carbon for subsequent disposal. From a safety standpoint, if a volatile hazardous chemical is spilled, the concern over inhalation exposure may warrant the need for respirators.

3.3.3 Hazard Categories and Chemistry Principles

The testing of chemicals/wastes to establish the nature of their hazard capacity/threat in accordance with regulatory requirements, falls into four categories: (1) reactivity, (2) ignitability/flammability, (3) corrosivity, and (4) EP toxicity. Commercial chemical products, specific wastes, and wastes from specific processes may be listed as hazardous wastes because they are known to present toxic hazards in the manner of the tests above and/or are known to present serious toxic hazards to mammals/humans. In the discussion to follow, various chemical groups will be examined primarily in the context of reactivity, ignitability, and corrosivity.

Chemistry of Corrosives

The EPA defines corrosivity in terms of pH (i.e., wastes with pH <2 or ≥ 2.5) or in terms of ability to corrode steel (SAE 20) at a rate of >6.35 mm (0.250 in.) per year at a temperature of 55°C (13°F). This discussion will address corrosivity as it applies to acids and caustics. Acids are compounds that yield H^+ions (actually H_3O^+ ions) when dissolved in water. Common industrial acids include acetic, nitric, hydrochloric, and sulfuric. acids. The terms *concentrated* and *dilute* refer to the concentrations in solution. Mixing a concentrated acid with enough water will produce a dilute acid. For example, a bottle of concentrated HCl direct from the manufacturer is approximately 12N in HCl, while a solution of HCl used in a titration may be only 0.5N. The latter is a dilute acid solution.

Strong and *weak* acids are classified by how completely they ionize in solution. For example, HCl is classified as a strong acid because it is completely ionized to H^+ and Cl^- ions. Acetic acid is classified as a weak acid because it does not totally ionize in solution. As mentioned earlier, weak acids such as acetic acid have higher pK_as. The pK_a for acetic acid is 4.75. The negative antilog of this value (1.76×10^{-5}) can be used to calculate the concentrations at equilibrium of the acetate and hydrogen ions. Strong acids include perchloric, hydrochloric, sulfuric, nitric, and hydriodic acids. Examples of weak acids include boric, hydrocyanic, carbonic, and acetic acids. Thus, the terminology "strong versus weak acid" may bear little relationship to the nature or extent of potential hazard, while the terms "concentrated versus dilute" most often do.

The acidic nature of a given solution is characterized by its pH, where pH is the negative logarithm of the molar H^+ concentration (-log $(H^+])$. A solution with pH <7 is acid, a solution with pH 7 is neutral, and a solution with pH >7 is basic. For example, the pH of lemon juice is 2, while the pH of lye is about 14.

Acids

Acids may be inorganic, such as H_2SO_4, and are then known as mineral acids, or they may be organic, like acetic acid. Mineral acids may be weak or strong, but organic acids tend to be uniformly weak. Table 12 gives a list of commonly occurring acids along with their relative strengths. It should be noted that salts of several metals (e.g., Al^{3+}, Fe^{3+}, and Zn^{4+}) dissolve in water to produce acid solutions. Acids include a variety of compounds, many of which have other significant properties that contribute to their "reactivity." Typical reactions of acids are: neutralization of bases (strong and weak) and oxidation of substances. Characteristics of common acids are presented in Table 13. Examples of neutralization of bases are the following reactions:

$H^+ + OH^- \rightarrow H_2O$
$HCI + NaOH \rightarrow H_2O + NaCI$
$CaCO_3 + 2HCl \rightarrow CaCl_2 + H2O + CO_2$

Examples of oxidation reactions are as follows:

$Zn° + 2HCl \rightarrow Zn^{2+} + 2Cl^- + H^2\uparrow$
$2NaI + 2H_2SO_4 \rightarrow I_2 + SO_2 + 2H_2O + Na_2SO_4$

Bases

A base is any material that produces hydroxide ions when it is dissolved in water. The words alkaline, basic, and caustic are often used synonymously. Common bases include sodium hydroxide (lye), potassium hydroxide (potash lye), and calcium hydroxide (slaked lime). The concepts of strong versus weak bases, and concentrated versus dilute bases are exactly analogous to those for acids. Strong bases such as sodium hydroxide dissociate completely while weak bases such as the amines dissociate only partially. As with acids, bases can be either inorganic or organic. Typical reactions of bases include neutralization of acids, reaction with metals, and reaction with salts:

Table 12. Relative Strengths of Acids in Water

Perchloric acid	$HClO_4$	↑
Sulfuric acid	H_2SO_4	↑
Hydrochloric acid	HCl	↑
Nitric acid	HNO_3	↑
Phosphoric acid	H_3PO_4	Increasing
Hydrofluoric acid	HF	Acid
Acetic acid	CH_3COOH	Strength
Carbonic acid	H_2CO_3	↑
Hydrocyanic acid	HCN	↑
Boric acid	H_3BO_3	↑

Table 13. Properties of Some Common Acids and Bases

Acids—Sulfuric. Nitric. Hydrochloric, Acetic

a. *These acids are highly soluble in water.*
b. *Concentrated solutions are highly corrosive and will attack materials and tissue.*
c. *If spilled on skin, flush with lots of water.*
d. *Sulfuric and nitric acids are strong oxidizers and should not be stored or mixed with any organic material.*
e. *Sulfuric, nitric, and hydrochloric acids will attack metals upon contact and generate hydrogen gas which is explosive.*
f. *Acetic acid (glacial) is extremely flammable. Its vapors form explo sive mixtures in the air. It is dangerous when stored with any oxi dizing material, such as nitric and sulfuric acids, peroxides, sodium hypochlorite, etc.*
g. *Breathing the concentrated vapors of any of these acids can be ex tremely harmful. Wear appropriate equipment.*
h. *When mixing with water, always add acids to water, never water to acids.*

Bases (Caustics)—Sodium Hydroxide, Ammonium Hydroxide, Calcium Hydroxide (Slaked Lime), Calcium Oxide (Quick Lime)

a. *These bases are highly soluble in water.*
b. *Concentrated solutions are highly corrosive. They are worse than most acids because they penetrate the skin (Saponification reactions) .*
c. *If spilled on skin, flush immediately with lots of water.*
d. *When mixed with water, they generate a significant amount of heat-- especiaily sodium hydroxide and calcium oxide.*
e. *Unless unavoidable, do not store or mix concentrated acids and bases, as this gives off much heat--diiute, then mix.*
f. *Do not store or mix ammonium hydroxide with other strong bases. It can release ammonia gas which is extremely toxic.*
g. *Do not store or mix ammonium hydroxide with chlorine compounds (i.e., sodium hypochlorite). It can release chlorine gas which is extremely toxic.*

An example of a reaction with a metal is

$2Al + 6NaOH \rightarrow 2Na_3AlO_3 + 3H_2 \uparrow$
(reaction goes slowly)

An example of a reaction involving salt is:

$Pb(NO_3)_2 + 2NaOH \rightarrow Pb(OH)_2 + 2NaNO_3$

Characteristics to remember about some common bases are presented in Table 13.

3.3.4 Properties of Organics

Most compounds in which carbon is the key element are classified as organic. Common examples of organic compounds include degreasing solvents, lubricants, and heating and motor fuels. This subsection highlights some of the more common characteristics of organics as they relate to hazards. Various relevant classes of organics are presented in terms of chemical behavior and physical properties. In order to facilitate the discussion to follow, a few basic definitions will be presented first.

Definitions

Covalent — refers to a chemical bond in which there is an equal/even sharing of bonding electron pairs between atoms. This is typical of the bonding between carbon atoms and between carbon and hydrogen atoms in organic compounds.

Hydrocarbons — chemical compounds consisting primarily of carbon and hydrogen.

Aliphatic — organic compound with the carbon backbone arranged in branched or straight chains (e.g., propane).

Aromatic — organic molecular structure having the benzene ring (C_6H_6) as the basic unit (e.g., toluene, xylene).

Saturated — the condition of an organic compound in which each constituent carbon is covalently linked to four different atoms. This is generally a stable configuration (e.g., $CH_3CH_2CH_3$-- propane).

Isomers — different structural arrangements with the same chemical formula, (e.g., n-butane and t-butane).

Unsaturated — an organic compound containing double or triple bonds between carbons (e.g., ethylene [$CH_2=CH_2$]). Multiple bonds tend to be sites of reactivity.

Functional Group — an atom or group of atoms, other than hydrogen, bonded to the chain or ring of carbon atoms (e.g., the -OH group of alcohols, the -COOH group of carboxylic acids, the -O- group of ethers). Functional groups determine the behavior of molecules. Consequently, the unique hazards of an organic compound are often determined by its functional group(s).

General Properties

Most organic compounds are flammable. They tend to melt and boil at lower temperatures than most inorganic substances. Because many organic compounds volatilize easily at room temperature and possess relatively low specific heats and ignition temperatures, they tend to burn easily. Moreover, organic vapors often have high heats of combustion which, upon ignition, facilitate the ignition of surrounding chemicals, thus compounding the severity of the hazard.

Most organic compounds are less stable than inorganics. However, the presence of one or more halogen atoms (F,Cl,Br,I) in the molecular structure of an organic compound increases its stability and inertness to combustion. Thus, partially halogenated hydrocarbons burn with less ease than their nonhalogenated analogs. Fully halogenated derivatives, such as carbon tetrachloride (CCl_4) and certain polychlorinated biphenyls (PCBs) are almost noncombustible.

Most organic compounds are water-insoluble. Notable exceptions are the lower molecular weight alcohols, aldehydes, and ketones, all known to be "polar" molecules. This characteristic is of importance to firefighting because the specific gravity of the compound will then be a major determinant of the suitability of water for the suppression of fires involving the chemical.

Except for alkanes and organic acids, organic compounds tend to react easily with oxidizing agents such as hydrogen peroxide or potassium dichromate. Moreover, a mixture of an oxidizing agent and organic matter is usually susceptible to spontaneous ignition. Notably, except for flammability and oxidation, organic compounds tend to react slowly with other chemicals.

Nomenclature

The basic system of aliphatic organic nomenclature is shown in Table 14. The prefix for the name is based on the number of carbons involved and remains the same for each type of compound described. The suffix is determined by the type of compound and is independent of the number of carbons in the molecule. Thus, methane, methanol, methanol (formaldehyde), and methanoic (formic) acid represent an alkane, an alcohol, an aldehyde, and a carboxylic acid, respectively, each with one carbon per molecule. In contrast, methanol, ethanol, and propanol are all alcohols, but with one, two, and three carbons per molecule, respectively. The boiling points provided in Table 4 show the systematic trends in chemical properties as the number of carbons per molecule increases within a given chemical group, and as the various chemical groups are compared for a specific number of carbons per molecule. Thus, in general, within any group, the larger molecules are less volatile than the smaller ones. Also, alkanes tend to be more volatile than aldehydes. Systematic trends can also be observed for other properties, such as water solubility. It should be noted than the boiling points provided in Table 4 are for the straight-chain isomers of the molecules. If the values for branched chain molecules are included, the comparisons become complicated.

Table 14. Nomenclature for Aliphatics

Number of Carbons	Prefix	Alkanes		Alcohols		Aldehydes		Acids	
		Ending	b.p.	Ending	b.p.	Ending	b.p.	Ending	b.p.
1	Meth	ane	-150°C	anol	65°C	anal		anoic (formic)	100°C
2	Eth		-90°C		78°C		20°C	(acetic)	120°C
3	Prop		-40°C		95°C		50"C	(propionic)	140°C
4	But		0°C		120"C		75°C	(butyric)	160°C
5	Pent		35°C		140°C		105°C	(valeric)	185°C
6	Hex		70°C		160"C		130°C		205°C
7	Hept		100°C		175°C		155°C		225°C
8	Oct		125°C		195°C		170°C		240°C
9	Non		150°C		215°C		185°C		255°C
10	Dec		175°C		230°C		210°C		270°C
11	Undec		195°C						

Number of Carbons	Prefix	Alkenes Ending	Alkynes Ending
1	as- above	-	-
2		ene	yne
4			

a. Common name in parentheses
b. Commonly called acetylenes

Alkenes and alkynes are similar in structure to the alkanes except the alkenes contain a carbon-to-carbon double bond (C=C) and the alkynes contain a carbon-to-carbon triple bond (C≡C). The name prefixes are exactly the same as for the alkanes with the same number of carbons, but the endings are -one for compounds with double bonds and their derivatives and -yne for compounds with triple bonds and their derivatives. Ethene (ethylene) and propene (propylene) are alkenes. Ethyne (acetylene) is an alkyne.

Aromatics are molecules based on single or triple benzene rings. Some of the more common aromatics include benzene, toluene, xylene, and phenol. As previously mentioned, benzene is a 6-carbon ring with the formula C_6H_6. The ring has alternating double and single bonds, and is quite stable. The substitution of a methyl group (-CH_3) for one of the hydrogens gives methyl benzene or toluene. The substitution of another methyl group gives dimethyl benzene or xylene. Substitution of a hydroxyl (-OH) for a hydrogen on the benzene ring gives hydroxy benzene or phenol. Aromatics can also be named more specifically based on a system of assigning names or numbers to various positions on the benzene ring. By using the numbering system for the carbons on single or multiple benzene rings in combination with the names of the relevant substituents, any aromatic compound can be assigned a unique name.

3.3.5 Functional Groups

Alkanes — Presented as (C_nH_{2n+2}), these are saturated hydrocarbons. The lower molecular weight alkanes (ethane through butane) are gases at standard temperature and pressure. The remainder are water-insoluble liquids, that are lighter than water and thus form films or oil slicks on the surface of water. Hence, water is not used to suppress fires involving materials, such as gasoline, that include substantial proportions of liquid alkanes. Alkanes are relatively unreactive with most acids, bases, and mild oxidizing agents. However, with addition of sufficient heat, alkanes will react and burn in air or oxygen when ignited. In fact, low molecular weight alkanes (LPG, butane, gasoline) are commonly used as fuels. Consequently, the biggest hazard from alkanes is flammability.

Organic Carboxylic Acids — (RCOOH) are usually weak acids but can be very corrosive to skin. However, The substitution of Cl atoms on the carbon next to the carboxylic carbon, produces a stronger acid. Thus, trichloracetic acid is almost a strong acid whereas acetic acid is a weak one.

Organic Sulfonic Acids — (RSO_2H) are generally stronger acids than organic carboxylic acids.

Organic Bases — (such as amines, RNH_2) are weak bases but can be corrosive to skin or other tissue.

Alcohols — (ROH) are not very reactive. The lower molecular weight alcohols (methanol, ethanol, propanol) are completely miscible with water, but the heavier alcohols tend to be less soluble. Most common alcohols are flammable. Aromatic alcohols like phenol are not as flammable (flashpoint = 79°C) and are fairly water soluble (~9 g/L).

Alkenes — Also known as olefins, and denoted as C_nH_{2n} the compounds are unsaturated hydrocarbons with a single carbon-to-carbon double bond per molecule. The alkenes are very similar to the alkanes in boiling point, specific gravity, and other physical characteristics. Like alkanes, alkenes are at most only weakly polar.

Alkenes are insoluble in water but quite soluble in nonpolar solvents like benzene. Because alkenes are mostly insoluble liquids that are lighter than water and flammable as well, water is not used to suppress fires involving these materials. Because of the double bond, alkenes are more reactive than alkanes.

Esters — These are not very reactive. Only the lowest molecular weight esters have appreciable solubility in water (e.g., ethyl acetate, 8 percent). Methyl and ethyl esters are more volatile than the corresponding unesterified acids. Most common esters are flammable. Esters are often easily recognizable due to their sweet to pungent odors.

Ethers (R-O-R) are low on the scale of chemical reactivity. Aliphatic ethers are generally volatile, flammable liquids with low boiling points and low flashpoints. Well known hazardous ethers include diethyl ether, dimethyl ether, and tetrahydrofuran. Beyond their flammability, ethers present an additional hazard because they react with atmospheric oxygen in the presence of light to form organic peroxides.

Organic Peroxides — (R-O-O-R) are very hazardous. Most of the compounds are so sensitive to friction, heat, and shock that they cannot be handled without dilution. As a result, organic peroxides present a serious fire and explosion hazard. Commonly encountered organic peroxides include benzoyl peroxide, peracetic acid, and methyl ethyl ketone peroxide.

Aldehydes and Ketones — These share many chemical properties because they possess the carbonyl (C=O) group as a common feature of their structure. Aldehydes and ketones have lower boiling points and higher vapor pressures than their alcohol counterparts. Aldehydes and ketones through C_4 are soluble in water and have pronounced odors. Ketones are relatively inert while aldehydes are easily oxidized to their counterpart organic acids.

3.3.6 Flammables

Flammability, the tendency of a material to burn, can only be subjectively defined. Many materials that we normally do not consider flammable will burn, given high enough temperatures. Neither can flammability be gauged by the heat content of materials. Fuel oil has a higher heat content than many materials considered more flammable because of their lower flashpoint. In fact, flashpoint has become the standard for gauging flammability.

The most common systems for designating flammability are the Department of Transportation (DOT) definitions, the National Fire Protection Association's (NFPA) system, and the Environmental Protection Agency's (EPA) Resource Conservation and Recovery Act's (RCRA) definition of ignitable wastes, all of which use flashpoint in their schemes. The NFPA diamond, which comprises the backbone of the NFPA Hazard Signal System, uses a four-quadrant diamond to display the hazards of a material. The top quadrant (red quadrant) contains flammability information in the form of numbers ranging from zero to four. Materials designated as zero will not burn. Materials designated as four rapidly or completely vaporize at atmospheric pressure and ambient temperature, and will burn readily (flashpoint $<73°F$ and boiling point $<100°F$). The NFPA defines a flammable liquid as one having a flashpoint of 200°F or lower, and divides these liquids into five categories:

1. Class IA: liquids with flashpoints below 73°F and boiling points below 100°F. An example of a Class IA flammable liquid is n-pentane (NFPA Diamond: 4).
2. Class IB: liquids with flashpoints below 73°F and boiling points at or above 100°F. Examples of Class IB flammable liquids are benzene, gasoline, and acetone (NFPA Diamond: 3).
3. Class IC: liquids with flashpoints at or above 73°F and below 100°F. Examples of Class IC flammable liquids are turpentine and n-butyl acetate (NFPA Diamond: 3).
4. Class II: liquids with flashpoints at or above 100°F but below 140°F. Examples of Class II flammable liquids are kerosene and camphor oil (NFPA Diamond: 2).
5. Class III: liquids with flashpoints at or above 140°F but below 200°F. Examples of Class III liquids are creosote oils, phenol, and naphthalene. Liquids in this category are generally termed combustible rather than flammable (NFPA Diamond: 2).The DOT system designates those materials with a flashpoint of 100°F or less as flammable, those between 100°F and 200°F as combustible, and those with a flashpoint of greater than 200°F as nonflammable. EPA designates those wastes with a flashpoint of less than 140°F as ignitable hazardous wastes. To facilitate the comparison of these systems they are presented graphically in Figure 10.

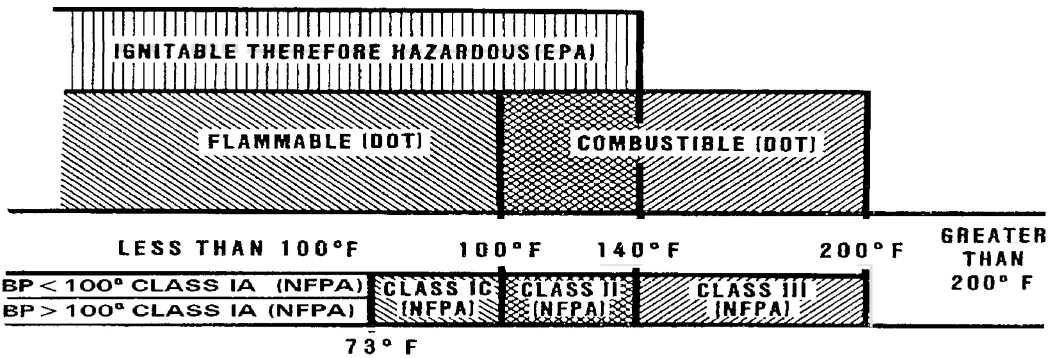


Figure 10. Illustrative classification of flashpoint designators.

These designations serve as useful guides in storage, transport, and spill response. However, they do have limitations. Since these designations are somewhat arbitrary, it is useful to understand the basic concepts of flammability.

The elements required for combustion are few--a substrate, oxygen, and a source of ignition. The substrate, or flammable material, occurs in many classes of compounds but most often is organic. Generally, compounds within a given class exhibit increasing heat contents with increasing molecular weights (MW) (see Table 15).

Other properties specific to the substrate that are important in determining flammable hazards are the auto-ignition temperature, boiling point, vapor pressure, and vapor density. Auto-ignition temperature (the temperature at which a material will spontaneously ignite) is more important in preventing fire from spreading (e.g., knowing what fire protection is needed to keep temperatures below the ignition point) but can also be important in spill or material handling situations. For example, gasoline has been known to spontaneously ignite when spilled onto an overheated engine or manifold. The boiling point and vapor pressure of a material are important not only because vapors are more easily ignited than liquids, but also because vapors are more readily transportable than liquids (they may disperse, or when heavier than air, flow to a source of ignition and flash back). Vapors with densities greater than one do not tend to disperse but rather to settle into sumps, basements, depressions in the ground, or other low areas, thus representing active explosion hazards.

Table 15. Heat Content/increasing Weight Relationships

Compound	MW	Heat Content Kg. Calories/gm.MW
methane	16	210.8
ethane	30	368.4
propane	44	526.3
methanol	32	170.9
ethanol	46	327.6
propanol	60	480.7

Oxygen, the second requirement for combustion, is generally not limiting. Oxygen in the air is sufficient to support combustion of most materials within certain limits. These limitations are compound specific and are called the explosive limits in air. The upper and lower explosive limits (UEL and LEL) of several common materials are given in Table 16.

Table 16. Explosive Limits of Hazardous Materials

Compound	LEL %	UEL %	Flashpoint °F	Vapor Density
Acetone	2.15	13	-4	2.0
Acetylene	2.50	100	Gas	0.9
Ammonia,	16	25	Gas	0.6
Benzene	1.30	7.1	12	7.8
Carbon monoxide	12.4	74	Gas	1.0
Gasoline	1.4	7.6	-45	3-4
Hexane	1.1	7.5	-7	3.0
Toluene	1.2	7.1	40	3.1
Vinyl chloride	3.6	33	Gas	2.2
p-xylene	1.0	6.0	90	3.7

The source of ignition may be physical (such as a spark, electrical arc, small flame, cigarette, welding operation, or a hot piece of equipment), or it may be chemical in nature, such an an exothermic reaction. In any case, when working with or storing flammables, controlling the source of ignition is often the easiest and safest way to avoid fires or explosions.

Once a fire has started, control of the fire can be accomplished in several ways: through water systems (by reducing the temperature), carbon dioxide or foam systems (by limiting oxygen), or through removal of the substrate (by shutting off valves or other controls). Chapter 4 provides detailed discussion on the theories of fire and specific information on hydrocarbons, as well as chemical specific fire characteristics.

3.3.7 Water Reactive Chemicals

The characteristics of a chemical or substance that would categorize it as a reactive material include (1) it reacts violently with water, (2) it forms potentially explosive mixtures with water, or (3) when mixed with water or other chemicals, it generates toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment. Because water is the most common fire suppressant, the characteristic of reactivity is especially relevant since the application of water to eliminate or prevent the spread fires may be counterpro-ductive rather than helpful. Several categories of chemicals will be discussed from this standpoint; however, several of these same chemicals also present additional hazards.

Substances that Produce H_2

Metals — Several metals react with water and air with the extent of reactivity being dependent upon the physical state of the metal. The highly reactive metals such as lithium, sodium, and potassium are pyrophoric (i.e., they ignite spontaneously in air without an ignition source). In contrast, the less reactive metals such as magnesium, zirconium, titanium, aluminum, and zinc, are highly pyrophoric only as dusts.

Lithium, sodium, and potassium (alkali metals) react rapidly with water to release hydrogen (H_2) gas:

$$2Na + 2H_2 0 \rightarrow 2Na^+ + 2OH^- + H_2 \uparrow$$

Sufficient heat is generated to ignite the hydrogen gas so that it can react explosively with the oxygen in air. Metals like magnesium, aluminum, titanium, and zirconium in pure form also react with water to release H_2, but heat must be supplied to initiate the reaction. The generalized representation is:

$$\text{metal} + \text{water} + \text{heat} \rightarrow \text{metal oxide or hydroxide} + H_2 \uparrow \quad (7)$$

Hydrides — True hydrides (i.e., those in which the hydrogen is in its anionic or most reduced form) are salt-like compounds in which the hydrogen is combined with alkali metals, either alone as simple hydrides or in association with other elements as complex hydrides. Hydrides react with water to release hydrogen.

Simple hydrides:

$$LiH + H_2O \rightarrow H_2\uparrow + LiOH$$

Complex hydrides:

$$LiAlH_4 + 4H_2O \rightarrow Al(OH)_3 + LiOH + 4H_2\uparrow$$

Peroxides — Compounds containing the O^{2-} ion are hazardous primarily as oxidizing agents but also as water reactives. An example is the liberation of oxygen from the mixture of sodium peroxide and water:

$2Na_2O_2 + 2H_2O \rightarrow 4NaOH + O_2 \uparrow$

Substances That Produce Alkaline Aqueous Solutions

This group is exemplified by nitrides, carbides, and phosphides. Nitrides will react with water to generate ammonia (NH_3), which can be released depending on how alkaline the solution becomes. It is unlikely that sufficient NH_3 will be produced under normal circumstances to create a hazard.

$N_3 + 3H_2O \rightarrow NH_3\uparrow + 3OH^-$
$Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3 \uparrow$

Carbides, which are binary compounds containing anionic carbon, occur as covalent and as salt-like compounds. The salt-like carbides are water-reactive and, upon hydrolysis, yield flammable hydrocarbons. Typical hydrolysis reactions include:

$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2 \uparrow$ (acetylene)
$Al_4C_3 + 12H_2O \rightarrow 4Al(OH)_3 + 3CH_4 \uparrow$ (methane)

Other similar carbides are Be_2C and Mg_2C_3. Notably, each reaction is sufficiently exothermic to ignite the specific RBS formed upon hydrolysis.

Phosphides are binary compounds containing anionic phosphorus (P^{3-}). Heavy metal, alkali, and alkaline earth metal phosphides exist but few of them are commercially important. Phosphides hydrolyze to the flammable and toxic gas phosphine (PH_3). The hydrolysis reaction of aluminum phosphide is given below:

$AlP + 3H_2O \rightarrow PH_3 \uparrow + Al(OH)_3$

Substances That Produce Acidic Aqueous Solutions

Inorganic Chlorides/Halides — These metallic salts are formed from the reaction of a weak base with the strong acid HCl. Salts such as these dissolve in water to produce a markedly acidic solution. This is exemplified by aluminum chloride, which is corrosive due to the acidity resulting from the hydrolysis that produces aluminum and chlorine ions. Anhydrous $AlCl_3$ hydrolyzes violently when contacted by water.

Several nonmetallic chlorides also react with water with varying degrees of violence to produce hydrochloric acid. Although these compounds are themselves nonflammable, the heat generated by hydrolysis is sufficient to ignite adjacent flammable materials. These nonmetallic chlorides include antimony pentachloride ($SbCl_5$), boron trichloride (BCl_3), phosphorus oxychloride ($POCl_3$), phosphorus pentachloride (PCl_5), phosphorus trichloride (PCl_3), silicon tetrachloride ($SiCl_4$), thionyl chloride ($SOCl_2$), sulfuryl chloride (SO_2Cl_4) and titanium tetrachloride ($TiCl_4$). Because of their acid-producing tendencies, many of these chlorides are considered to be corrosive.

Organic Chlorides/Halides — Several organic compounds also are hydrolyzed (or react with water) to produce corrosive materials. Notable inclusions among these compounds are acetic anhydride ($[CH_3CO_2]_2O$), and acetyl chloride (CH_3COCl), both of which produce acetic acid upon reaction with water. Both acetic anhydride and acetyl chloride are corrosive; in addition, mixtures of the vapors of acetic anhydride and acetic acid are flammable in air, and acetyl chloride itself is flammable.

Oxidation/Reduction Phenomena

The explosive potential of oxidation/reduction reactions has resulted time and time again in chemical disasters. Perhaps the largest of these was the explosion of the S.S. Grandcamp at Texas City, Texas, in 1947, where thermal decomposition (redox reactions of ammonium nitrate and subsequent oxidation reactions of the decomposition products) lead to the deaths of over 600 people and over $33 million (1947 dollars) damage. The addition or loss of electrons involves an accompanying transfer of energy, often a violently exothermic transfer. The substance that gives up electrons (and is therefore oxidized) is the reducing agent. The substance that gains electrons (and is therefore reduced) is the oxidizing agent.

Oxidizing agents are generally recognizable by their structures or names. They tend to have oxygen in their structures and often release oxygen as a result of thermal decomposition. Oxidizing agents often have "per-" prefixes (perchlorate, peroxides, permanganate) and often end in "-ate" (chromate, nitrate, chlorate).

Strong oxidizers have more potential incompatibilities than perhaps any other chemical group (with the exception of water reactive substances). It is safe to assume that they should not be stored or mixed with any other material except under carefully controlled conditions. Common oxidizing agents listed in decreasing order of oxidizing strength include:

Fluorine	Chlorine
Ozone	Suifuric acid (concentrated)
Hydrogen peroxide	Oxygen
Hypochlorous acid	Metallic iodates
Metal chlorates	Bromine
Lead dioxide	Ferric salts
Metallic permanganates	Iodine
Metallic dichromates	Sulfur
Nitric acid (concentrated)	Stannic salts

Reducing agents present similar problems. They react with a broad spectrum of chemical classes, and the reactions can be exothermic and violent. Reducing agents are, by definition, highly oxidizable and may react with air or moisture in the air. Common reducing agents include:

Hydrogen	Sulfides
Metals (Li, Na, K, Ca, Sr, Ba)	Sulfites
Hydrazine	Iodides
Metal acetylides	Nitrides
Complex hydrides	Nitrites
Metal hydrides	Phosphites
Metal hypoborates	Metallic azides
Metal hypophosphites	

3.3.8 Toxic Materials

Toxic Metals - The most common toxic metals in industrial use are cadmium, chromium, lead, silver, and mercury; less commonly used are arsenic, selenium, (both metalloids), and barium. Cadmium, a metal commonly used in alloys and myriads of other industrial uses is fairly mobile in the environment and is responsible for many maladies including renal failure and a degenerative bone disease called "itai itai" disease. Chromium, most often found in plating wastes, is also environmentally mobile and is most toxic in the Cr^{+6} valence state. Lead has been historically used as a component of an antiknock compound in gasoline and, along with chromium (as lead chromate), in paint and pigments. Lead, because of its history as an air emission, has been fairly mobile and is particularly soluble in acid environments. Silver is used widely in the electronics industry. Intake of silver compounds can result in permanent discoloration of the skin and may result in damage to kidneys, lungs, mucous membranes, and other organs.

Mercury enjoys its seeming environmental ubiquity due to its use as a fungicide and as an electrode in the chlorine production process. Elemental mercury is relatively immobile, but is readily transformed to more mobile organometallic compounds through bacterial action. Mercury is the responsible agent for the infamous Minimata syndrome which is characterized by degeneration of the central nervous system. Arsenic and selenium are both commonly used to decolorize glass or to impart a desirable color. Arsenic occurs in a number of important forms, many of which have been used as contact herbicides. Important forms of arsenic include arsenic trioxide and pentoxide, and arsenic acids, arsenites and arsenates, and various organic arsenic compounds. Selenium often occurs as selenous acid. Both arsenic and selenium are fairly mobile and toxic. In general, toxic metals can be readily removed from aqueous solution through precipitation reactions, either as the sulfide or (more commonly) as the hydroxide.

Cyanides - Cyanides are dangerously toxic materials that can cause instantaneous death. They occur in a number of industrial situations but are commonly associated with plating operations, and sludges and baths from such sources. Cyanide is extremely soluble and many cyanide compounds, when mixed with acid, release deadly hydrogen cyanide gas. Cyanide is sometimes formed during the combustion of various nitrile, cyanohydrin, and methacrylate compounds. Cyanides (CN^-) are commonly treated by chlorine oxidation to the less toxic cyanate (CNO^-) form, then acid hydrolyzed to CO_2 and N_2. Obviously, care should be taken that the cyanide oxidation is complete prior to acid hydrolysis of the cyanate.

Hydrogen Sulfide - Hydrogen sulfide is a commonly occurring decomposition product of organic matter. It is relatively water soluble at higher pHs where it is predominantly dissociated as H^+ and $S^=$ ions. As the pH is decreased below 7, undissociated gas H_2S begin to predominate and is released. Since its vapor density is >1.0, H_2S gas tends to settle in low places and creates a toxicity hazard. H_2S is readily oxidizable by a number of means to less toxic $S0_3^=$ or $S0_4^=$ forms.

Pesticides and Bioaccumulators - Pesticides include the broad categories of insecticides, fungicides rodenticides, and herbicides. Insecticides in common use fall into three categories. The chloroinsecticides have chlorine in their structure. They are less soluble than the other insecticide forms and much less biodegradable (i.e., more persistent). While they are less acutely toxic, several have been identified as potential carcinogens. Carbamatea are a relatively new form of pesticide. They are less persistent and less toxic than chioroinsecticides, but some are also suspected carcinogens. Organophosphate insecticides are generally more acutely toxic than the other categories but they are not persistent.

Many formerly common herbicides now have been banned or restricted in their use, e.g., 2,4-D and 2,4,5-T. However, the number and diversity of herbicides far exceeds that of insecticides. There are both organic and inorganic herbicides. Examples of inorganic herbicides are $CuSO_4$ and $NaClO_4$.

There are at least 22 chemical families of organic herbicides. Even a cursory treatment of the chemistry of these materials would be extensive. Herbicides of limited toxicity (Treflan, Atrazine) as well as extremely toxic ones (Paraquat, Dinoseb) are in use in many parts of the world. They range from water soluble to insoluble. The detailed chemistry of each should be determined prior to handling.

3.3.9 Chemical Compatibility

Chemical incompatibility can manifest itself in many ways; however, discussions will be limited to those combinations resulting in fires, explosions, extreme heat, evolution of gas (both toxic and nontoxic), and polymerization.

Because of the number of chemicals and subsequent multiple number of potential reactions, it is impractical and (perhaps impossible) to list all potential reactions. Several systems exist for determining the reactions between classes of chemicals however none of them are definitive. Because all of the potential reactions for individual chemicals are not cataloged and because there are no (or very few), pure solutions of waste materials, laboratory compatibility testing is recommended for most materials. An appropriate protocol for compatibility testing would involve the following steps:

1. Obtain all available information about the material. If it is a surplus or off-specification product, obtain an analysis or a Material Safety Data Sheet. If it is a waste, check for previous analyses, and if none exists, obtain one. (Even if a previous analysis exists, consider running a few screening-type field analyses for confirmation of important properties such as pH, redox potential or other oxidizer test, cyanide, sulfide, and flashpoint.)

2. Once the identity of the material is known, the literature can be consulted to determine potential reactions. At this point, incompatibility may be obvious. If not, then laboratory testing for compatibility is required.

Compatibility testing is almost by nature an experiment with the unknown. As such, safety must be the watchword. Procedures for compatibility testing should take into account the most severe adverse reaction possible, not just that expected. Such testing should always be performed under a vent hood while wearing, as a minimum, face shield, rubber apron, and gloves. Generally, compatibility testing entails mixing a small volume of one substance with another and observing for heat, gas generation, or polymerization. Polymerization need not be violent to cause problems. Anyone who has ever had to chisel out or replace a tank of solidified material can attest to this. Often it is advisable to heat the mixture to expected storage or process temperature and then observe for further heat, gas, or polymerization.

Observation of a reaction does not necessarily preclude mixing. Moderate heat or gas generation may not present a problem. However, a number of safety precautions should be taken before mixing the material if any heat or gas generation occurs. If heat is generated, the amount should be determined and a heat balance calculated so that effects of heating on the storage tank and tank base can be calculated. Expansion of the material with heating should also be considered so as to avoid overfilling the receiving tank.

Generation of gas requires a gas analysis before mixing. If the gas is toxic or if discharge of the resultant gas violates an air quality constraint, the materials should not be mixed. If the gas is nontoxic, care should still be taken to assure that the gas generation rate does not exceed the design venting capacity of the tank. Remember that most tanks are designed to withstand a water gage internal pressure of only about eight inches. (A typical person can provide about 24 inches water gage by blowing). Secondly, even if the gas is nontoxic, it may still displace air and (for inside tanks especially) create an asphyxiation hazard.

3.3.10 Toxicology

Toxicology is the science that studies the harmful effects chemicals can have on the body. All chemicals affect man to some degree, depending on the time of exposure, concentration, and human susceptibility. One chemical may only cause a slight rash or dizziness while another may result in cancer or death. It is the degree of exposure and toxicity that are of practical concern.

The means by which chemicals enter the body are inhalation (breathing), ingestion (swallowing), and absorption (skin or living tissue contact). Once in the system these chemicals may produce such symptoms as tissue irritation, rash, dizziness, anxiety, narcosis, headaches, pain, fever, tremors, shortness of breath, birth defects, paralysis, cancer, and death, to mention a few. The amount of chemical that enters the body is called the "dose." The relationship that defines the body response to the dose given is called the "dose-response curve." The lowest dose causing a detectable response is the "threshold limit." The "limit" is dependent on factors such as particle size of contaminant, solubility, breathing rate, residence time in the system, and human susceptibility.

To accomplish meaningful studies, measurements of various parameters are essential. Dose is one of them, and in inhalation studies dose is proportional to the air concentration of the contaminant multiplied by the length of time it is breathed. The units of concentration are ppm (a volume/volume description of concentration--parts of air contaminant per one million parts of the air mixture) for gases and vapors, and mg/m^3 (a weight/volume description—milligrams of air contaminant per cubic meter of air mixture). Other concentration units exist, such as fibers per cubic centimeter (f/cc) for asbestos, and "rems" for radiation. Dose for oral or skin applications is measured by weight or volume in assigned units such as grams or cubic centimeters.

Toxicity data are presented in the literature by such terms as "LD_{50}" and "LC_{50}", that lethal dose per kilogram of body weight or lethal concentration that can kill 50 percent of an animal population. Such data are found, for example, in the Registry of Toxic Effects of Chemical Substances (RTECS). With data such as these obtained from animals closely resembling the human in biochemistry, relative toxicities can be established to characterize chemicals. These data in conjunction with air contaminant threshold limit values (TLV) or permissible exposure limits (PEL), set by law for short periods of exposure or eight-hour, time-weighted average exposure, have produced safe working exposure limits for the worker. Many of these values are contained in the OSHA Standards and the American Conference of Governmental Industrial Hygienist's (ACGIH) Threshold Limit Values and Biolosical Exposure Indices.

Human response to chemicals may be described by two types of biological effects--acute and chronic. An acute effect generally results after a single significant exposure, with severe symptoms developing rapidly and coming quickly to a crisis. An example of an acute effect is a few minutes exposure to carbon monoxide of various concentrations that cause headache, dizziness, or death. The chronic effect results from a repeated dose or exposure to a substance over a relatively prolonged period of time. Examples of chronic effects are possible reduction in life span, increased susceptibility to other diseases, and cancer as a result of smoking. Some materials, such as lead, can bioaccumulate (be stored in the body) and cause continuing effects, or reach a threshold value where an effect on the body occurs after a prolonged period of time, or "latency" period. An example of such a chemical is asbestos, which may produce asbestosis twenty years after the initial exposure.

An effect which exists but has not been widely studied because of its immensity and related problems is "synergism." Synergism occurs when the effect of two chemicals is greater than or less than either chemical alone. Inhalation of isopropyl alcohol and carbon tetrachloride can be well below safe concentration limits separately, but together, produce severe effects including renal failure. Toxicology and epidemiology, the sciences that study diseases in a general population, are closely related. Most of the present occupational concentration limits for hazardous material have resulted from illnesses and deaths of workers, and from use of both disciplines.

Some materials cause genetic changes that can cause cancer (carcinogen), mutation (mutagens), and birth defects (teratogens). These effects are often hard to document due to latency periods and synergisms.

The USOSH Hazard Communication Standard, 29 CFR 1910.1200, has categorized certain target organ effects, including examples of signs and symptoms and chemicals which have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but they are not intended to be all-inclusive. These are summarized for the reader in Table 17.

Table 17. Target organ effects categorized under the Hazard Communication Act.

A. **Hepatotoxins:** Chemicals which produce liver damage;
Signs and Symptoms: Jaundice; liver enlargement;
Chemicals: Carbon tetrachloride; nitrosamines.

B. **Nephrotoxins:** Chemicals which produce kidney damage;
Signs and Symptoms: Edema; proteinuria;
Chemicals: Halogenated hydrocarbons; uranium.

C. **Neurotoxins:** Chemicals which produce their primary toxic effects on the nervous system;
Signs and Symptoms Narcosis: Behavioral changes; decrease in motor functions;
Chemicals: Mercury; carbon disulfide.

Table 17 Continued

D. **Agents which act on the blood or hematopoietic system:** Decreases hemoglobin function; deprive body tissues of oxygen; Signs and Symptoms: Cyanosis; loss of consciousness;
Chemicals: Carbon monoxide; cyanides.

E. **Agents which damage the lung:** Chemicals which irritate or damage the pulmonary tissue;
Signs and Symptoms: Cough; tightness in chest; shortness of breath;
Chemicals: Silica; asbestos.

F. **Reproductive toxins:** Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis);
Signs and Symptoms: Birth defects; sterility;
Chemicals: Lead: KEPONE.

G. **Cutaneous hazards:** Chemical which affect the dermal layer of the body;
Signs and Symptoms: Defatting of the skin; rashes; irritation;
Chemicals: Ketones; chlorinated compounds.

H. **Eye hazards:** Chemicals which effect the eye or visual capacity;
Signs and Symptoms: Conjunctivitis; corneal damage;
Chemicals: Organic solvents; acids.

3.4 GLOSSARY OF FIRE AND HAZARDOUS MATERIALS HANDLING TERMINOLOGY

Following is a glossary of terms that are widely used by hazardous materials handling specialists and fire fighters. Approximately 700 terms are explained with cross reference to related terminology in the glossary as well as other sections of the handbook. Some terms are given more extensive explanation than others depending on their relevance and importance to the information compiled in the handbook.

A

Abiotic: Unconnected with living organisms.
Acaricide: The name of a chemical pesticide used to control spiders, ticks, mites; miticide.
Accelerant: A chemical substance used to initiate or promote fire. Flammable liquids may be referred to as accelerants.
Acceptable Daily Intake (ADI): The dally intake of a chemical that is considered without appreciable risk on the basis of all the facts known at the time it is defined.
Accident: An uncontrolled event which has the potential for damaging life or property; synonym for incident.
Accident Mechanism: The series of events which constitute the course of events culminating in the release of hazardous chemicals outside of their normal containment.
Accumulative Chemicals: Those chemicals which tend to build up in the tissues of humans or animals or remain persistent in the environment.

Accumulative Pesticides: Those pesticides which tend to build up in the tissue of animals or remain persistent in the environment.
Acetylcholinesterase (AChE): In pesticides, an enzyme that will most rapidly hydrolyze acetylcholine as substrate, will not hydrolyze most non-choline esters, is inhibited by excess substrate, and is derived primarily from nervous tissue.
Acid: A hydrogen-containing compound which reacts with water producing hydrogen ions; a proton donor; a liquid having a pH of less than 2. Acidic chemicals are corrosive.
Acid gas: A gas that forms an acid when dissolved in water.
Acidosis: body acid imbalance.
Activated Carbon (activated charcoal): Activated carbon or charcoal is commonly used in gas-adsorption.
Acuity: Pertains to the sensitivity of a bodily organ to perform its function.
Acute: Severe, often dangerous effect. Also used to denote an exposure to high concentrations of a contaminant for short duration.
Acute Dermal Poisoning: A single dose of toxic chemicals absorbed through the skin in amounts capable of causing death.
Acute Effects: Acute effects usually occur rapidly as a result of short-term exposures, and are of a short duration. Examples include irritation, corrosivity, sensitization and lethal dose. Note that these examples do not adequately define the entire range of acute effects which may occur as a result of occupational exposure, such as, for example, narcosis.
Acute Inhalation Poisoning: A single dose of toxic chemicals absorbed into the lungs in amounts capable of causing death.
Acute Hepatitis: liver damage without jaundice.
Acute Oral Poisoning: A single exposure of a toxic chemical of high toxicity that, if untreated, would be lethal.
Acute Radiation Exposure: Exposure to high radiation levels over a short period of time, usually less than 24 hours.
Acute Toxicity: The term refers to short-term poisonous effects. The toxicity of a chemical determined at the end of 24 hours which causes death or injury from a single or limited exposure.
Adapter: A device for making a connection when threads do not match or when they are different sizes.
Additive Effect: An effect which is the result of two chemicals acting together and which is the simple sum of the effects of the chemicals acting independently. See *Antagonistic effect* and *Synergistic effect*.
Adenoma: A tumor, usually benign (q.v.), occurring in glandular tissue.
Adenocarcinoma: A malignant tumor originating in glandular tissue.
Adiabatic Ignition: Refers to the rapid compression of flammable vapors that generates a sufficient amount of heat to cause the ignition of those vapors.
Adjuvant: In immunology, a substance injected with antigens (usually mixed with them but sometimes given prior to or following the antigen) which non-specifically enhances or modifies the immune response to that antigen.
Adrenal gland: organ attached to the kidney.
Adverse effect: An undesirable or harmful effect to an organism, indicated by some result such as mortality, altered food consumption, altered body and organ weights, altered enzyme levels or visible pathological change.
Aerodynamic diameter: The diameter of a unit density sphere having the same settling velocity as the particle in question of whatever shape and density.

Aerosol: A gaseous colloidal system. A system in which liquid, solid or solid-liquid combinations are distributed in a finely divided state through a gas, usually in air. Particles within aerosols are usually less than one micron (0.001 mm) in diameter.
Aetiology: The science of the investigation of the cause or origin of disease.
AFFF: Abbreviation for *Aqueous Film Forming Foam*, which is an extinguishing agent that may be used on many flammable liquids. Discussions and examples may be found in Chapter 4 of the handbook.
Air Sampling: Refers to the collection and analysis by instrument of samples of air to determine the presence of hazardous materials. The reader should review Chapter 2 for the objectives and types of air sampling techniques.
Air monitoring: The sampling for and measuring of contaminants in the air.
Alarm: Any signal indicating the need for emergency response; also, the device that transmits an alarm.
Albuminuria: protein in the urine.
Alcohol: The hydrocarbon derivative in which a hydroxyl radical (-OH) is substituted for a hydrogen atom and which has the general formula R-OH.
Aldehyde: A hydrocarbon derivative with the general formula R-CHO.
Aliphatic: Chemical compounds comprised of straight chain molecules as opposed to a ring structure.
Alkali: Any compound which forms the hydroxyl ion in its water solution. Common synonyms are base; hydroxide; caustic.
Alkanes: An analogous series of saturated hydrocarbons with the general formula C_nH_{2n+2}. These materials may be solids or liquids under normal conditions depending upon carbon content. The solids (paraffins) are major constituents of natural gas and petroleum. Alkanes are usually gases at room temperature (an example is methane) when containing less than 5 carbon atoms per molecule. Low carbon number alkanes produce anaesthesia and narcosis at low concentrations and at high concentrations they can cause cell damage and death. The higher carbon number alkanes are generally not toxic but have been shown to interfere with normal metabolic processes.
Alkalosis: increase in body alkalinity.
Alkenes: A class of hydrocarbons referred to as olefins. These are usually liquids, but can also be gases at room temperature conditions. These are generally more toxic than the alkanes, but less toxic than aromatics.
Alkyl: The general name for a radical of an alkane; an alkyl halide is a halogenated hydrocarbon whose hydrocarbon backbone originated from an alkane.
Alkynes: An analogous series of unsaturated hydrocarbons with the general formula C_nH_{2n-2}; the alkynes all contain just one triple bond between carbon atoms.
Allergy: A response of a hypersensitive person to chemical and physical stimuli.
Alpha Particle: A positively charged particle emitted by certain radioactive particles. An alpha particle consists of two neurons and two protons and is identical with the nucleus of the helium atom. It is the least penetrating of the three common forms of radioactive substances (alpha, beta, gama). It is not normally considered dangerous to plants, animals or humans unless expose to large quantities internally.
Alveoli: Tiny air sacs of the lungs at the end of a bronchiole, through which gas exchange takes place by which the blood takes in oxygen and gives up its carbon dioxide in the process of respiration.
Amine: The hydrocarbon derivative in which an amine group (NH_2) is substituted for a hydrogen atom and which has the general formula R-NH_2.

Anaerobic: Able to live where there is no oxygen; opposite of aerobic.
Analogue: A compound in one analogous series that has a property common with a compound in another analogous series; for example, methyl chloride is an analogue of methyl fluoride.
Anaphylactic: pertaining to an extreme allergic reaction.
Aneuploidy: Deviation from the normal number of chromosomes, excluding exact multiples of the normal haploid (q.v.) complement.
Anemia: fewer red blood cells than normal.
Angstrom (A): Unit of measure of wavelength equal to 10 meters or 0.1 nanometers (millimicrons).
Aniline Point: The lowest temperature a chemical aniline and a solvent (such as the oil in oil-in-base muds) will completely mix.
ANSI: The *American National Standard Institute*. A professional group that works to create voluntary standards.
Antagonistic effect: The effect of a chemical in counteracting the effect of another; for example, the situation where exposure to two chemicals together has less effect than the simple sum of their independent effects; such chemicals are said to show antagonism.
Antigen: A substance that elicits a specific immune response when introduced into the tissues of an animal.
API Gravity: A scale devised by the *American Petroleum Institute* (API) designating an oil's specific gravity or the ratio of the weight of oil to pure water.
Aromatic: The name originally given to cyclical compounds containing the benzene "ring" because the first benzene-type compounds isolated smelled "good".
Arson: Arson is the willful and malicious burning of the property of another. This meaning has been broadened by statute in many jurisdictions to include one's own property.
Arteriosclerosis: hardening of the arteries.
ASME: Abbreviation for the American Society of Mechanical Engineers.
ASP: Abbreviation for Associate Safety Professional, a designation devised by the American Society of Safety Engineers.
Asphalt: Hydrocarbon material ranging in consistency from heavy liquid to a solid. Most common source is residue left after fractional distillation of crude oils; used primarily for surfacing roads.
Asphyxia: Suffocation from lack of oxygen. Chemical asphyxia is produced by a substance, such as carbon monoxide, that combines with hemoglobin to reduce the blood's capacity to transport oxygen. Simple asphyxia is the result of exposure to a substance, such as carbon dioxide, that displaces oxygen.
Asphyxiant: A gas or vapor which, when inhaled, may lead to asphyxia. Examples of asphyxiating materials are carbon dioxide and carbon monoxide.
Aspirate: to inhale liquid into the lungs.
ASSE: Abbreviation for American Society of Safety Engineers.
ASTM: Abbreviation for American Society for Testing and Materials.
Atmospheric Pressure: The pressure exerted over the surface of the earth by the weight of the atmosphere; at sea level, approximately 14.7 psi.
Atomic Energy Commission (AEC): The independent civilian agency of the federal government with statutory responsibility for atomic energy matters; the body of five persons appointed by the President to direct the agency.
Atomic Number: Number of protons in nucleus of an atom. Each chemical element has been assigned a number in a complete series from 1 (hydrogen) to 103 (lawrencium).
Atomic Weight: The mass of an element relative to its atoms.

Atrophy: Wasting of a tissue or an organ.
Auto-Ignition Temperature: The minimum temperature to which a material must be heated to initiate self-sustained combustion, independent of any open flame.
Automatic nervous system: control voluntary movements.
Autophagosome: A membrane-bound body within a cell, containing degenerating cell organelles (q.v.).

B

Backdraft: The term given to a type of explosion caused by the sudden influx of air into a mixture of gases, which have been heated to above the ignition temperature of at least one of them.
Bacteria: Small, relatively simple organisms found in soil, water, and alimentary tract of animals and man. Some cause diseases in man.
Base Pairing: The linking of the complementary pair of polynucleotide chains of nucleic acids by means of hydrogen bonds between the opposite purine and pyrimidine pairs.
Benign: Relating to a growth which does not invade surrounding tissue (Not malignant).
Beta: A type of radiation, essentially an electron or positron, which can cause skin burns. Beta emitters are harmful if they enter the body but can be shielded by protective clothing.
Beta Particle: An elementary particle emitted from a nucleus during radioactive decay.
Bill of Lading: Commercial document which accompanies a shipment of materials and lists all items in the shipment.
Bioaccumulation: Refers to the process occurring when toxic substances are passed through the food chain from soil to plants to grazing animals to humans.
Bioassay: The utilization of living organisms to determine the biological effect of some substance, factor, or condition.
Biochemical Mechanism: A chemical reaction or series of reactions, usually enzyme catalyzed, which produces a given physiological effect in a living organism.
Biochemical Oxygen Demand (BOD): The amount of oxygen required by bacteria stabilize decomposable organic matter under aerobic conditions.
Bioconcentration: Refers to the process in which chemicals concentrate in plant and animal tissues.
Biodegradable: Refers to waste material that is capable of being broken down by bacteria into basic elements.
Biological Agents: Microorganisms (e.g., bacteria or certain nutrients) added to the water column or soil to increase the rate of biodegradation of contaminants.
Biological Half-Life ($t_{1/2}$): The time taken for the concentration of a xenobiotic in a body fluid or tissue to fall by half by a first-order process.
Biological Hazardous Wastes: Substances of human or animal origin other than food wastes, which is to be disposed of and could harbor or transmit pathogenic organisms. Examples are pathological specimens such as tissues, blood elements, excreta, secretions, bandages.
Biological Monitoring: Refers to the analysis of the amounts of potentially toxic substances or their metabolites present in body tissues and fluids as a means of assessing exposure to these substances and aiding timely action to prevent adverse effects. The term is also used to mean assessment of the biological status of populations and communities of organisms at risk in order to protect them and to have an early warning of possible hazards to human health.
Biomagnification: Bioconcentration of xenobiotics up a food chain e.g. from prey to predator.
Biotransformation: The enzyme-mediated transformation of xenobiotics via Phase 1 (q.v.) and Phase 2 (q.v.) reactions.

Bilirubinuria: bilirubin in urine.
Bipyridyls: A group of synthetic organic pesticides which includes the herbicide Paraquat.
Blasting Agents: Any material or mixture consisting of fuel and oxidizer intended for blasting, not otherwise defined as an explosive.
BLEVE (Boiling Liquid Expanding Vapor Explosion): *See Boilover;* the same phenomenon may occur in a pressurized container, resulting in an explosion or bursting of the tank or vessel in which a fire is occurring. The term is almost exclusively used to describe a disastrous effect from a crude oil fire.
Boiling Point: The temperature at which the vapor pressure of a liquid just equals atmospheric pressure.
Boilover: Crude oil often contains some entrained water and/or an emulsion layer. In addition, crude-oil storage tanks will have some accumulations of water on the uneven tank bottoms. In a fire, when a heat wave is formed and comes in contact with any water, a steam explosion occurs, thus agitating the hot oil above it with great force. The evolution of the steam explosion can be understood by examining the reaction of water to high temperatures. When water is heated to its boiling point of 212°F., water vapor, or *steam,* is generated. The steam that is produced expands approximately 1,700 times in volume over the volume of the water that boiled away. Should a heat wave of a temperature well above 212°F. contact any water entrained in the oil, or some of the bottom water, which is usually in larger quantities, it can be readily imagined that this instantaneous generation of steam will act like a piston, causing the oil to be flung upward with considerable violence. When the reaction is so strong, it causes the oil to overflow the tank shell. This sudden eruption is what is known as a *boilover*. Boilovers of sufficient magnitude, to cascade enough burning crude oil out of the tank to not only cover the entire dike area but even enough to overflow the dike wall as well, have occurred. When the hot oil and steam reaction takes place, the oil is made frothy, or sudsy, which in turn further increases its volume. The reaction resulting from the heat wave contacting entrained water can be expected to be of lesser activity than from contact with bottom water. The reason for this difference is that the quantities of water converted to steam in a given spot are usually less. Of course, with entrained water, there possibly can be several of these "frothover"-type eruptions during the progress of the fire.
Bone marrow depression: inactivity of blood-forming organ.
Branching: A configuration in which a carbon atom attaches itself to another carbon atom that has two or three other carbon atoms attached to it, forming a *branch,* or side chain. When the carbon attaches to another carbon that has only one other carbon attached to it, a straight chain is formed, rather than a branched chain.
Bronchial Tubes (Bronchioles): Branches or subdivisions of the trachea (windpipe) which carry air into and out of the lungs.
BTU: British Thermal Unit: The amount of energy required to raise one pound of water 1°F.
Building Codes: There are several building codes that are widely adopted throughout the United States: (1) The Southern Standard Building Code; (2) The Uniform Building Code; (3) The Basic Building Code; (4) The National Building Code; and (5) Building Officials and Code Administrators (BOCA). The purpose of the building codes are to regulate the safe construction of buildings.
Building Survey: That portion of the pre-fire planning process that involves the gathering of all the necessary information to develop a pre-fire plan of a building or property.
Buffer: Any substance in a liquid which tends to resist the change in pH when acid or alkali is added.
Bulk Container: A cargo container, such as may be transported by truck or railroad, or an ocean-going vessel designed to transport large quantities of a single product.

Bunker "B" Oil: A relatively viscous fuel oil (No. 5 fuel) used primarily as a fuel for marine and industrial boilers.
Bunker "C" Oil: A very viscous fuel oil (No.6) used as a fuel for marine and industrial boilers.
Burning Agent: Compounds such as gasoline which are used to ignite and sustain combustion of material that would not otherwise burn.

C

Calcification: deposition of calcium in tissues.
Calorie: The amount of energy required to raise one gram of water 1°C.
Cancer: The disease which results from the development of a malignant tumor and its spread into surrounding tissues.
Carbonyl: The functional group with the structural formula -C-.
Carcinogen: A cancer-causing agent. A chemical is considered to be a carcinogen if: (a) It has been evaluated by the International Agency for Research on Cancer (IARC) and found to be a carcinogen or potential carcinogen; or (b) It is listed as a carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or (c) It is regulated by OSHA as a carcinogen. The reader may refer to 52 FR 31884.
Carcinogenesis: The production of cancer. Any chemical which can cause cancer is said to be carcinogenic.
Carcinogenic: capable of causing cancer.
Carcinoma: A malignant epithelial tumor.
Cardiopulmonary Resuscitation (CPR) (EMS): Opening and maintaining an airway, providing artificial ventilation, and providing artificial circulation by means of external cardiac compression as defined by the American Health Association.
Cardiovascular: pertaining to heart and blood vessels.
Catalase: A haem-based enzyme which catalyzes the decomposition of hydrogen peroxide into oxygen and water. It is found e.g. in peroxisome located in the liver.
Catalyst: A substance which changes the speed of a chemical reaction but undergoes no permanent change itself.
Ceiling Value (CV): The airborne concentration of a potentially toxic substance which should never be exceeded in the breathing zone.
Cell Line: A defined population of cells which has been maintained in a culture for an extended period and which has usually undergone a spontaneous process of transformation conferring an unlimited culture lifespan on the cells.
Central nervous system: controls involuntary bodily functions such as breathing and heart beat.
Celebral: pertaining to brain.
CFR: Abbreviation for Code of Federal Regulations.
Chain: The way carbon atoms react with each other, producing covalent bonds between them, resembling a chain with carbon atoms as the links.
Chemical Dispersion: In oil spills, the process of spraying chemical dispersants to remove stranded oil from areas not considered biologically sensitive.
Chemical Oxygen Demand (COD): Means of measuring the pollution strength of domestic and industrial wastes based on the fact that most organic compounds can be oxidized by the action of strong oxidizing agents under acid conditions to carbon dioxide and water.
Chemical Properties: Properties of a material that relate to toxicity, flammability, or chemical reactivity.

Chemical Protective Clothing and Equipment: Safe use of this type of protective clothing and equipment requires specific skills developed through training and experience. It is generally not available to, or used by, first responders. This type of special clothing may protect against one chemical, yet be readily permeated by chemicals for which it was not designed. It offers little to no protection against heat. Examples of this type of equipment have been described as Vapor Protective Suits, also known as Totally-Encapsulating Chemical Protective (TECP) Suits or Level A protection, and Liquid Splash Protective Suits, also known as Level B protection. No one suit will protect you from all hazardous materials. Do not assume any protective clothing is resistant to heat or flame exposure unless so certified by the manufacturer. Refer to *Protective Materials*, and to Chapters 2 and 6.
Chemosis: A swelling around the eye - a consequence of oedema of the conjunctiva.
CHEMTREC: An organization established in the United States, which stands for the Chemical Transportation Emergency Center. CHEMTREC is an emergency information center that can provide technical advise on how best to handle a specific hazard materials incident. In the U.S., the toll free number is 1-800-424-9300. Further information can be found in Chapters 1 and 8 of the handbook.
Chloracne: a skin desease resembling childhood acne but caused by exposure to chlorinated aromatic organic compounds.
Cholinesterase: Also referred to as an pseudocholinesterase inhibitor. A substance which inhibits the enzyme cholinesterase and thus prevents transmission of nerve impulses from one nerve cell to another or to a muscle.
Chromatograph: An instrument which can separate and analyze mixtures of chemical substances.
Chromosomal Aberration: An abnormality of chromosome number or structure.
Chromosome: The heredity-bearing gene carrier situated within the cell nucleus and composed of DNA and protein.
Chronic Effects: Chronic effects generally occur as a result of long-term exposure, and are of long duration. The term is often used to cover only carcinogenicity, teratogenicity, and mutagenicity. These effects are serious concerns in the workplace, however there are many other chronic effects such as blood dyscrasia (e.g., anemia), chronic bronchitis, and liver atrophy. The reader may refer to 52 FR 31884.
Chronic Toxicity: The effect of a chemical (or test substance) in a mammalian species (usually rodent) following prolonged and repeated exposure for the major part of the lifetime of the species used for the test. Chronic exposure studies over two years are often used to assess the carcinogenic potential of chemicals.
Cilia: Tiny hair-like "whips" in the bronchi and other respiratory passages that normally aid in the removal of dust trapped on these moist surfaces.
Cirrhosis: progressive disease of the liver.
Class A Explosive: Under the U.S. Department of Transportation (DOT) safety regulations, as per 49 CFR 173.53, there are nine types of Class A explosives including solid or liquid explosives, and ammunition, which can be detonated under conditions specified by DOT. These regulations provide specific descriptions of tests for the different types of Class A explosives.
Class B Explosive: Under the U.S. Department of Transportation (DOT) safety regulations, as per 49 CFR 173.88, Class B explosives are defined as those explosives which in general function by rapid combustion rather than detonation and include some explosive devices such as special fireworks, flash powders, some pyrotechnic signal devices and liquid or solid propellant explosives which include some smokeless powders. The regulations provide specific descriptions of and tests for Class B explosives.

Class C Explosive: Under the U.S. Department of Transportation (DOT) safety regulations, as per 49 CFR 173.100, Class C explosives are defined as certain types of manufactured articles which contain Class A, or Class B explosives, or both as components but in restricted quantities, and certain types of fireworks. The regulations include specific descriptions of, prescribed uses for, and tests for Class C explosives.

Clastogens: Agents which cause chromosome breakage.

Cohort: A group of individuals, identified by a common characteristic, who are studied over a period of time.

Colitis: inflammation of the large intestine.

Combustible Gas Indicator (CGI): Hazard Monitored: Flammable vapors and gases including alcohols, acids, aldehydes, ketones, esters, aromatics, amines, nitro compounds, high (lethal) concentrations of hydrogen sulfide, hydrogen cyanide, carbon monoxide, and ammonia. Application: This instrument is used to determine the concentration of flammable vapors and gases. This information is used to assess explosive potential and the risk of working in that type of atmosphere. This is a qualitative measurement only. Components: Aspirator bulb or pump to draw sample; meter readout with needle or LCD; audio and/or visual alarm; NICAD or regular batteries; zero and/or voltage adjustment. Detection Method: Combustion of vapor/gas on heated platinum filament. Operation: A sample of the atmosphere is drawn through the detector. The flammable components of the sample will combust on the surface of the platinum filament which increases the temperature of the filament. The increased temperature increases the electrical resistance reducing the current through the detector which is detected by a potentiometer. The change in current is indicated by an increase in the deflection of the meter needle. Readout: The meter provides an indication of 0 to 100 % of the LEL (lower explosion limit). When the concentrations are above the LEL, the meter will indicate greater than 100 %. With most CGIs, the meter will return to 0 when the concentrations are greater than the UEL (upper explosion limit). Instruments with audio and visual alarms can be set at whatever level desired by the operator. Calibration : The following is a list of commonly used CGIs and their calibration gases: MSA 260 (Pentane); MSA 2A (Pentane); Gastech (Hexane); National Mine (Methane). Calibration of CGIs should be checked before and after use. Actual calibration requires return of the instrument to the factory or by trained technicians. Limitations : Instrument sensitivity can be reduced by the following compounds: selenium compounds including hydrogen selenide, silicon compounds including silicone, arsenic, volatile heavy metals such as tetraethyl lead. High humidity may also reduce the instrument's sensitivity. Halogenated hydrocarbons can corrode the detector. The sensitivity of the CGI varies with different vapors and gases so it is only truly accurate when measuring the calibration gas.

Combustible Liquids: Any liquid having a flash point temperature above 100 °F but below 200 °F except any mixture having components with flash points of 200 °F or higher, the total volume of which make up 99 % or more of the total volume of the mixture. This definition can be found in 52 FR 31878. Also refer to 49 CFR 173.115.

Combustion: A chemical reaction caused by oxidation that produces light and heat. The production of light in the combustion process is the difference between oxidation and combustion: Oxidation, regardless of slowness, will give off heat but no light will be produced.

Common Name: The name originally given to a compound upon its discovery, prior to the adoption of an organized system of assigning proper names.

Complexing Agent: A material which forms a chemical complex with a second material (very tightly bound at the molecular level) when the two come in contact.

Compressed Gas: A gas that is under pressure, either still in the gaseous state, or liquified. The term *compressed gas* means: (i) a gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 °F; or (ii) a gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 °F, regardless of the pressure at 70 °F; or (iii) a liquid having a vapor pressure exceeding 40 psi at 70 °F as determined by ASTM D-323-72. Refer to 49 CFR 173.300.

Compressed Gas (Flammable): Under U.S. Department of Transportation regulations (refer to 49 CFR 173.300), any compressed gas is designated a flammable compressed gas if: (a) Either a mixture of 13 percent or less (by volume) with air forms a flammable mixture or the flammable range with air is wider than 12 percent regardless of the lower limit; (b) Using the Bureau of Explosives' (i) Flame Protection Apparatus, the flame projects more than 18 inches beyond the ignition source with the valve fully opened, or, the flame flashes back and burns at the valve with any degree of valve opening; (ii) Open Drum Apparatus, there is any significant propagation of flame away from the ignition source; (iii) Closed Drum Apparatus, there is any explosion of the vapor-air mixture in the drum.

Compressed Gas (Liquefied): Under U.S. Department of Transportation regulations (refer to 49 CFR 173.300), a liquefied compressed gas is defined as a gas which, under the charged pressure, is partially liquid at a temperature of 70 °F.

Compressed Gas (Non-liquefied): Under U.S. Department of Transportation regulations (refer to 49 CFR 173.300), a non-liquefied compressed gas is defined as a gas other than gas in solution which under the charged pressure is entirely gaseous at a temperature of 70 °F.

Compressed Gas (Refrigerant Gas or Dispersant Gas): The term *refrigerant gas* or *dispersant gas* applies to all flammable or nonflammable, nonpoisonous refrigerant gases, dispersant gases (fluorocarbons) referred to in 49 CFR 173.300 (i) and mixtures thereof, or any other compressed gas meeting one of the following: (a) a nonflammable mixture containing not less than 50 % fluorocarbon content, having a vapor pressure not exceeding 260 psig at 130 °F; (b) a flammable mixture containing not less than 50 % fluorocarbon content, not over 40 % by weight of a flammable component, having a vapor pressure not exceeding 260 psig at 130 °F.

Condensation: Act or process of reducing from one form to another denser form such as steam to water.

Conduction: The transfer of heat through a medium.

Conjugate: A water soluble derivative of a chemical formed by its combination with glucuronic acid, glutathione, sulphate, acetate, glycine etc.

Conjunctiva: The mucous membrane that covers the eyeball and the under-surface of the eyelid.

Contaminant (Air): A harmful, irritating, or nuisance material that is foreign to the normal atmosphere.

Control Limit: The limiting airborne concentration of potentially toxic substances which are judged to be "reasonably practicable" for the whole spectrum of work activities and which must not normally be exceeded.

Convection: The transfer of heat with a medium.

Cornea: transparent covering of the eye.

Corrosive: The term refers to a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in Appendix A to 49 CFR Part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours.

Corrosive Poison: A type of poison containing a strong acid or base which will severely burn the skin, mouth, stomach, etc.

Covalent Binding: The irreversible interaction of xenobiotics or their metabolites with macromolecules such as lipids, proteins, nucleic acids.
CSP: Abbreviation for Certified Safety Professional; a designation devised by the American Society of Safety Engineers.
Cracking: The breaking of covalent bonds, usually between carbon atoms.
Critical Pressure: The pressure required to liquify a gas at its critical temperature.
Critical Temperature: The temperature above which it is impossible to liquify a gas.
Crude Oil: Petroleum in its natural form before subjected to any refining process.
Cryogenic: Pertaining to liquified gases stored at temperatures approaching absolute zero. Normally, they have a boiling point of about -100°C.
Cryogens: Gases that must be cooled to a very low temperature in order to bring about a change from a gas to a liquid.
Cryogenic Gas: A gas with a boiling point of -150°F. or lower.
Cryogenic Liquid: A cryogenic liquid is a refrigerated liquefied gas having a boiling point colder than -130 °F at one atmosphere, absolute. A material that meets this definition is subject to the same requirements for compressed gases without regard to whether it meets the standard definition of a compressed gas.
Cumulative Effect: The result of some poisons which build up or are stored in the body so that small amounts contacted over a period of time can sicken or kill a person or animal.
Cutaneous Hazards: The term refers to a specific target organ characterization of effect. These are chemicals which affect the dermal layer of the body. Signs and symptoms include defatting of the skin; rashes; irritation. Examples are ketones and chlorinated compounds.
Cyanosis: Blue appearance of the skin, especially on the face and extremities, indicating a lack of sufficient oxygen in the arterial blood.
Cyclical: The structure of certain molecules where there is no end to the carbon chain; the molecule is a closed structure resembling a ring, where what would be the "last" carbon in the chain is bonded to the "first" carbon in the chain. There are cyclical compounds in which the closed structure contains the atoms of other elements in addition to carbon.
Cytochrome P-450: A haemprotein involved, e.g. in the liver, with Phase 1 reactions of xenobiotics.
Cytogenetics: The branch of genetics that correlates the structure and number of chromosomes with heredity and variation.
Cytoplasm: The ground substance of the cell In which are situated the nucleus, endoplasmic reticulum, mitochondria and other organelles.
Cytotoxic: Causing disturbance to cellular structure or function often leading to cell death.
Cystitis: inflammation of the bladder.

D

Databank: A databank contains preselected factual information in summary form, with a sophisticated search system to enable the right information to be located.
Database: Usually online computer-based bibliographic databases which provide references and in some cases abstracts of papers in the more recent literature.
Daughter: The term is used to describe the nuclide formed by the radioactive decay of another nuclide, which in this context is called the parent.
Decay Product: Refers to a nuclide, either radioactive or stable, resulting from the disintegration of a radioactive material.

Decomposition: The term is often used to describe a change in the composition of organic matter to a less complex form; may be accomplished by the introduction of heat, through the addition of neutralized chemicals, or through the process of biodegradation.

Decontamination: This term refers to the removal of hazardous materials from personnel and equipment to the extent necessary to prevent potential adverse health effects. Contaminated clothing and equipment should be removed after use and stored in a controlled area (referred to as the *hot zone*) until cleanup procedures can be initiated. In some cases, protective clothing and equipment cannot be decontaminated and must be disposed of in a proper manner.

Deflagration: This term refers to an exothermic reaction in a material which propagates from the burning gases to the unreacted material via conduction, convection and radiation. In this process the reaction zone progresses at a rate less than the velocity of sound.

Deflocculating Agent: An adjuvant which inhibits precipitation or the settling of solids in the suspension fluid.

Defoamer: Any chemical that prevents or minimizes frothing or foaming in another agent.

Degeneration: deterioration; worsening.

Degradability: Refers to the ability of a chemical to break down into less complex compounds or elements. The term *degradation* refers to the breakdown of a more complex chemical into a less complex form; the process can be the result of the action of microbes, oxidation, water, sunlight, or other agents.

Demyelination: A chemically produced condition which removes or severely damages the myelin sheath around the spinal cord and nerves.

Deoxyribonucleic acid (DNA): The constituent of chromosomes which stores the hereditary information of an organism in the form of a sequence of nitrogenous bases. Much of this information relates to the synthesis of proteins.
other agents.

Derivative: A compound made from a hydrocarbon by substituting another atom or group of atoms for one of the hydrogen atoms in the compound.

Dermal: Through or by the skin; of or penetrating the skin.

Dermal Irritation: A localized skin reaction resulting from either a single or multiple exposure to a physical or chemical entity at the same site. It is characterized by the presence of irritation (redness), oedema and may or may not result in cell death.

Dermal Toxicity: Refers to the degree that a poison is absorbed through the skin.

Dermatitis: Inflammation of the skin from any cause. There are two general types of skin reaction: primary irritation dermatitis and sensitization dermatitis.

Desiccant: A chemical that is capable of absorbing or removing moisture. The term *desiccation* refers to dehydration (removal of tissue moisture) by chemical or physical action.

Desiccation: Dehydration (removal of tissue moisture) by chemical or physical action.

Detector Tubes: Hazard Monitored: Specific vapors and gases. Application: This instrument is used to determine the concentrations of specific vapors or gases in atmosphere. Information can be used to assess hazards and to establish control methods. Components: Bellows or piston pump; detector tubes. Detection Method: Chemical reaction with color change. Operation: The sample is drawn through the detector tube at a constant flow rate. If the sample contains the vapor or gas in question, it will react with the chemical on the packing material. The result of the reaction is a color change. The chemical's concentration is directly proportional to the length of the colored stain. Readout: The tubes are normally read directly in ppm or % from a scale on the tube. Some tubes have scales in millimeters. With the latter type, the length of the stain is read in mm and referenced on the instructions; e.g., 10 mm = 150 ppm. Calibration: The tubes are supplied calibrated. The pump must be checked regularly to verify flow rate and sample volume per pump stroke. Limitations: Following is a list of problems that contribute to poor accuracy with this instrument: leaks in the pump, insufficient contact or analysis time, high humidity, high temperature, difficulty in reading the scale, interferences from other chemical compounds, improperly stored tubes, out-of-date tubes, operator error.

Detonation: The term is generally used to describe an exothermic reaction that is characterized by the presence of a shock wave in the material that establishes and maintains the reaction. The reaction propagates at a rate equal to or exceeding the speed of sound.

Deuterium: An isotope of hydrogen whose nucleus contains one neutron and one proton, thus making it nearly twice as heavy as the nucleus of normal hydrogen (normal hydrogen has a single proton). This material is commonly referred to as *heavy hydrogen*. It occurs naturally as 1 atom to 6,500 atoms of normal hydrogen and is not radioactive.

"Di-": The prefix that means two.

Diatomic: Two atoms, as in a *diatomic* molecule, which contains two atoms bound covalently to each other.

Diffusion Flame: The flame produced by the spontaneous mixture of fuel vapors or gases and air.

Dispersants: These are chemicals which reduce the surface tension between oil and water, thus facilitating he breakup and dispersal of an oil slick in the form of an oil-in-water emulsion.

Dispersing Agent: An adjuvant that reduces the attraction between particles.

Distribution: Dispersal of a xenobiotic and its derivatives throughout an organism or environmental matrix, including tissue binding and localization.

Dose: In the context of chemicals, the term *dose* means the amount, quantity, or portion of the chemical exposed to or applied to the target (e.g., a human being). It may also refer to a consistent measure used in toxicological testing to determine acute and chronic toxicities. An alternate definition is the amount of ionizing radiation energy absorbed per unit mass of irradiated material at a specific location, such as a part of the human body, measured in REMS, or an inanimate body, measured in rads.

Dose-Effect Curves: Demonstrate the relation between dose and the magnitude of a graded effect, either in an individual or in a population. Such curves may have a variety of forms. Within a given dose range they may be linear but more often they are not.

Dose Equivalent: The amount of effective radiation when modifying factors have been taken into account. The product of absorbed dose multiplied by a quality factor multiplied by a distribution factor, expressed numerically in units of REMS.

Dose Projections: A computed estimate of the potential dose to individuals at a given location. The projection is based upon the amount of pollutant released from a source or multiple sources and prevailing meteorological transport and dispersion parameters.

Dose Rate: The chemical's dose delivered per unit time; or the radiation dose delivered per unit time.

Dose-Response Curves: Demonstrate the relation between dose and the proportion of individuals responding with a quantal effect (q.v.). In general, dose-response curves are S-shaped (increasing), and they have upper and lower asymptotes, usually but not always 100 and 0%.

Dose-Response Relationship: The systematic relationship between the dose (or effective concentration) of a drug or xenobiotic and the magnitude (or intensity) of the response it elicits.

Dosimeter (dose meter): An instrument which measures the accumulated energy to which one may be exposed, i.e., noise, radiation, etc.

DOT: Abbreviation for the United States Department of Transportation.

Downwind: Refers to the direction toward which the prevailing wind is blowing. This term is important in evaluating the risks for potential receptors in the pathways of pollutant discharges. The reader should refer to Chapter 8 for a discussion of spills and isolation distances downwind from the source.
Dry Bulb Temperature: Temperature of air as determined by a standard thermometer.
Dry Chemical: A term applied to an extinguishing agent suitable for use on flammable liquids and electrical fires.
Dry-pipe Sprinkler Systems: A fire protection sprinkler system that has air instead of water under pressure in its piping; dry systems are often installed in areas subject to freezing.
Dry-pipe Valve: A valve in a dry-pipe sprinkler system designed so that moderate air pressure will hold back a much greater water pressure.
Dry Powder: A term applied to the extinguishing agent suitable for use on combustible metals.
Dusts: Solid particles generated by mechanical processes such as crushing and grinding, without any chemical change from the paren material. Their size range is typically between 0.1 and 100 microns.

E

Ecotoxicology: Is concerned with the toxic effects of chemical and physical agents in living organisms, especially on populations and communities within defined ecosystems; it includes transfer pathways of these agents and their interaction with the environment.
ED_{50}: The median effective dose (normally expressed as mg/kg or mg/g of body weight) producing a designated effect in 50 percent of the exposed test organism population.
Effective Concentration: The concentration of a chemical effective in producing a specified result such as an increase in oxygen consumption, paralysis, death, etc.
Electromagnetic Radiation: The propagation of varying electric and magnetic fields through space at the speed of light, exhibiting the characteristics of wave motion.
Elevated Storage System: A system of storing impounded water supplies above the grade level at which the water will be used.
Elutriator: A device used to separate respirable and non-respirable particulates such as the cyclone or horizontal types.
Emergency Action Plan: A written statement covering the actions employers and employees must take to insure employee safety from fire and other emergencies.
Emergency Medical Services (EMS): Functions required to provide urgent medical care for ill or injured patients, such as communications, transportation, medical personnel and/or administration.
Emetic: a chemical that induces vomiting.
Emission Standard: A quantitative limit on the emission or discharge of a potentially toxic substance from a particular source. The simplest system is uniform emission standard where the same limit is placed on all emissions of a particular contaminant.
Emphysema: A lung disease resulting from the enlargement of the alveoli accompanied by destruction of normal tissue.
Encephalitis: inflammation of the brain.
Encephalopathy: brain disease.
Endocrine gland: hormone-secreting gland.
Endolytic Insecticides: Systemic insecticides remaining in their original form until decomposed by the biological system.

Endoplasmic Reticulum: A complex pattern of membranes that permeates the cytoplasmic matrix of cells.
Endothermic: The absorption of heat. Endothermic materials produce products with more total energy than the reacting substance.
Environmental Protection Agency (EPA): The United States federal agency having the responsibility of implementing the Resource Conservation and Recovery Act and having responsibilities in administering and enforcing programs dealing with environmental problems of water and air pollution, toxic substances, pesticides, radiation, noise, and solid waste management.
Environmental Quality Standard (EQS): The concentration of a potentially toxic substance which can be allowed in an environmental component, usually air (air quality standard - or water, over a defined period. Synonym: ambient standard.
Enzymic (or enzymatic) Process: A chemical reaction or series of reactions catalyzed by an enzyme or enzymes. An enzyme is a protein which acts as a highly selective catalyst permitting reactions to take place rapidly in living cells under physiological conditions.
Epidemiology: The statistical study of categories of persons and the patterns of diseases from which they suffer in order to determine the events or circumstances causing these diseases.
Epigenetic Changes: Changes in an organism brought about by alterations in the action of genes. Epigenetic transformation refers to those processes which cause normal cells to become tumor cells without any mutations having occurred.
Epileptiform fits: seizures.
Epithelium: outermost living layer of the skin.
Eradicant Fungicide: Pesticides which kill fungus after it appears on or in a plant.
Erythema: Refers to a condition where abnormal redness of the skin appears, as in inflammation.
Eschar: The slough or dry scab that forms for example on an area of skin that has been burnt.
Esophagus: tube connecting mouth and stomach.
Essential Plant Operations: Plant operations such as the monitoring of plant power supplies, water supplies, and other essential services which cannot be shut down for every emergency alarm. They may also include chemical or manufacturing processes that must be shut down in stages or steps.
Ester: The hydrocarbon derivative with the general formula R-C-O-O-R'.
Esters: Organic compounds which may be made by interaction between an alcohol and an acid, and by other means and includes solvents and natural fats.
Etiologic Agent: An etiologic agent is a viable microorganism, or its toxin, which causes or may cause human disease. Refer to those agents listed by the U.S. Department of Health, Education, and Welfare in 42 CFR 72.3. The reader may also refer to 49 CFR 173.386.
Etiology: The study or knowledge of the causes of disease.
Ether: A hydrocarbon derivative with the general formula R-O-R'.
European Inventory of Existing Chemical Substances (ENMECS): This is a list of all chemicals either alone or as components in preparations supplied to a person in a Community Member State at any time between 1st January 1971 and 18th September 1981.
Eutrophication: A complex series of inter-related changes in the chemical and biological status of a water body most often manifested by a depletion of the oxygen content caused by decay of organic matter resulting from a high level of primary productivity and typically caused by enhanced nutrient input.
Evacuate: Means move all people from a threatened area to a safer place. To perform an evacuation, there must be enough time for people to be warned, to get ready, and to leave an area. If there is enough time, evacuation is the best protective action. Begin evacuating people nearby and those outdoors in direct view of the scene. When additional help arrives, expand the area to

be evacuated downwind and crosswind to at least the extent recommended in this guidebook. Even after people move to the distances recommended, they may not be completely safe from harm. They should not be permitted to congregate at such distances. Send evacuees to a definite place, by a specific route, far enough away so they will not have to be moved again if the wind shifts.
Evacuation warden: An employee designated to assist in the evacuation of employees from the workplace. **Evaporation**: The process by which molecules of a liquid escape through the surface of the liquid into the air space above.
Evaporation Rate: The ratio of the time required to evaporate a measured volume of a liquid to the time required to evaporate the same volume of a reference liquid under ideal test conditions. The higher the ratio, the slower the evaporation rate.
Exclusion Zone: The area surrounding a particular incident site (such as a spill, a fire, or a hazardous waste pile or subarea under remediation), wherein only trained and fully protected hazardous materials workers may enter to perform necessary operation.
Exothermic: The liberation of heat.
Explosive: The term refers to a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature. Refer to Class A, B and C Explosive for definitions important to hazardous materials transportation.
Explosive Range: The *explosive range* tells us that a certain mixture of fuel vapor and air is required for the vapor to become ignitable. It is essentially a concentration range for fuel in air, in which the vapors of a flammable material will burn. The terms *flammable limit* and *combustible limit* are often used to describe the explosive range. These three terms have identical meaning and are interchangeable with each other. See lower explosion limit and upper explosion limit.
Exposure: Property that may be endangered by a fire.

F

FDA: Abbreviation for the United States Food and Drug Administration.
FEMA: Abbreviation for the United States Federal Emergency Management Agency.
Fibrosis: The formation of fibrous tissue usually as a reparative or reactive process.
Field Sampling Instrumentation: Field sampling instrumentation are commonly employed for air quality sampling and to determine action levels that may warrant personal protection for worker safety. The purpose of conducting air monitoring falls into four primary objectives: namely for the purpose of selecting personal protective equipment such as respirators; to delineate areas within the work site where protection is needed; to assess potential health effects on workers; to determine medical monitoring requirements. Field instruments are useful because they can provide real time measurements; that is, they can provide an immediate measure of the quality of air or existence of contaminants and their potential threat to workers. Most field instruments have the disadvantage of providing more qualitative information as opposed to quantitative data that a laboratory could provide. The characteristics of filed instruments include portability, reliability, sensitivity, selectivity, amplification of measurement signals, they are designed to be inherently safe, and as already noted they provide fast response times to detection. The types of general survey instruments typically fall into the direct reading category. In general, they may be characterized as being able to detect and/or measure only specific classes of chemicals and are normally not designed to measure airborne concentrations below 1 ppm. Also, they are based on obtaining grab samples. Examples of direct reading survey instruments are oxygen meters (MSA, Industrial Scientific Corp.), combustible gas indicator or CGI (MSA, Industrial Scientific Corp.), photoionization detectors or the PID (HnU meter or Photovac TIP), the flame ionization detector or FID (the

Foxboro Century OVA), the spectrophotometer or IR instrument (Foxboro MIRAN), chemical specific instruments (MSA H_2S and CO Monitor), and real time dust monitors (MIE Miniram). In contrast to direct reading instruments the other option is sample collection followed by post laboratory analysis. This approach enables detection and measurement of specific chemical compounds. Airborne concentrations below 1 ppm can be readily detected, and the additional advantage of generating a TWA (time weighted average) sample is possible. Examples include sampling pump and adsorption tubes (Gilian and MSA models) and the sampling pump and filter cassettes (Gilian and MSA models).

Fire Brigade: An organization of industrial plant personnel who are trained to use the fire fighting equipment and to carry out fire prevention activities within the plant.

Fire Brigade Organization Statement: A written statement that identifies the scope of the fire brigade, organizational structure, training requirements, brigade size, and functions of the brigade members.

Fire Department Connection: Connections provided at ground level through which the fire department supplies sprinkler systems or standpipe systems.

Fire Detection Devices: The devices and connections installed in a building for the purpose of detecting the presence of heat, smoke, and/or flame.

Fire Door: A specially constructed, tested, and approved door installed for the purpose of preventing the spread of fire.

Fire Hazards: Conditions that are conducive to fire or are likely to increase the extent or severity of fire. The terms *hazard* or *hazardous* are also used to indicate the type of material or rate of burning.

Fire Point Temperature: The temperature a liquid must be before the released vapor is in sufficient quantity to continue to burn, once ignited.

Fire Prevention: Fire protection activities that deal with preventing fires starting by eliminating fire hazards through inspection and education programs.

Fire prevention code or ordinance: A law enacted in a political jurisdiction for the purpose of enforcing fire prevention and safety regulations.

Fireproof: The word *fireproof* is a misnomer as it means that something absolutely will not burn. Other terms such as *fire resistive* or *fire resistant* should be used to indicate the degree of resistance to fire.

Fire protection engineer: A graduate of an accredited institution of higher learning who has specialized in engineering problems related to fire protection.

Fire Pump: A water pump used in private fire protection for providing additional water supply to installed fire protection systems.

Fire Report: The official report of a fire, generally prepared by the person in charge of the fire incident.

Fire Resistive: Material and design of building construction meant to withstand the maximum effect of a fire for a specific period of time.

Fire Stream: A stream of water from a fire nozzle, used to control and combat fires.

Fire Tetrahedron: A four-sided, solid geometric figure that resembles a pyramid, with one of the sides forming the base. Each side indicates one of the four elements required to have fire.

Fire Triangle: A plane geometric figure in which the three sides of an equilateral triangle represent oxygen, heat, and fuel, the elements necessary to sustain combustion.

First Order Process: A chemical process where the rate of reaction is directly proportional to the amount of chemical present.

First-Pass Effect: Biotransformation of a xenobiotic before it reaches the systemic circulation. The biotransformation of an intestinally absorbed xenobiotic by the liver is referred to as a hepatic first-pass effect.
First Responder: A trained hazard materials specialist who is first to arrive at a hazard materials incident such as a spill.
Fissile Material: This term refers to radioactive materials. The term means any material consisting of or containing one or more fissile radionuclides. Fissile radionuclides are plutonium-238, plutonium-239, plutonium-241, uranium-233, and uranium-235. Neither natural nor depleted uranium are fissile material. **Fission**: The process in which large radionuclides fragment into smaller pieces and release radiation in the form of particles of energy. The splitting of an atomic nucleus into two parts accompanied by the release of a large amount of radioactivity and heat.
Fission Products: The nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by the fission fragments' radioactive decay.
Fit Factor (FF): The FF is the protection for a particular individual wearing a specific respirator. The FF must be measured using quantitative fit testing methods.
Flame Impingement: The points where flames contact the surface of a container or designated surface.
Flame Spread: The speed at which a flame will cross the surface of a material, influenced by the physical form of the fuel, air supply, the moisture content of the fuel, specific gravity, size and form, the rate and period of heating, and the characteristics/nature of the heat source. A higher flame-spread critically affects the severity of the fire in a given period of time.
Flammable: The term refers to a chemical that falls into one of the following categories: (a) aerosol, flammable, (b) gas, flammable, (c) liquid, flammable, (d) solid flammable.
Flammable Gas: The term *gas, flammable* means: (a) a gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 % by volume or less: or (b) a gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 % by volume, regardless of the lower limit.
Flammable Liquids: Any liquid having a flash point temperature below 100 °F.
Flammable Solid: The term *flammable, solid* means a solid other than a blasting agent or explosive that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard.
Flashover: The stage of a fire in which a room or other confined area becomes heated to the point that flames flash over the entire surface of the area.
Flash Point Temperature: The lowest temperature a liquid may be and still have the capability of liberating flammable vapor at a sufficient rate that, when united with the proper amounts of air, the air-fuel mixture will flash if a source of ignition is presented. The amounts of vapor being released at the exact flash point temperature will not sustain the fire and, after flashing across the liquid surface, the flame will go out.
Fly Ash: These are fine particles of ash of a solid fuel which are either carried out of the flue with waste gases produced during combustion or are recovered from the waste gases.
Foam: A sudslike extinguishing agent formed by mixing a foam-producing compound with water. Mechanical foam is produced by agitation, chemical foam is produced when two or more chemicals react.
Foaming Agent: A material which causes a chemical to form a thick foam; often applied to reduce drift or assist in the containment of certain types of chemical spills or fires.

Foam Generators: Devices for mixing chemical or mechanical foam in proper proportion with a stream of water to produce foam.
Foci: A small group of cells occurring e.g. in the liver distinguishable, in appearance or histochemically, from the surrounding tissue. They are indicative of an early stage of a lesion which may lead to the formation of neoplastic nodules or hepatocellular carcinomas.
Foetus: The young of mammals when fully developed in the womb. In human beings, this stage is reached after about 3 months of pregnancy. Prior to this, the developing mammal is at the embryo stage.
Fog Stream: A water stream of finely divided particles used for fire control.
Frame-Shift Mutation: A change in the structure of DNA such that the transcription of genetic information into RNA is completely altered because the start point for reading has been altered: i.e. the reading frame has been altered.
Frangible Disc: A safety release device that will burst at a predetermined pressure.
Free Burning: The second phase of burning in which materials or structures are burning in the presence of adequate oxygen.
Free Radical: An atom or group of atoms bound together chemically with at least one unpaired electron. A free radical is formed by the introduction of energy to a covalently bonded molecule, when that molecule is broken apart by the energy. It cannot exist free in nature and, therefore, must react quickly with other free radicals present.
Freezing Point: The temperature at which a liquid changes to a solid.
Fuel: Anything that will burn.
Fuel Oils: Refined petroleum products having specific gravities in the range of 0.85 to 0.98 and flash point temperatures above 55 °C. This includes auto diesel, industrial heating fuels, various bunker fuels, furnace fuels. Refer to Chapter 4 for specific examples and discussion of properties.
Fuel Value: Refers to the amount of potential energy that can be released by a fuel during combustion. Expressed in units of BTUs per pond of fuel. Examples are asphalt (17,158 BTU/lb typical value), LPG (18,000 BTU/lb), wood shavings (8,250 BTU/lb).
Fuel Oils: Refined petroleum products having specific gravities in the range from 0.85-0.98 and flash points greater than 55°C; includes furnace, auto diesel, and stove fuels, plant or industrial heating fuels and various bunker fuels.
Fugacity: The tendency for a substance to transfer from one environmental medium to another.
Full Protective Clothing: Clothing that will prevent gases, vapors, liquids, and solids from contacting the skin; includes helmet, self- contained breathing apparatus, coat and pants customarily worn by firefighters, rubber boots, gloves, bands around legs, arms and waist, and face mask, as well as covering for neck, ears, and other parts of head not protected by the helmet, breathing apparatus or face mask.
Fully Encapsulating Suit (FES): Sometimes referred to as a *Moon Suit*; personal protective clothing that provides complete skin, eye, and respiratory protection, and includes positive-pressure SCBA. The reader should refer to Chapter 2 for detailed discussions. Refer to Protective Materials.
Fumes: Solid particles formed by the condensation of vaporized solids, usually molten metals. Particles are much smaller than dusts with typical size ranges between 0.01 and 1.0 microns.
Functional Group: An atom or group of atoms, bound together chemically, that has an unpaired electron, which when it attaches itself to the hydrocarbon backbone, imparts special properties to the new compound thus formed.
Fungicide: Pesticide that controls or inhibits fungus growth.
Fusible link: A connecting link device that fuses or melts when exposed to heat. Used in sprinkler heads, fire doors, and ventilators.
Fusible plug: A safety relief device that will melt at a predetermined temperature.

G

Gallbladder: organ that secretes bile.
Gamma: A type of electromagnetic radiation; a form of ionizing radiation.
Gamma Rays: High energy, short wave-length electromagnetic waves, comprised of photons or fine packets of energy which travel in straight paths at the speed of light. Gamma rays are very penetrating but do not make the target radioactive. Gamma rays can be shielded against by the use of dense materials such as lead or depleted uranium.
Gas: A state of matter defined as a fluid with a vapor pressure exceeding 40 psia at 100° F.
Gasolines: Mixture of volatile, flammable liquid hydrocarbons used in internal combustion engines. Typical flash point temperature is around -40 °C.
Gastric: pertaining to the stomach.
Gastrointestinal Syndrome: Illness resulting from acute exposure to a chemical or ionizing radiation, resulting in damage to the gastrointestinal tract.
Gated Wye: A hose appliance that has one female inlet and two or more male outlets with a gate valve on each of the male outlets.
Gelling Agents: Chemicals that are used to increase the viscosity of oils or other substances; applied to reduce the rate of spread over a water body's surface during a spill.
Gene: A part of the DNA (q.v.) molecule which directs the synthesis of a specific polypeptide chain.
General Formula: The general molecular formula for an analogous series of compounds that will give the actual molecular formula for any member of the series as long as the number of carbon atoms in the compound is known. This number is substituted for the letter "*n*" in the formula.
Genetic Toxicology: The study of chemicals which can produce harmful heritable changes in the genetic information carried by living organisms in the form of deoxyribonucleic acid (DNA).
Genome: All the genes (q.v.) carried by a cell.
Genotoxic: Able to cause harmful heritable changes in DNA.
Genotype: The genetic constitution of an organism cf. Phenotype.
Glaucoma: increased pressure inside the eyes.
Glycerol: A series of substituted hydrocarbons with three hydroxyl radicals substituted for hydrogen atoms.
Glycol: A hydrocarbon derivative with two hydroxyl radicals substituted for two hydrogen atoms.
Glycosuria: glucose in the urine.
Gravimetric: Of or pertaining to measurement by weight.
Gravity Tank: An aboveground water storage tank for fire protection and water service. A water level of 100 feet provides a static pressure head of 43.3 psi minus friction loss in piping when water is flowing.
Grid System Water Mains: An interconnecting system of water mains in a cris-cross or rectangular pattern.
Guinea Pig Maximization Test: One of a number of skin tests for screening possible contact allergens. Considered to be a useful model for predicting likely moderate and strong sensitizers in humans.

H

H.A.D.(Heat Actuating Devices): Thermostatically controlled devices used to activate fire equipment, alarms, or appliances.

Haemosiderin: An iron-protein molecule; inter alia, a source of the iron required for hemoglobin synthesis.
Halide: A halogenated compound.
Halogenated: A compound that has had a halogen atom substituted for another hydrogen atom. A halogenated hydrocarbon is a hydrocarbon that has had at least one hydrogen atom removed and replaced by a halogen.
Halogenated Aromatic Hydrocarbons: A group of chemical compounds constructed primarily of carbon and hydrogen, containing one or more ring structures, thus giving then distinctive odors (aromatics). These compounds contain halogens (chlorine or bromine) which impart toxic effects. Examples are dioxin, PCBs, DDT (dichlorodiphenyltrichloroethane), and PBBs. To most biological substances, halogenated aromatic hydrocarbons are foreign, unnatural substances, metabolized with difficulty or not at all. They are soluble in fats and oils; most are not soluble in water. They tend to accumulate in the fatty tissue of animals and remain there indefinitely, their concentration increasing with the age of the animals.
Halogenation: The chemical reaction whereby a halogen is substituted for another atom, usually a hydrogen atom.
Halogens: The elements of group VIIA: fluorine, chlorine, bromine, iodine, and astatine.
Halon: Halogenated extinguishing agent. Halon extinguishes fires by inhibiting the chemical reaction of fuel and oxygen.
Handline: Small hoselines that can be handled and maneuvered without mechanical assistance.
Haploid: The condition in which the cell contains one set of chromosomes.
Hazardous Materials Classes: The hazard class of a hazardous material is indicated by its class (or division) number, or its class name. For a placard corresponding to the primary hazard class of a material, the hazard class or division number must be displayed in the lower corner of the placard. However, no hazard class or division may be displayed on a placard representing the subsidiary hazard of the material. The class or division number must appear on the shipping paper after each shipping name. The reader should refer to Chapter 1 for detailed information on hazardous materials classes.
Hazard (Toxic): The set of inherent properties of a chemical substance or mixture which makes it capable of causing adverse effects in man or the environment when a particular degree of exposure occurs.
Head Wave: A term important to oil spills. The term refers to an area of oil concentration which occurs behind and at some distance from containment booms. This area is significant to the positioning of mechanical recovery devices and is the region where droplet breakaway boom failure phenomenon is initiated when current flow exceeds critical velocity.
Health Hazard: The term refers to a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees.
Heat: A form of energy; the total amount of vibration in a group of molecules.
Heat Stress: The burden, or load of heat, that must be dissipated if the body is to remain in thermal equilibrium.
Heat Transfer: The movement and dispersion of heat by conduction, convection, or radiation.
Heavy Metals: High-density metallic elements generally toxic to plant and animal life in low concentrations (e.g. mercury, chromium, cadmium, arsenic, and lead).
Hematoma: swelling containing blood.
Hematopoietic: formation of blood cells.

Hematopoietic Agents: The term refers to a specific target organ characterization of effect. Hematopoietic agents are chemicals which act on the blood or hematopoietic system by decreasing hemoglobin function or depriving the body tissues of oxygen. Signs and symptoms include cyanosis; loss of consciousness. Examples are carbon monoxide and cyanides.
Hemoglobin: The red coloring matter of the blood which carries the oxygen.
Hemoglobinuria: hemoglobin in the urine.
Hemolysis: destruction of red blood cells.
Hemolytic anemia: loss of red blood cells resulting from destruction.
Hepatocyte: Liver cell; more specifically a parenchymal cell of the liver.
Hepatotoxic: Harmful to the liver.
Hepatotoxins: The term refers to a specific target organ characterization of effect. Hepatotoxins are chemicals which produce liver damage. Signs and symptoms are jaundice and liver enlargement. Examples are carbon tetrachloride and nitrosamines.
High Efficiency Particulate Air (HEPA) Filter: A HEPA filter is a particulate filter that has a removal efficiency of at least 99.97 % for 0.03 micron size particles. This types of filter is most often used when working with asbestos abatement projects.
Histology: The study of the anatomy of tissues and their cellular structure.
Histopathology: The study of microscopic changes in tissues.
HNU Photoionizer: Hazard Monitored: Organic and inorganic vapors and gases. Application: This instrument is used to determine the relative concentrations of air contaminants. Information can be used to establish levels of protection and other control measures such as action levels. It will not detect methane. Components: Survey probe with ultraviolet lamp (9.5, 10.2, 11.7 eV); needle meter readout; lead-acid gel battery; span potentiometer; range selector; zero control. Detection Method: Photoionization. Operation: Ultraviolet light photons are generated by the UV lamp and directed at the sample. If the energy of the photons is sufficient it will ionize the molecules of the vapor/gas in the sample. The amount of energy necessary to photoionize a molecule is represented by its Ionization Potential (IP). Thus the lamp energy must be equal to or greater than the IP of a compound. Once ionized, the freed electrons are collected at an electrode to generate a current. The greater the current, the higher the concentration. Readout: The meter can be read on the following ranges: 0-20, 0-200, 0-2000 ppm (span = 9.8 benzene equivalents). Calibration: The instrument is factory calibrated to benzene. The calibration should be checked before and after use with a calibration check gas. Once calibrated, the span setting can be changed. HNU Systems supplies isobutylene as a check as for the instrument. Limitations: Because the instrument is sensitive to many organic and inorganic vapors/gases, it cannot be used as a qualitative instrument in unknown situations. It is strictly qualitative except when the nature of the contamination is known and the instrument has been calibrated to or a calibration curve has been generated for the contaminant being monitored. High humidity reduces the instrument's sensitivity. Atmospheres with concentrations of vapors and gases above the detection limits of the instrument will cause inconsistent instrument behavior.
Homeostasis: The tendency in an organism toward maintenance of physiological and psychological stability.
Hormone: a biochemical secreted by the body that exerts an effect on an organ elsewhere in the body.
Horsepower: A measure of power; one horsepower is equivalent to a force that will raise 33,000 pounds one foot in one minute.
Hose Cabinet (Rack): A recessed cabinet in a wall that contains a wall hydrant and connected length of hose.

Hose Clamp: A mechanical device for compressing fire hose to stop the flow of water.
Hose Reel: Cylinders around which fire hose may be manually or mechanically rolled to keep it neat and orderly.
Hydrant Hose House: A structure built around a yard hydrant containing fire hose, nozzles, axes, and other fire fighting tools.
Hydrant Wrench: A specially designed tool used to open or close a hydrant and to remove hydrant caps.
Hydration: Process in which particles go into a water solution and become surrounded by a sheath of water molecules.
Hydrocarbon: A covalent compound containing *only* hydrogen and carbon.
Hydrocarbons: The basic building blocks of all organic chemicals which are composed solely of carbon and hydrogen. Hygroscopic. Readily absorbing or retaining moisture.
Hydrocarbon Backbone: The molecular fragment that remains after hydrogen atom is removed from a hydrocarbon; the hydrocarbon portion of a hydrocarbon derivative.
Hydrocarbon Derivative: A compound that began as a hydrocarbon, had a hydrogen atom removed from the chain somewhere, and had functional group attached to replace the hydrogen atom.
Hydrolysis: Hazardous waste chemical treatment method wherein chemical compounds are decomposed by a reaction with water; agents such as alkaline solutions as well as high temperatures and pressures are often used to promote desired reaction.
Hydrophilic: Refers to a substance or chemical that has a high affinity for moisture or water.
Hydrophobic: Refers to a substance or chemical that is poorly soluble in water; water repellant. A *hydrophobic agent* is a chemical having the ability to resist wetting by water. It can be used in the treatment of synthetic sorbents to decrease the amount of water absorbed, hence increasing the volume of oil they can absorb before becoming saturated.
Hydrosphere: Water above, on or in the Earth's crust, including oceans, seas, lakes, groundwater and atmospheric moisture.
Hydroxyl: The functional group of the alcohols; the structural formula is -O-H, usually written -OH.
Hygroscopic: The ability of a material to absorb moisture from air.
Hyperemia: congestion of blood vessels from excexx blood.
Hyperglycemia: high blood sugar level.
Hypergolic: Any material that spontaneously ignites upon contact with another. Many hygroscopics are used as rocket fuels.
Hypertension: high blood pressure.
Hypertrophy: exaggerated growth of a tissue.
Hypocholesterolaemia: A lowering of the cholesterol content of the blood.
Hypotension: low blodd pressure.
Hypotriglyceridaemia: A lowering of the triglyceride content of blood.

I

IDLH: Immediately Dangerous to Life and Health. The OSHA definition for IDLH is the maximum concentration of contaminant from which one can escape in 30 minutes without suffering irreversible health effects or escape-impairing effects such as dizziness, fatigue, impaired judgement, or slowing. Based on human and animal studies IDLH may be considered the LOEL (lowest observable effect level); or 500 x PEL if no other data are available; or any concentration that is above the chemical's Lower Explosive Limit (LEL). IDLH values can be found in AIHA Hygienic Guides, the NIOSH Pocket Guide, and commercial databases.

Ignitable Waste: A liquid with a flash point less than 60°C (140°F), a waste which is an oxidizer, or ignitable compressed gas or non-liquid which is liable to cause fires through friction, absorption of moisture, spontaneous chemical changes or when ignited burns so vigorously and persistently as to create a hazard.

Ignition Continuity: The continuation of burning caused by the radiated heat of the flame.

Ignition temperature: The exact minimum temperature that has the capability of igniting a flammable vapor mixture.

Immediately Dangerous to Life or Health Concentration (IDLHC: The maximum exposure concentration from which one could escape within 30 minutes without any escape impairing symptoms or any irreversible health effects. This value should be referred to in respirator selection.

Immobilization Threshold: The minimal amount of a substance causing cessation of movement in a test organism when applied in a particular manner.

Immune response: The development of specifically altered reactivity following exposure to an antigen. This may take several forms, e.g. antibody production, cell-mediated immunity. immunological tolerance.

Immunotoxic: Harmful to the immune system.

Incident Command System (ICS): An ICS is an organized approach to control and manage operations at an emergency incident. The OSHA Hazardous Waste Operations and Emergency Response regulations (29 CFR 1910.120 (q) (3) (iii)) require that and ICS be implemented by the senior emergency response official on the scene. The reader should refer to Appendix 6, of the OSHA rule for more information on ICS.

Incipient Stage Fire: A fire in its beginning stage that can be controlled or extinguished using portable fire extinguishers, Class II standpipe, or small hose systems without the need for protective clothing or breathing equipment.

Incompatible Waste: (1) A hazardous waste unsuitable for placement within a specific portion of a landfill because it may cause containment material to corrode or decay or, when combined with other wastes, might produce heat, pressure, fire, explosion, violent reaction, toxic dusts, mists, fumes, or gases. (2) Hazardous wastes which, if mixed, would become more hazardous than either waste individually.

Indirect Application: A method of extinguishing fire by applying water fog into a superheated atmosphere to obtain the maximum heat absorption and steam generation for smothering and cooling the fire area.

Inert (chemical): Not having active properties.

Inflammable Liquids: Liquids emitting vapors which become combustible at a certain temperature.

Initiator: An agent which starts the process of tumor formation, usually by action on the genetic material.

Inorganic: Term used to designate compounds that generally do not contain carbon.

In-Place Protection: Means people go inside a building and remain inside until the danger passes. In the case of short-term spills and toxic vapor clouds, the material may be deflected by a multi-story building and pass by without affecting the occupants of the building. In-place protection if used when evacuating the public would cause greater risk than staying where they are, or when an evacuation cannot be performed. Direct the people inside to close all doors and windows and to shut off all ventilating, heating and cooling systems. In-place protection may not be the best option if:

(a) the vapors are flammable;

(b) if it will take a long time for the gas to clear the area; or
(c) if buildings cannot be tightly closed.
Vehicles can offer some protection for a short period if the windows are closed and the ventilating systems are shut off. They are not as effective as buildings for in-place protection.
Input Heat: The amount of heat required to produce the evolution of vapors from a solid or liquid.
In Vitro: Biological processes occurring (experimentally) in isolation from the whole organism.
Interior Structural Fire Fighting: The act of fire suppression and rescue inside buildings or enclosed structures where a fire has gone beyond the incipient stage.
Intoxication: state of being poisoned by a toxic chemical.
Irritant: The term refers to a chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for four hours exposure or by other appropriate techniques, it results in an empirical score of five or more. A chemical is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.
Ischaemia: A deficiency of blood supply to a part of the body relative to its localized requirements.
"Iso": The prefix (meaning the same) given to a compound having the same number and kind of atoms as another compound, as in *iso*mer.
ISO: International Organization for Standardization. An international standards-writing body headquartered in Geneva, Switzerland, composed of national standards associations from some 55 countries. All member countries are given equal status and are entitled to one vote regardless of size or economic development. Technical work is carried on in committees.
Isomer: A compound with a molecular formula identical to another compound but with a different structural formula. That is, a compound may possess exactly the same elements, and exactly the same number of atoms of those elements as another compound, but those atoms are arranged in a different order from the first compound.
Isotope: One of two or more atoms with the same atomic number (the same chemical element) but with different atomic weights; isotopes usually have very nearly the same chemical properties but somewhat different physical properties.
i. v.: Abbreviation for intravenous (administration).

K

Keratosis: inflammation of the cornea.
Ketone: A hydrocarbon derivative with the general formula R-C-R'.
Kinetic Molecular Theory: A theory that states all molecules are in constant motion at all temperatures above absolute zero; molecules will move (or vibrate) faster at higher temperatures because of the energy absorbed.

L

Laryngeal: upper throat area.
Larynx: voice box.
Latent Heat of Vaporization: The amount of heat a substance must absorb when it changes from a liquid to a vapor or gas.
Latent Period: The time which elapses between exposure and the first manifestation of damage.

LC_{50}: Concentration of an active ingredient in the air which, when inhaled, kills half of the test animals exposed to it; expression of a compound's toxicity when present in the air as a gas, vapor, dust, or mist; generally expressed in ppm when a gas or vapor, and in micrograms per liter when a dust or mist: often used as the measure of acute inhalation toxicity. The lower the LC_{50} number value the more poisonous the pesticide.
LD_{50} : Dosage or amount of an active ingredient which, when taken by mouth or absorbed by the skin, kills half of the test animals exposed; an expression used to measure acute oral or acute dermal toxicity.
LD_{100}: The dose of an active ingredient taken by mouth or absorbed by the skin which is expected to cause death in 100% of the test animals so exposed.
Lesion: A pathological disturbance such as an injury, an infection or a tumor.
Lethal Concentration: Amount of toxic substance in air which will likely cause death if inhaled.
Lethal Dosage: (1) Amount of a toxic substance which is likely to cause death when ingested. (2) Dose of ionizing radiation sufficient to cause death; media lethal dose (MLD or LD50) is amount required to kill within a specified period of time (usually 30 days) half of the organisms exposed; the LD50/30 for people is about 400-450 roentgens.
Lethal Time (LT): The time required for a defined dose of toxicant to produce a given mortality level in a test organism.
Lesion: deseased or damaged tissue.
Levels of Protection: These are designated levels of skin, eye and respiratory protection for hazard materials workers. There are four levels of protection defined under OSHA standards. Following is a summary of the OSHA recommended levels of personal protection. *Level A* - Recommended Personal Protective Equipment: Positive pressure-demand, full face SCBA or positive-pressure demand supplied air respirator with escape SCBA. Fully encapsulating, chemical-resistant suit. Inner chemical-resistant gloves. Chemical-resistant, safety boots/shoes. Two-way radio communications. Optional Recommended Equipment: Cooling unit. Coveralls. Long Cotton Underwear. Hard Hat. Disposable Gloves and Boot Covers. Protection Provided: The highest level of respiratory, skin, and eye protection. Conditions Under Which Should Be Used: The chemical substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system on either: - measured (or potential for) high concentration of atmospheric vapors, gases, or particulates or - site operations and work functions involving a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to the skin or capable of being absorbed through the intact skin. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible. Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection is determined. Limiting Criteria: Fully encapsulating suit material must be compatible with the substances involved. *Level B* - Recommended Personal Protective Equipment: Positive pressure-demand , full facepiece SCBA or positive pressure-demand supplied-air respirator with escape SCBA. Chemical-resistant clothing (overalls and long-sleeved jacket; hooded one- or two-piece chemical splash suit; disposable chemical-resistant one-piece-suit). Inner and outer chemical-resistant gloves. Chemical-resistant safety-boots/shoes. Hard hat. Two-way radio communications. Optional Recommended Equipment: Coveralls. Long Cotton Underwear. Face Shield. Hard Hat. Disposable Gloves and Boot Covers. Protection Provided: The same level of respiratory protection, but less skin protection than Level A. It is the minimum level recommended for initial site entries until the hazards have been further identified. Conditions under Which Should Be Used: The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection. This involves atmospheres which have IDLH

concentrations of specific substances that do not represent a severe skin hazard; or atmospheres that do not meet the criteria for use of air-purifying respirators; or atmospheres that contain less than 19.5 % oxygen, which is the minimum safe level. This level of protection should be used when the presence of incompletely identified vapors or gases is indicated by direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin. This level of protection should also be used when operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection is determined. Limiting Criteria: Use only when the gases and vapors present are not suspected of containing high concentrations of chemicals that are harmful to shin or capable of being absorbed through the intact skin. Use only when it is highly unlikely that the work being done will generate either high concentrations of vapors, gases, or particulates or splashes of material that will affect exposed skin. *Level C* - Recommended Personal Protective Equipment: Full facepiece, air-purifying canister equipped respirator. Chemical-resistant clothing (overalls and long-sleeved jacket; hooded one- or two- piece chemical splash suit; disposable chemical-resistant one-piece suit). Inner and outer chemical-resistant gloves. Chemical-resistant safety boots/shoes. Hard hat. Two-way radio communications. Optional Recommended Equipment: Coveralls. Long Cotton Underwear. Face Shield. Disposable Boot Covers. Escape Mask. Protection Provided: The same level of skin protection as Level B, but a lower level of respiratory protection. Conditions under Which Should Be Used: The atmospheric contaminants, liquid splashes, or other direct contact will not adversely effect any exposed skin. The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant. All criteria for the use of air-purifying respirators are met. Limiting Criteria: Atmospheric concentration of chemicals must not exceed IDLH levels. The atmosphere must contain at least 19.5 % oxygen, which is the minimum safe level. *Level D* - Recommended Personal Protective Equipment: Coveralls, Safety boots/shoes, safety glasses or chemical splash goggles, hard hat. Optional Recommended Equipment: Gloves, face shield, escape mask. Protection Provided: No respiratory protection and minimal skin protection. Conditions under Which Should Be Used: The atmosphere contains no known hazard. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals. Limiting Criteria: This level should not be worn in the Exclusion Zone of a hazardous work site. The atmosphere must contain at least 19.5 % oxygen, which is the minimum safe level.

Leukemia: cancer of the blood cells.

Limit value (LV): The limit at or below which Member States of the European Community must set their environmental quality standards and emission standards. These limits are set by Community Directives.

Liquid: A fluid with a vapor pressure no higher than 40 psia.

Liquified Gas: A gas that has been converted to a liquid by pressure and/or cooling.

Liver Nodule: A small node, or aggregation of cells within the liver.

Local Alarm System: A combination of alarm components designed to detect a fire and to transmit an alarm on the immediate premises.

Looped Water Main: A water main arranged in a complete circuit so water will be supplied to a given point from more than one direction. Also called a grid system.

Lower Explosion Limit (LEL): The LEL is expressed as a percentage of the total volume of the air-fuel mixture; it is the lowest concentration of vapor fuel in air under which spontaneous combustion will occur. An example is gasoline. A mixture containing 1.5% gasoline vapor in air (concentration of air being 98.5% in this mixture) will spontaneously combust. The LEL in this

example is 1.5% or simply 1.5. Below this concentration, the mixture is described as being too "lean"; or in other words, there is insufficient fuel for spontaneous combustion to occur.
Lymph: clear, yellow fluid found throughout the body.
Lymph nodes: glands that produce lymph.
Lymphatic system: vessels that carry the lymph to the body.

M

Macrophages: A large phagocytic cell found in connective tissues, especially in areas of inflammation.
Malignancy: A cancerous growth. (A mass of cells showing both uncontrolled growth and the tendency to invade and destroy surrounding tissues).
Malignant: very injurious or deadly.
Mammary tissue: milk-producing tissue of the breast.
Manometer: Instrument for measuring pressure; essentially a U-tube partially filled with a liquid (usually water, mercury, or a light oil), so constructed that the amount of displacement of the liquid indicates the pressure being exerted on the instrument.
Maximum Allowable Concentration (MAC): Exposure concentration not to be exceeded under any circumstances.
Maximum Use Concentration (MUC): Also known as the Maximum Use Level or MUL. It is the maximum outside contaminant concentration a respirator can adequately protect against. The MUC can be calculated from the following relation: MUC = PF or FF x PEL (or other standard). The MUC is limited to a chemical cartridge's rated capacity.
Median Effective Concentration (EC_{50}): The concentration of toxicant or intensity of other stimulus which produces some selected response in one half of a test population.
Median Effective Dose (ED_{50}): The statistically derived single dose of a substance that can be expected to cause a defined nonlethal effect in 50% of a given population of organisms under a defined set of experimental conditions.
Median Lethal Concentration (LC_{50}): The concentration of a toxicant lethal to one half of a test population.
Median Lethal Dose (LD_{50}): The statistically derived single dose of a chemical that can be expected to cause death in 50% of a given population of organisms under a defined set of experimental conditions. This figure has often been used to classify and compare toxicity among chemicals but its value for this purpose is doubtful. One commonly used classification of this kind is as follows:

Category	LD_{50} Orally to Rat mg/kg body weight
Very toxic	<25
Toxic	>25 to 200
Harmful	>200 to 2000

Melting Point: The temperature at which a solid changes to a liquid.
Mesothelioma: A tumor of the mesothelium of the pleura, pericardium or peritoneum, arising as a result of the presence of asbestos bodies. A locally malignant spreading tumor diagnostic of exposure to asbestos.
Metabolic Activation: The biotransformation (q.v.) of relatively inert chemicals to biologically reactive metabolites.

Metabolism (Heat): Energy resulting from physical and chemical changes which are constantly occurring in the body. Term used for heat stress evaluation.
Methemoglobinemia: type of blood disease.
Microbar: A unit of pressure, commonly used in acoustics which equals 1 dyne per square centimeter or one newton. A reference point for the decibel, is 0.0002 dyne per square centimeter, or 20 Newtons/M^2.
Micron: A unit of length equal to 10^{-4} centimeter, approximately 1/25,000 of an inch.
Mists: Liquid particles generated by physical processes such as splashing, vaporization and condensation.
Mixed Function Oxidases: Oxidizing enzymes which are involved in the metabolism of many foreign compounds giving products of different toxicity from the parent compound.
Molecular Formula: A method of representing a molecule by a written formula, listing which atoms and how many of them are in the molecule, without showing how they are bonded to each other. **Monitor:** The measurement of the environmental factors which may adversely affect health.
"Mono-": The prefix that means one.
Monomer: A simple, small molecule that has the special capability of reacting with *itself* to form a giant molecule called a polymer.
Mucous membrane: tissue lining of nose, mouth, esophagus, stomach, and intestine.
Multigeneration Study: A toxicity test in which at least three generations of the test organism are exposed to the chemical being assessed. Exposure is usually continuous.
Mutagen: Substance causing genes in an organism to mutate or change.
Mutagenic: Capable of producing a genetic change.
Mutagenic Agent: A chemical agent bringing changes in the hereditary makeup of the individual when applied to a living organism, resulting in progeny differing from the parent in some respect.
Mutagenesis: The production of mutations. Any chemical which causes mutations is said to be mutagenic. Some mutagenic chemicals are also carcinogenic. See *Carcinogenesis* .
Munant: an organism that has undergone a generic change.
Mutation: Any relatively stable heritable change in the genetic material.

N

Naphtha: Various volatile and often flammable liquid hydrocarbon mixtures used as solvents and diluents; consists mainly of hydrocarbons with higher boiling point than gasolines and lower boiling point than kerosene; principal component of chemical dispersants used prior to 1970.
Naphthenes: Class of hydrocarbons with similar physical and chemical properties to alkanes; insoluble in water, generally boil at 10-20°C higher than corresponding carbon number alkanes.
Narcosis: Stupor or unconsciousness produced by chemical substances.
Nausea: upset stomach; feeling of need to vomit.
Necrosis: Death in a particular part of a living tissue; example: death of a certain area of a leaf.
"Neo-": A prefix given to an isomer of another compound. It exists in compounds that were named long ago and is used only when the compound it best known by its common name.
Neoplasm: Any new and morbid formation of tissue e.g. a malignancy.
Nephritis: inflammation of the kidneys.
Nephrotoxic: Harmful to the kidney.
Nephrotoxins: The term refers to a specific target organ characterization of effect. Nephrotoxins are chemicals which produce kidney damage. Signs and symptoms are edema and proteinuria. Examples are halogenated hydrocarbons and uranium.

Neurotoxins: The term refers to a specific target organ characterization of effect. Neurotoxins are chemicals which produce their primary toxic effects on the central nervous system. Signs and symptoms are narcosis, behavioral changes, and decrease in motor functions. Examples are mercury and carbon disulfide.
Nephrosis: kidney degeneration.
Neurogenic: pertaining to the nerves.
Neurologic: pertaining to the nervous system.
NFPA : National Fire Protection Association
NIOSH: Abbreviation for National Institute of Occupational Safety and Health.
Nitrophenols: Synthetic organic pesticides containing carbon, hydrogen, nitrogen, and oxygen: used as wood preservatives, fungicides, or disinfectants: affect liver and central nervous system in the human body.
Non-Target Organisms: Those organisms which are not the intended specific targets of a particular use of a pesticide.
No Observed Effect Level (NOEL): The maximum dose or ambient concentration which an organism can tolerate over a specific period of time without showing any adverse effect and above which adverse effects are detectable.
"Normal": The designation given to a straight-chain compound that has isomers. The designation in the molecular formula is an *"n-"* in front of the formula.
Nuisance Dust: Generally refers to innocuous dust, not recognized as the direct cause of a serious pathological condition.

O

Occupational Hygiene: The applied science concerned with the recognition, evaluation and control of chemicals, physical and biological factors arising in or from the workplace which may affect the health or well-being of those at work or in the community.
Ocular: Relating to the eye.
Olfactory: pertaining to the sense of smell.
Olefins: A synonym for the alkene series.
On Scene Commander (OSC): The overall coordinator of an oil spill response team, usually a representative of an oil company, a government official, or an independent oil spill cleanup contractor; responsible for on-site strategical decisions and actions throughout each phase of a cleanup operation and who maintains close liaison with the appropriate government agencies to obtain support and provide progress reports on each phase of the emergency response.
Oral Toxicity: How poisonous a pesticide is to an animal or person when taken by mouth.
Organelle: A structure with a specialized function which forms part of a cell.
Organic : Term used to designate chemicals that contain carbon. To date nearly one million organic compounds have been synthesized or isolated. Many occur in nature; others are produced by chemical synthesis.
Organic Peroxide: The term refers to an organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.
Organic Vapor Analyzer (OVA): Hazard Monitored: Toxic concentrations of organic vapors. Application: This instrument is used to determine the relative concentrations of air contaminants. The information is used to establish levels of protection and other control measures such as site specific action levels. When equipped with the gas chromatograph option, it can be used for limited

qualitative assessment of samples. Components: Survey probe with meter readout; self-contained hydrogen cylinder for detector; low and high audible alarm; range selector; lead-acid gel battery; gas select control; pressure gauges. Detection Method: Flame ionization. Operation: The sample is drawn by a pump to the detector where it is ionized (combusted). The electrons released are collected at an electrode which generates a current. The greater the current, the higher the concentration of contaminant. The instrument will detect only organic compounds. Readout: The meter can be read on the following ranges: 0-10, 0-100, 0-1000 ppm methane equivalent. Calibration: The instrument is factory calibrated to methane. The calibration should be checked before and after use with a calibration check gas. Limitations: The instrument used in the survey mode in unknown atmospheres is strictly qualitative. Because the instrument is extremely sensitive to methane, it has limited application in areas where toxic vapors and gases are found with methane because the methane masks the other compounds. It is limited to about 8 hours of use due to hydrogen supply and battery life. Its use requires very high grade hydrogen: 99.95% pure. This instrument requires more training than other instruments when used in the gas chromatograph mode.

Organophosphate: Synthetic organic pesticides that contain carbon, hydrogen, and phosphorous; highly toxic to humans as they prevent proper transmission of nerve impulses.

ORM (Other Regulated Material): Under U.S. Department of Transportation regulations, an *Other Regulated Material* (ORM) is a material that: (a) May pose an unreasonable risk to health and safety or property when transported in commerce; and (b) Does not meet any of the definitions of the other hazard classes specified in subchapter C of the regulation; or (c) Has been reclassified an ORM (specifically or permissively).

ORM-A: This is a U.S. designation, where the reader should refer to 49 CFR 173.500. An ORM-A material is a material which has an anesthetic, irritating, noxious, toxic, or other similar property and which can cause extreme annoyance or discomfort to passengers and crew in the event of leakage during transportation. A list of the chemicals specified as ORM-A materials can be found in the regulation.

ORM-B: This is a U.S. designation, where the reader should refer to 49 CFR 173.500. An ORM-B material is a material (including a solid when wet with water) that is capable of causing significant damage to a transport vehicle from leakage during transportation. Materials meeting one or both of the following criteria are ORM-B designated materials: (a) A liquid substance that has a corrosion rate exceeding 0.250 inch per year on aluminum at a test temperature of 130 °F; and (b) Specifically designated by name in the Hazardous Materials Table found in 49 CFR 172.101.

ORM-C: This is a U.S. designation, where the reader should refer to 49 CFR 173.500. An ORM-C material is a material which has other inherent characteristics not described as an ORM-A or ORM-B but which make it unsuitable for shipment unless properly identified and prepared for transportation. Each ORM-C material is specifically named in the Hazardous Materials Table found in 49 CFR 172.101.

ORM-D: This is a U.S. designation, where the reader should refer to 49 CFR 173.500. An ORM-D material is a material such as a consumer commodity, which though otherwise subject to certain regulations, presents a limited hazard during transportation due to its form, quantity and packaging. They must be materials for which exceptions are provided in 49 CFR 172.101. A shipping description applicable to each ORM-D material or category can be found in the Hazardous Materials Table found in 49 CFR 172.101. In order to be transported under the proper shipping name of *consumer commodity*, a material must meet the that definition. It may be reclassified and offered for shipment as ORM-D material provided that an ORM-D exception is authorized in specific sections applicable to the material.

ORM-E: This is a U.S. designation, where the reader should refer to 49 CFR 173.500. An ORM-E is a material that is not included in any other hazard class, but is subject to the requirements of Title 49, Subchapter C. ORM-E materials include hazardous waste and substances as defined in 49 CFR 171.8.
OSHA: Abbreviation for Occupational Safety and Health Act.
OS & Y Valve: A type of outside screw and yoke valve used on piping or in pits connected to sprinkler systems. The position of the stem shows the valve to be either open or closed.
Osteroporosis: a condition in which bones become very fragile.
Osteosclerosis: hardening of bone tissue.
Ovarian: pertaining to the egg-forming organ in the female reproductive system.
Oxidation: The chemical combination of any substance with oxygen.
Oxidizer: The term refers to a chemical other than a blasting agent or explosive that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.
Oxygen Deficiency: An atmosphere having less than the percentage of oxygen found in normal air. Normally, air contains about 21 per cent oxygen at sea level. When the oxygen concentration in air is reduced to approximately 16 per cent, many individuals become dizzy, experience a buzzing in the ears, and have a rapid heartbeat. OSHA indicates 19.5% as the lower limit of oxygen acceptable in industry.
Oxygen Meter: Hazard Monitored: Oxygen deficient atmospheres. Application: The instrument is used to determine atmospheric oxygen concentration. The information can be used to assess the presence of other asphyxiant, flammable or toxic gases/vapors. The information is also considered in respirator selection. Components: Aspirator bulb or pump to draw sample, but also can be passive; meter readout with needle or LCD; audio and/or visual alarm or neither; NICAD or regular batteries; calibration adjustment. This instrument can be combined with a CGI and/or gas specific detection instrument such as a H_2S meter. Detection Method: Electrochemical cell. Operation: A sample of the atmosphere is drawn or allowed to diffuse into the detector. Oxygen in the sample reacts with the electrolyte n the cell generating a current. The higher the concentration, the greater the current. A potentiometer detects the increased current which is read on a meter needle or LCD. Readout: The instrument reads out as percent oxygen. Most instruments read from 0 to 25 % oxygen. Calibration : The instrument is easily calibrated to ambient oxygen in a clean atmosphere by adjusting a screw or knob. It should be calibrated at the same temperature and pressure it will be used in. Limitations : The instrument can be affected by temperature and pressure. Oxidizers can cause increased readings. Carbon dioxide can reduce instrument sensitivity.

P

Packing Group: This is a U.S. Department of Transportation designation that is assigned to a hazardous material in transport. The designation must appear by law on shipping papers and manifests. The Packing Group is designated by an upper case Roman Numeral **I**, **II**, or **III** depending on the degree of hazard. The designations are as follows : **I** refers to *Most Hazardous*; **II** refers to *Moderately Hazardous*; **III** refers to *Least Hazardous*. The reader should refer to Title 49, CFR, Section 172.101 (Hazardous Materials Table).
Pancreas: insulin producing gland.
Pancreatitis: inflammation of the pancreas.
Papilloma: type of tumor.
Paraffin Series: An older name given to the alkanes.

Parakeratosis: Imperfect formation of horn cells of the epidermis.
Parenchyma(-al): The specific or functional constituent of a gland or organ.
Partition Coefficient: A constant ratio that occurs when a heterogeneous system of two phases is in equilibrium; the ratio of concentrations (or strictly activities) of the same molecular species in the two phases is constant at constant temperature.
Pathogen: Any disease-producing organism.
PEA: Professional Environmental Auditor, a designation devised and trademarked by the author.
Pendent sprinkler: An automatic sprinkler head designed for placement and operation with the head pointing downward from the piping.
Periorbital: area surrounding the eye socket.
Peripheral nervous system: nervous system controlling the arms and legs.
Periphral neuritis: pertaining to the body cavity that surrounds all the abdominal organs.
Permeability: The property of soil or rock allowing passage of water through it; depends not only on the volume of openings and pores, but also on how these openings are connected to each other.
Peroxide: The hydrocarbon derivative with the general formula R-O-O-R'; also the name of the peroxide radical which has the structural formula -O-O-.
Personal Protective Clothing: Clothing and equipment such as coat, boots, pants, helmet, gloves, and breathing apparatus that shield the body from heat, smoke, fumes, and other harmful conditions.
Pesticides: Those chemicals used in agriculture to control the severity and incidence of pests and diseases which reduce agricultural yields; in addition, they have a number of non-agricultural uses.
pH: Means used to express the degree of acidity or alkalinity of a solution with neutrality indicated as 7.
Phagocytosis: The ingestion of micro-organisms, cells, and foreign particles by phagocytes; hence phagocytic *Macrophages*.
Pharmacodynamics: The study of the way in which xenobiotics exert their effects on living organisms. Synonym: toxicodynamics.
Pharmacokinetics: The study of the movement of xenobiotics within an organism. Such a study must consider absorption, distribution biotransformation, storage and excretion. Synonym: toxicokinetics.
Pharyngeal: pertaining to the pharynx.
Pharynx: sac surrounding the mouth, nose, and esophgus.
Phases of Fire: A degree of flame progression. Phase I, fire in incipient stage and beginning to grow. Phase II, free burning, flame propagation is at its greatest. Phase III, oxygen is deficient in the burn area, producing a smoldering phase.
Phenyl: The general name for the radical of benzene.
Pheromones: Chemicals produced by insects and other animals to communicate with other members of the same species; some are used to monitor insect populations; most pheromones used today are synthetic.
Phlebitis: inflammation of a vein.
Photoallergy: allergic response to a combination of a chemical and sunlight.
Photodegradable: Able to decompose through a chemical reaction initiated by direct exposure to the sun's ultraviolet light.
Photosensitization: word used to describe either photoallergy or phototoxicity.
Phototoxicity: irritant response to a combination of a chemical and sunlight.

Physical Description: A brief summarization of the form of a substance, specifying whether it is solid, powder, flakes, crystals, liquid, gas, etc., accompanied by identification of color and odor where applicable.
Phytotoxic: Poisonous to plants.
Physiology: The science and study of the functions or actions of living organisms.
Pigmentation: coloration.
Piscicide: Pesticide used to control fish.
Placards: (1) Diamond-shaped markers 10-3/4" square required on a transporting vehicle such as a truck or tank car or a freight container 640 cu ft or larger. (2) Diamond-shaped sign required on outside of vehicles transporting radioactive materials displaying same standard warning terms and symbols as a label. (3) Paper forms of various designs used to identify RR cars requiring special attention (dangerous, explosives, etc.).
Plasma: fluid part of blood and lymph.
Pleural thickening: thickening of tissue surrounding the lungs.
Pleurisy: inflammation ofthe lung cavity.
Pneumonia: infectious disease of the lungs that impairs breathing.
Pneumoconiosis: A chronic disease of the lungs resulting from the inhalation of various kinds of dusts. The pneumoconioses which include siderosis (iron oxide), silicosis (free silica), asbestosis (asbestos), etc., generally require a period of years for development.
Pneumonitis (Chemical): Inflammation of the lungs resulting from inhalation of chemical vapors and characterized by an outpouring of fluid in the lungs.
Potentiation: The increase in toxicity (usually considered an undesirable effect) of a pesticide when combined with one or more pesticides.
Poisonous Materials: Based on the definitions found in 49 CFR 173.325, poisonous materials are divided into three groups according to the degree of hazard in transportation: (a) Poison A; (b) Poison B; (c) Irritating Material. Following is a brief definition of each group. *Poisonous Materials (Poison A)* - Extremely dangerous poisons, Class A, are poisonous gases or liquids of such nature that a very small amount of the gas, or vapor of the liquid, mixed with the air is dangerous to life. *Poisonous Materials (Poison B)* - Class B poisons are those substances, liquid or solid (including pastes and semi-solids), other than Class A poisons or Irritating materials, which are known to be so toxic to man as to afford a hazard to health, or which, in the absence of adequate data on human toxicity, are presumed to be toxic to man because they fall within the categories, in tests specified by regulations, for oral toxicity, toxicity on inhalation, or toxicity by skin absorption when tested on laboratory animals. *Poisonous Materials (Irritating Materials)* - An Irritating Material is a liquid or solid substance which upon contact with fire or when exposed to air gives off dangerous or intensely irritating fumes, such as bromobenzyl cyanide, chloracetophenone, diphenylamine-chlorarsine, and diphenylchlorarsine, but not including any Class A poisonous material.
Polychlorinated Biphenyls: A series of hazardous chemical compounds which have been manufactured for more than 40 years for such common purposes as electrical insulation and heating/cooling equipment. Now suspected to be carcinogens, PCBs have been disposed of in the air, on land and in water; recent surveys have detected the presence of PCBs in every part of the country, even those remote from PCB manufacturers.
Polymerization: The chemical reaction in which a special compound, called a monomer, combines with itself to form a long-chain molecule called a polymer.
Polymerize: The chemical reaction whereby a compound reacts with itself to form a polymer.
Polyneuropathy: disease of several peripheral nerves.

Positive Pressure Self-Contained Breathing Apparatus (SCBA): This apparatus provides a constant, positive pressure or flow within the facepiece, even when the wearer inhales deeply while doing strenuous or heavy work. In the U.S., only those apparatus certified by NIOSH and the Mine Safety and Health Administration in accordance with 30 CFR Part 11. It should be used in accordance with the requirements for respiratory protection specified in the OSHA Hazardous Waste Site Operations and Emergency Response Standard (29 CFR 1910.120) and/or the Fire Brigade Standard (29 CFR 1910.156). Chemical cartridge respirators or other filtering masks are not acceptable substitutes for positive pressure self-contained breathing apparatus. Demand-type SCBA does not meet the OSHA Fire Brigade Standard.

Post Indicator Valve (PIV): A post-type valve that provides a visual means of indicating "open" or "shut" position. It is found on the supply main of installed fire protection systems.

Potentiation: The effect of a chemical which does not itself have an adverse effect but which enhances the toxicity of another chemical.

ppm: Parts of vapor or gas or other contaminant per million parts of air by volume.

Pre-action System: A type of automatic sprinkler system in which thermostatic devices are employed to charge the system with water before individual sprinkler heads are fused.

Predicted Environmental Concentration: The concentration in the environment of a chemical calculated from the available information on certain of its properties, its use and discharge patterns and the associated quantities.

Pre-fire Planning: The act of preparing to fight a fire in a particular building or group of buildings by advance planning of possible fire fighting operations.

Pressurized Gas: A gas that is still in the gaseous state, but under higher pressure than 14.7 psia.

Preventative Actions: Directions given by the Incident Commander at an emergency to prevent the problem from increasing.

Products-of-Combustion: Materials given off or released during the burning process.

Prolonged Exposure: More than a brief (or one-time) contact with a hazardous material such as radioactivity or a pesticide or the residue of that material.

Promoter (Carcinogenicity): An agent which increases tumor production by a chemical when applied after exposure to the chemical.

Proper Name: An agreed-upon system of naming organic compounds according the longest carbon chain in the compound.

Proportioner: A device for inducing the correct amount of agent into streams of water, especially for foam and wetting agents.

Proportioning: The occurrence of intermolecular collisions between oxygen and hydrocarbon molecules.

Proprietary System: A fire protection system that is owned and operated by the owner of the property.

Protection Factor (PF): The ratio of contaminant concentration outside of the respirator facepiece to that inside. It is taken as an indication of fit. PF values are established by manufacturers for specific types of respirators and are indicators only. Actual protection will depend on how a specific respirator fits a specific individual. Refer also to Fit Factor.

Protective Actions: Procedures taken during or after a hazardous materials incident for the protection of the general public from exposures occurring as a consequence of the incident.

Protective Materials: Refers to Chemical Protective Clothing such as suits and gloves. Following is a summary of the major materials used for chemical protective clothing (CPC). The reader will find specific recommendations and information on garments in Chapter 6. *Tyvek* - Product of DuPont. This is a spun-bonded nonwoven polyethylene fibers fabric. The Tyvek suit has reasonable wear, puncture and abrasion resistance. It provides excellent protection against particulate contaminants. It is inexpensive and suitable for disposable garments. *Nomex* - Product of DuPont. The material is comprised of an aromatic polyamide fiber. The material is noncombustible and is flame resistant up to 220 °C, and hence is used to provide the wearer with good thermal protection. Suits made from this material are very durable and are acid resistant. This material is used in firefighters' turnout gear and some fully encapsulating suits. *Polyethylene* - Used as a coating on polyolefin material such as Tyvek which increases the suit's resistance to acids, bases, and salts. Suits made from this material are considered good general purpose disposable products. *Saranax* - Made of Saran, a Dow Chemical product. This is usually coated on to Tyvek. The suit is a very good general purpose disposable product. It provides better overall protection than polyethylene and has excellent resistance to chlorinated hydrocarbons. *Polyvinyl Alcohol (PVA)* - This material resists degradation and permeation by aromatic and chlorinated hydrocarbons and petroleum compounds. The major drawback with this material is that it is water soluble and hence is limited to gloves. *Nitrile* - This material is also referred to as Buna-N, milled nitrile, nitril latex, NBR, and acrylonitrile. It resists degradation by petroleum compounds, alcohols, acids, and caustics. It is used extensively in boots and gloves, and is relatively inexpensive. *Polyvinyl Chloride (PVC)* - This material resists degradation by acids and caustics. It is used in boots, gloves, laboratory aprons, splash suits, and fully encapsulating suits. *Butyl Rubber* - This material resists degradation by many contaminants except halogenated hydrocarbons and petroleum compounds, which is a common deficiency of many protective materials. It is especially resistant to permeation by toxic vapors and gases. It is an expensive material used in boots, gloves, splash suits, laboratory aprons, and fully encapsulating suits. *Neoprene* - This material resists degradation by caustics, acids, and alcohols. I is used in boots, splash suits, and fully encapsulating suits. It is considered by many as a good all-around protective material. *Natural Rubber* - This material is a synthetic latex. It resists degradation by alcohols and caustics, and is used in boots and gloves. *Viton* - Product of DuPont. This is a member of the flouroelastomer family and is similar to Teflon in some respects. It has excellent resistance to degradation and permeability by aromatic and chlorinated hydrocarbons and petroleum compounds. It is very resistant to oxidizers. It is an extremely expensive material that is used in gloves and fully encapsulating suits.

Psychometer: An instrument consisting of wet and dry bulb thermometers for measuring relative humidity.

Pulmonary Agents: The term refers to a specific target organ characterization of effect. These are agents which damage the lungs. Chemicals which irritate or damage the pulmonary tissue are categorized as pulmonary agents. Signs and symptoms include persistent coughing; tightness in chest; shortness of breadth. Examples are silica and asbestos.

Pulmonary Alveoli: Minute air-filled sacs in a vertebrate lung, thin walled and surrounded by blood-vessels.

Pulmonary fibrosis: fibrous tissue forming in the lung.

Pyrolysis: The process of chemically decomposing an organic substance by heating in an oxygen-deficient atmosphere. High temperatures and closed chambers are used. Major products from pyrolysis of solid waste are water, carbon monoxide, and hydrogen. Some processes produce an oil-like liquid of undetermined chemical composition; gas may contain hydrocarbons and frequently there is process residue of a carbon char. All processes leave a residue of inorganic material. Gaseous products cannot be mixed with natural gas in principal distribution systems unless there is additional chemical processing. Applied to solid waste, pyrolysis has the features of effecting major volume reduction while producing storable fuels.

Pyrophoric: The term means a chemical that will ignite spontaneously in air at a temperature of 130 °F or below.

Pyrophoric Liquid: Any liquid that ignites spontaneously in dry or moist air at or below 130°F (54°C).

Q

Quantal Effect: An effect that either happens or does not happen, e.g. death. Synonym: all-or-none response.

R

RAD: Radiation Absorbed Dose; basic unit of absorbed dose of ionizing radiation; the absorption of 100 ergs of radiation energy per gram of absorbing material.
Radiant Temperature: The temperature resulting from the body absorbing radiant energy.
Radiation: The transfer of heat with no medium.
Radiation Authority: For radioactive materials, the Radiation Authority is usually a state agency or state designated official. The responsibilities of this authority include evaluating radiological hazard conditions during normal operations and during emergencies.
Radiation Heat: The transmission of heat through the medium of heat rays.
Radiation Illness: An acute organic disorder that follows exposure to relatively severe doses of ionizing radiation; characterized by nausea, vomiting, diarrhea, blood cell changes, and, in later stages, by hemorrhage and loss of hair.
Radiation Monitoring: Continuous or periodic determination of the amount of radiation present in a given area.
Radiation Saturation: A phenomenon in which a survey meter's capability to measure radiation levels is overwhelmed, causing the meter to incorrectly read "zero".
Radiation Sterilization: Use of radiation to cause a plant or animal to become incapable of reproduction; the use of radiation to kill all forms of life, especially bacteria, in food and surgical sutures.
Radical: An atom or group of atoms bound together chemically that has one or more unpaired electrons; it cannot exist in nature in that form, so it reacts very fast with another radical present, to form a new compound; also known as a "free" radical.
Radioactive Material: From 49 CFR 173.403, a radioactive material is any material having a specific activity greater than 0.002 microcuries per gram (uCi/g). Specifications and descriptions can be found in the regulations. The reader may also refer to the term *fissile material* in this glossary.
Radioactive Tracer: A small quantity of radioactive isotope used to follow biological, chemical or other processes by detection, determination or localization of the radioactivity.
Radioactive Wastes: Conventional materials that have been contaminated with radiation; not classified as hazardous and not covered by RCRA, they are specifically controlled by the U.S. Atomic Energy Act.
Radioactivity: Spontaneous decay or disintegration of an unstable atomic nucleus accompanied by the emission of radiation.
Radioecology: Study of the effects of radiation on species of plants and animals in natural communities.
Radiopharmaceutical: A material containing radioisotopes used in medical diagnosis or therapy.

Rate-of-rise Alarm System: One of the systems installed for detecting fire by an abnormal rate of increase of heat; operates when a normal amount of air in a pneumatic tube expands rapidly when heated and exerts pressure on diaphragms.
Recommended Limit: A maximum concentration of a potentially toxic substance which is suggested to be safe. Such limits often have no statutory implications and in which case a control or statutory guide level should not be exceeded.
Reducer Couplings: Couplings with a large and small connector for connecting hose couplings of two different sizes.
Registered Pesticide: A pesticide approved by the U.S. Environmental Protection Agency for use as stated on the label of the container.
Registry of Toxic Effects of Chemicals (RTEC): Volumes containing over 58,000 toxicity evaluations of specific chemicals and formulations.
Relative Biological Effectiveness (RBE): Factor used to compare the biological effectiveness of different types of ionizing radiation; inverse ratio of the amount of absorbed radiation required to produce a given effect to a standard radiation required to produce the same effect.
Relative Humidity: The ratio of the quantity of water vapor present in the air to the quantity which would saturate it at any specific temperature.
REM: Radiation Equivalent Man, the unit of dose equivalent; takes into account the effectiveness of different types of radiation.
Remote Alarm System: An alarm signaling system with a direct, privately owned circuit that goes to a fire department into privately owned receiving equipment.
Renal: Associated with the kidneys.
REP: Abbreviation for Registered Environmental Professional, a designation devised by the National Registry of Environmental Professionals.
Reproductive Effects: pertaining to birth defects,death of a developing baby prior to birth, inability to have children (both men and women), and so on.
Reproductive Toxicology (mammalian): The study of the effects of chemicals on the adult reproductive and neuroendocrine systems, the embryo, foetus, neonate and prepubertal mammal.
Reproductive Toxins: The term refers to a specific target organ characterization of effect. These are chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis). Signs and symptoms include birth defects; sterility. Examples are lead and DBCP.
Resonance: A phenomenon whereby a structure, to satisfy the rules of covalent bonding, should be fluctuating (resonating) back and forth between two alternate molecular structures, both of which are "correct" for the molecule. It is a way of explaining what cannot be explained using only the rules of covalent bonding.
Respirable (dust): Term used to indicate particulate matter which can be inhaled. Generally considered to be 5 microns or less in aerodynamic diameter.
Respirator: A face mask which filters out poisonous gases and particles from the air, enabling a person to breathe and work safely; used to protect the nose, mouth, and lungs from hazardous materials.
Respiratory Toxicity: How poisonous a pesticide is to an animal or person when breathed in through the lungs; an intake of any toxic substance through air passages into the lungs.
Ribonucleic acid (RNA): A generic term for a group of nucleotide molecules, similar in composition to deoxyribonucleic acid (DNA), which perform a number of functions in programming the genetic code in cells. There are several types of RNA e.g. messenger RNA, ribosomal RNA, transfer RNA.

Risk (Toxic): The predicted or actual frequency of occurrence of an adverse effect of a chemical substance or mixture from a given exposure to humans or the environment.
Risk Assessment: The process of decision making applied to problems where there are a variety of possible outcomes and it is uncertain which event will happen.
Risk Evaluation: The determination of the significance of risk to those affected.
Risk Management: Judgements concerning the acceptability of risk.
Rodenticide: A pesticide used to control rodents.
Roentgen (R): The unit of radiation exposure in the air; units for quantities of X-ray or gamma radiation measured by detection and survey meters. Named after Wilhelm Roentgen, German scientist who discovered X-rays in 1895.
Rope Hose Tool: A piece of rope spliced to form a loop through the eye of a metal hook. Used for securing hose to ladders or other objects.
Rotameter: A flowmeter, consisting of a precision bored, tapered, transparent tube with a solid float inside.

S

Safety (Toxicological): Can be defined as the high probability that injury will not result from use of a substance under specific conditions of quantity and manner of use.
Salivary glands: glands in the mouth that secrete saliva.
Sarcoma: type of cancerous tumor.
Saturated: A hydrocarbon possessing only single covalent bonds between carbon atoms.
Self-Accelerating Decomposition Temperature: The temperature above which the decomposition of an unstable material proceeds by itself independently of the external temperature.
Sensitizer: The term refers to a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.
Sensitization: becoming allergic.
Shipping Papers: The shipping paper represents a document that contains vital information available that can help respond to a hazardous materials incident. The shipping paper contains information needed to identify the material(s) involved. This information can be used to initiate protective actions. The shipping paper contains the proper shipping name , the hazard class or division of the material(s), ID Number, Packing Group, and, when applicable, Reportable Quantity notation (RQ) (for use in reporting spill incidents). In addition, there must be available information that describes the hazards of the material and that can be used in the mitigation of an incident. This must be entered on or be with the shipping paper. Shipping papers are required for most hazardous materials in transportation.
Short Term Exposure Limit (STEL): The time weighted average (TWA) airborne concentration to which workers may be exposed for periods up to 15 minutes, with no more than 4 such excursions per day and at least 60 minutes between them.
Siamese: A hose appliance that has two or more female inlets and one male outlet; two or more inlets for one outlet.
SIC: Standard Industrial Code. Prepared by the United States Office of Management and Budget.
Silica Gel: A regenerative absorbent consisting of the amorphous silica. Used in dehydrating and in drying and as a catalyst carrier.
Silicosis: lung disease caused from inhaling silica.
Slopover: *see also Boilover*. Basically, the same principles that are responsible for a boilover are the cause of a "slopover". The fundamental difference is that in a slopover the reaction is from

water that has entered the tank since the start of a fire. Usually this introduction is the result of the firefighters' activities as they attempt to extinguish the crude oil (or liquid of similar characteristics) fire. A slopover will occur at some moment after the heat wave has been formed - which may be from only a few minutes of burning - and water or foam is being applied to the liquid surface. Either the water from the hose streams or, after the bubbles collapse, the water in the foam will sink into the oil, contacting the heat wave, where it is converted to steam, and the agitation of the liquid surface spills some amount of oil over the tank rim. Historically, slopovers, although still exposing the firefighters to the danger of the escaping, burning oil, are not as violent as are boilovers. Regardless of the term used to describe the occurrence - that is, boilover, slopover, frothover, or whatever - the likelihood of some event that will cause the oil to cascade over the tank shell and down into the dike area is always present when crude oil burns.

Smoke: A mixture of gases, vapors, and aerosols formed from the incomplete combustion of carbonaceous materials.

Solid Stream: A hose stream that stays together as a solid mass, as opposed to a fog or spray.

Solution: Mixture in which the components lose their identities and are uniformly dispersed. All solutions are composed of a solvent (water or other fluid) and the substance dissolved called the "solute". Air is a solution of oxygen and nitrogen. A true solution is homogeneous as salt in water.

Solvent: A substance which dissolves other substances, most commonly water but often an organic compound.

Spanner Wrench: A tool used by firefighters for tightening or loosening couplings.

Specific Gravity: A measure of the weight of a material (liquid or solid) as related to the weight of an equal volume of water.

Specific Heat: The ratio between the amount of heat necessary to raise the temperature of a substance and the amount of heat necessary to raise the same weight of water the same number of degrees.

Spectrophotometer: An instrument used for comparing the relative intensities of the corresponding colors produced by chemical reactions.

Spontaneous Ignition: A material proceeding without constraint by internal impulse or outside energy to kindle or set fire; quick or slow oxidation or combustion brought about by chemical, electrical, biological (bacterial) or physical processes (vibration, pressure, friction) without assistance of extraneous sources of heat (flame, sparks, hot or glowing bodies).

Spontaneously Combustible: The process of increase in temperature of a material to a point of ignition without drawing heat from its surroundings.

Sprinkler Connection: A siamese connection used by the fire department for increasing the water supply and pressure to a sprinkler system.

Standard Temperature and Pressure: Measured volumes of gases are generally recalculated to 0° Centigrade and 760 mm pressure.

Stabilization: (1) Stage of an incident when the immediate problem or emergency has been controlled, contained, or extinguished. (2) Hazardous waste chemical treatment method by which a chemical reaction produces an insoluble form of the waste or incorporates the waste into a form that is insoluble.

Standard Operating Procedures: Detailed instructions for implementation of emergency plans by the various response agencies.

Static Pressure: The potential pressure exerted in all directions by a fluid at rest. For a fluid in motion, it is measured in a direction normal (at right angles) to the direction of flow, thus it shows the tendency to burst or collapse the pipe. When added to velocity pressure, it gives total pressure.

STEL: *Short Term Exposure Limit* (STEL) refers to a safe level of exposure (see also TLV) from inhalation for a continuous period of time that is short (by OSHA standards either a 15 minutes or 5 minutes of continuous exposure). The concentration established by the STEL (usually in ppm) should not be exceeded during that period of exposure, and further, the time limit of continuous exposure should not be exceeded, else there is a health risk.
Straight Chain: The configuration of the molecule of a hydrocarbon when a carbon atom attaches itself to another carbon atom that has only one other carbon atom already attached to it.
Street Clothing and Work Uniforms: Garments, such as uniforms worn by police and emergency medical services personnel, provide little to no protection from the harmful effects of hazardous materials.
Structural Effect: The effect upon certain properties of an analogous series of compounds by *branching*. Properties such as boiling point, flash point, ignition temperature, and others change as branches are added to compounds, including isomers.
Structural Firefighters' Protective Clothing (SFPC):This category of clothing is usually referred to as *turnout* or *bunker gear*. This type of protective clothing is normally worn by firefighters during structural firefighting operations. It includes a helmet, coat, pants, boots, gloves, and a hood to cover parts of the head not protected by the helmet and facepiece. This clothing must be used with full-facepiece, positive-pressure, self-contained breathing apparatus (SCBA). This protective clothing should, at a minimum, meet the U.S. Department of Labor's Occupational Safety and Health Administration's (OSHA) Fire Brigades Standard (29 CFR 1910.156). Structural firefighters' protective clothing provides limited protection from heat. This clothing is not designed to provide adequate protection from harmful vapors or liquids that are encountered during most hazardous materials incidents.
Structural Formula: A drawing of the molecule, showing all the atoms of the molecule and how they are bonded to each other atom.
Structure-Activity Relationship (SAR): The correlation between molecular structure and biological activity. It is usually applied to observing the effect that the systematic structural modification of a particular chemical entity has on a defined biological end-point.
Subchronic Toxicity: The adverse effects occurring as a result of the repeated daily [oral] dosing of a chemical to experimental animals for part (not exceeding 10 %) of the life span. (Usually 1-3 months). Acute toxicity.
Substituted: A compound that has had one or more of its atoms removed and replaced by atoms of other elements in the molecule. A substituted hydrocarbon is a compound that has had a hydrogen atom removed and another atom substituted for it.
Superheating: Heating of a vapor, particularly saturated steam to a temperature much higher than the boiling point at the existing pressure; occurs in power plants to improve efficiency and to reduce condensation in the turbines.
Surface Active Agents: Chemicals which alter the forces of surface tension between adjacent molecules; generally decrease the surface tension of a fluid such as an oil, used to facilitate its dispersion throughout the water column.
Surfactant: An adjuvant which improves the emulsifying, dispersing, spreading, and wetting properties of a pesticide.
Synecology: The study of ecology dealing with interrelationships of living communities of organisms to each other and to the environment.
Synergism: Cooperative action of substances whose total effects is greater than the sum of their separate effects.

Synergistic Effect: An effect of two chemicals acting together which is greater than the simple sum of their effects when acting alone.
Synthesize: To make a molecule to duplicate a molecule made in nature.
Systemic: Spread throughout the body, affecting all body systems and organs, not localized in one spot or area.

T

Tare: A deduction of weight, made in allowance for the weight of a container or medium. The initial weight of a filter, for example.
Teratogenesis: Defects in embryonic and foetal development caused by a substance.
Teratogenic: capable of producing birth defects.
Test Animals: Laboratory animals exposed to pesticides so that toxicity and hazards can be determined.
Testicular atrophy: wasting away of male reproductive organs.
Tetany: intermittent spasms.
"Tetra-": The prefix that means four.
Thermal Degradation: The term refers to the decomposition or degradation of a material due to exposure to heat or energy. Materials can be thermally degraded into three principal ways: anaerobic pyrolysis, oxidative pyrolysis ("smoldering"), and flaming combustion.
Thorium: A naturally radioactive element with atomic number 90 and, as found in nature, an atomic weight of approximately 232. The fertile thorium 232 isotope is abundant and can be transmitted to fissionable uranium 233 by neutron irradiation.
Threshold: The point where a physiological or toxicological effect begins to be produced by the smallest degree of stimulation.
Thrombosis: blood clot.
Thymus: organ that forms cells involved in the immune response.
Thyroid: hormone-producing gland inthe throat.
Time Weighted Average Concentration: Refers to concentrations of contaminants which have been weighted for the time duration of sample. A sufficient number of samples are needed to permit a time-weighted average concentration throughout a complete cycle of operations or throughout the work shift.
TLV: The TLV or *Threshold Limit Value* refers to a safe level of exposure by inhalation. The definition was established by the American Conference of Governmental Hygienists. There are several variations or criteria levels for the TLV. As an example, hydrogen sulfide has a TLV for short-term exposure limits (STEL) of 15 minutes of only 5 ppm. Comparing this to the TLV-STEL of 400 ppm for carbon monoxide provides an indication of the need to be extremely careful when H_2S is suspected. Under OSHA Standards, and particularly on MSDS (Material Safety Data Sheets) compounds are associated with a time weighted average (TWA) TLV, which is the allowable concentration for an 8-hour continuous exposure period. For firefighting purposes, the short-term exposure is likely more realistic.
Toxic: Poisonous; relating to or caused by toxin; able to cause injury by contact or systemic action to plants, animals or people.
Toxicant: Any substance which is potentially toxic.
Toxicity: A relative property of a chemical agent and refers to a harmful effect on some biologic mechanism and the condition under which this effect occurs.

Toxicology: The study of chemical substances which exert deleterious effects on living organisms, their chemistry in relation to their mode of action, antidotes, and physiological effects.
Toxin: A toxic organic substance produced by a living organism.
Transformation (neoplastic): The conversion of normal cells into tumor cells (see below). Frequently this is the result of a genetic change and the same term is used to describe the genetic modification of bacteria for biotechnological purposes.
Transplacental: across the placenta from mother to developing baby.
Transmutation: The changing of one element into another by a nuclear reaction or series of reactions. Example: the transmutation of uranium-238 into plutonium-239 by absorption of a neutron.
"Tri-": The prefix that means three.
Trohoc: An epidemiological study which starts with the outcome and looks backwards for the causes.
Tumor (neoplasm): A growth of tissue forming an abnormal mass. Cells of a **benign** tumor will not spread and cause cancer. Cells of a malignant tumor can spread through the body and cause cancer.
Tumorigenic: Causing tumor formation.

U

Ulceration: destroyed tissue.
Ultraviolet Radiation: The portion of the electromagnetic spectrum emitted by the sun adjacent to the violet end of the visible light range. Often called "black light", it is invisible to the human eye but when it falls on certain surfaces it causes them to fluoresce or emit visible light; responsible for the photo-oxidation of certain compounds including hydrocarbons.
Unit: A molecular fragment that repeats itself in a series.
Unsaturated: A hydrocarbon with at least one multiple bond between two carbon atoms somewhere in the molecule.
Unstable (Reactive): The term refers to a chemical which in the pure state, or as produced or transported , will vigorously polymerize , decompose, condense, or will become self-reactive under conditions of shocks, pressure, or temperature.
Upper Explosion Limit: The UEL is expressed as a percentage of the total volume of the air-fuel mixture; it is the highest concentration of vapor fuel in air under which spontaneous combustion will occur. An example is gasoline. A mixture containing 7.6% gasoline vapor in air (concentration of air being 92.4% in this mixture) will spontaneously combust. The UEL in this example is 7.6% or simply 7.6. Above this concentration, the mixture is described as being too "rich"; or in other words, there is too much fuel and not enough oxygen for spontaneous combustion to occur.
Uranium: The basic raw material of nuclear energy, uranium is a radioactive element with the atomic number 92 and, as found in natural ores, an average atomic weight of approximately 238. The two principal natural isotopes are uranium 235 (0.7% of natural uranium) which is fissionable and uranium 238 (99.3% of natural uranium) which is fertile. Natural uranium also includes a minute amount of uranium 234.
Urinary system: kidney, bladder, and connecting tubes.
Urologic: pertaining to the urinary system.
USDA: Abbreviation for United States Department of Agriculture.

V

Vapor: The gaseous form of substances which are normally in the solid or liquid state and which can be changed to these states either by increasing the pressure or decreasing the temperature alone.
Vapor Control: Limiting the amount of vapor released from a pool of flammable or corrosive liquids is an operational concern. This technique requires the use of proper protective clothing, specialized equipment, appropriate chemical agents, and skilled personnel. Before engaging in vapor control, get advice from an authoritative source as to the proper tactics. There are several ways to minimize the amount of vapors escaping from pools of spilled liquids, such as special foams, adsorbing agents, absorbing agents, and neutralizing agents. To be effective, these vapor control methods must be selected for the specific material involved and performed in a manner that will mitigate, not worsen, the incident. Where specific materials are known, such as at manufacturing or storage facilities, it is desirable for the hazardous materials response team to arrange with the facility operators to select and stockpile these control agents in advance of a spill. In the field, first responders may not have the most effective vapor control agent for the material. They are likely to have only water and only one type of firefighting foam. Therefore, it is likely that water spray will be used. Because the water is being used to form a vapor seal, care must be taken not to churn or further spread the spill during application. Vapors that do not react with water may be directed away from the site using the air currents surrounding the water spray. Water spray has been used on large spills of some flammable materials in an attempt to reduce vapor concentration below the explosive limit. However, water sprayed into a confined area may actually increase the air concentration, possibly creating an explosive mixture of air and the flammable vapor. Before using water spray or other methods to safely control vapor emission or to suppress ignition, obtain trained technical advice, based on specific chemical name identification.
Vapor Density: A measurement of the weight of vapor compared to the weight of air.
Vapor Dispersion: The movement of vapor clouds in air due to turbulence, gravity spreading, and mixing.
Vaporization: The process of becoming a gas.
Vaporize: To evaporate; to form a gas and disappear into the air.
Vaporizer: A device for converting liquid to vapor by means other than atmospheric heat transfer.
Vapor Pressure: The pressure exerted by vapor molecules on the sides of a container, at equilibrium.
Vasoconstriction: narrowing of the blood vessels.
Venting Devices: A device that is designed to relieve excessive pressure from the vapor space of a container. To accomplish this, the device will be located on the tops of containers above the normal level of liquid of the full tank. Some vents are installed to allow for the venting of the tank during routine operations. Movement of liquid into or out of a container without the space above the liquid level having the ability to breathe will result in damage to the shell. Additional venting capacity is required to keep the internal pressures at a safe level during fire emergencies. The various types of venting devices in use include fusible plugs, spring-loaded relief valves, pop-up-type hatch covers, pressure/vacuum vents, and weighted caps.
Ventricular fibrillation: rapid contractions of the ventricles of the heart.
Vomitus: Stomach contents that are regurgitated; matter which is vomited.
Vinyl: The general name for the radical of ethylene.
Virus: A disease-producing organism (pathogen) that needs living cells to grow and can cause disease in plants and animals including people; too small to be seen with a normal microscope.

Viscosity: The thickness of liquids; the degree to which or the ease with which a liquid flows; usually increases when temperature decreases. A liquid with a low viscosity will flow very rapidly and any spill of that liquid will create problems very quickly; a high viscosity liquid will not flow as easily and can therefore be controlled more readily should it spill.
Visible radiation: The wavelengths of the electromagnetic spectrum between 10^{-4} cm to 10^{-5} cm.
Volatility: The tendency or ability of a liquid to vaporize. Such liquids as alcohol and gasoline, because of their well-known tendency to evaporate rapidly, are referred to as volatile liquids.
Volatilization: The changing of a liquid to a vapor.

W

Water Reactive: The term means a chemical that reacts with water to release a gas that is either flammable or poses a health hazard.
Water Reactive Materials: Water is sometimes used to flush spills and to reduce or direct vapors in spill situations. Some materials can react violently or even explosively with water. In these cases, consider letting the fire burn or leaving the spill alone until technical advice can be obtained. These materials require technical advice since:

1. water getting inside a ruptured or leaking container may cause an explosion.
2. water may be needed to cool adjoining containers to prevent their rupturing (exploding) or further spread of the fires;
3. water may be effective in mitigating an incident involving a water-reactive material only if it can be applied at a sufficient "flooding" rate for an extended period; and
4. the products from the reaction with water may be more toxic, corrosive, or otherwise more undesirable than the product of the fire without water applied.

When responding to an incident involving water-reactive chemicals, take into account the existing conditions such as wind, precipitation, location and accessibility to the incident, as well as the availability of the agents to control the fire or spill. Because of the great number of variables, the decision to use water on fires or spills involving water-reactive materials should be made by an authoritative source. For example, a producer of the material, who can be contacted through the emergency response telephone number or CHEMTREC.
Water Solubility: A measure of the ability of a liquid to mix with water.
Weight Effect: The change produced in certain properties, including flash point, boiling point, and water solubility, as the molecular weight (calculated by adding the atomic weights of all the atoms in the molecule) of compounds in an analogous series is increased or decreased.
Wet-pipe Sprinkler System: An automatic sprinkler system in which the pipes are constantly filled with water under pressure.
Wet-standpipe System: A building standpipe system constantly filled with water. Sections of small diameter fire hose are connected to the standpipe system on each floor.

X

Xenobiotic: A chemical which is not a natural component of the living organism exposed to it. Synonyms: drug, foreign substance or compound, exogenous material.
Xenobiotic Metabolism: The chemical transformation of compounds foreign to an organism by various enzymes present in that organism.

X-Ray: A penetrating form of electromagnetic radiation emitted either when the inner orbital electrons of an excited atom return to their normal state (these are characteristic X-rays), or when a metal target is bombarded with high speed electrons (bremsstrahlung).

4

Fire, Explosion and Chemical Reactivity Data for Industrial Chemicals

4.1 INTRODUCTION

This chapter is comprised of two sections. The first section is a guide to chemical compatibility. It provides a systematic approach to identifying incompatible binary chemical combinations. Further guidance can be found in 49 CFR, Parts 100 to 177. The second section provides summary descriptions of the fire hazard and chemical reactivity of various chemicals. The information is organized into the two information areas for each chemical. Chemicals are listed alphabetically, according to their most common chemical name. The reader can refer to the list of synonyms in Chapter 2 in order to identify a certain chemical compound. The following abbreviations are used in this subsection: CC - Closed Cup Method; OC - Open Cup Method. In a number of cases, the data entry for a certain property or characteristic is "No data", or "Not pertinent". The no data entry (or "no information found") means that no information could be found for that property in a review of the literature. "Not pertinent" refers to the fact that the particular property is not important in making a hazard or risk assessment of the chemical (as an example, a flash point would not be pertinent if the chemical is a combustible solid). Recommended fire extinguishing agents are generally listed in order of the most highly effective first.

4.2 GUIDE TO CHEMICAL COMPATIBILITY

This section is based in part upon information provided to the U.S. Coast Guard by the National Academy of Sciences — U.S. Coast Guard Advisory Committee on Hazardous Materials and represents general guidelines on chemical compatibility between binary mixtures. The accidental mixing of one chemical 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 containers, and fire and explosion are possible consequences of such reactions. The section contains a Compatibility Chart that shows chemical combinations believed to be dangerously reactive in the case of accidental mixing. It should be recognized, however, that the Chart provides a broad grouping of chemicals with an extensive variety of possible binary combinations. Although one group, generally speaking, can be considered dangerously reactive with another group where an "X" appears on the Chart, there may exist between the groups some combinations which would not dangerously react. The Chart should therefore not be used as an infallible guide. Its original intent was to serve as aid in the safe loading of bulk chemical cargoes, with the recommendation that proper safeguards be taken to avoid accidental mixing of binary mixtures for which an "X" appears on the Chart. The chart, provided as Figure 1, however provides general enough guidance for purposes of warehouse storing and stockpiling chemical operations, and as a guide for avoiding the mixing of incompatibly wastes where chemical analysis on the waste components are available. The information in this chart will also assist in applying proper safeguards which would include consideration of such factors as avoidance of the use of common cargo and vent lines and carriage in adjacent tanks having a common bulkhead in loading operations.

The following procedure explains how this section may be used as a guide in determining chemical compatibility information:

1. Determine the reactivity group of a particular product by referring to the alphabetical list in Table 1.

2. Enter the Chart (Figure 1) with the reactivity group that is listed in Table 2. Proceed across the chart. An "X" indicates a reactivity group that forms an unsafe combination with the product in question.

For example, crotonaldehyde is listed in Table 1 as belonging in Group 19 (Aldehydes). The Chart shows that chemicals in this group should be segregated from sulfuric and nitric acids, caustics, ammonia, and all types of amines (aliphatic, alkanol, and aromatic). According to note A, crotonaldehyde is also incompatible with non-oxidizing mineral acids.

It is recognized there are wide variations in the reaction rates of individual chemicals within the broad groupings shown reactive by the Compatibility Chart. Some individual materials in one group will react violently with some of the materials in another group and cause great hazard; others will react slowly, or not at all. Accordingly, a useful addition to the Guide is the identification of specific binary combinations which are found not to be dangerously reactive, even though an "X" appears on the chart for those two chemicals. A few such combinations are listed in Table 3.

In the section that follows, the reader will find detailed fire and chemical reactivity information for several hundred chemicals. This information should be carefully reviewed in preparing emergency response procedures and safe handling operations.

Figure 1. Chemical 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		×			×	×	×	×	×	×	×	×	×			×	×		A	E		
2. Sulfuric acid	×		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
3. Nitric acid		×			×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	
4. Organic acids		×			×	×	×	×	C			×				×	×			F		
5. Caustics	×	×	×	×							×	×				×	×		×	×	×	×
6. Ammonia	×	×	×	×						×	×	×	×			×	×		×			
7. Aliphatic amines	×	×	×	×							×	×	×	×	×	×	×	×	×	×	×	×
8. Alkanolamines	×	×	×	×							×	×	×	×	×	×	×	B	×			
9. Aromatic amines	×	×	×	C							×	×							×			
10. Amides	×	×	×			×						×									×	
11. Organic anhydrides	×	×	×		×	×	×	×	×													
12. Isocyanates	×	×	×	×	×	×	×	×	×	×					D					×		×
13. Vinyl acetate	×	×	×			×	×	×														
14. Acrylates		×	×				×	×														
15. Substituted allyls		×	×				×	×				D										
16. Alkylene oxides	×	×	×	×	×	×	×	×														
17. Epichlorohydrin	×	×	×	×	×	×	×	×														
18. Ketones		×	×				×	B														
19. Aldehydes	A	×	×		×	×	×	×	×													
20. Alcohols, glycols	E	×	×	F	×		×					×										
21. Phenols, Cresols		×	×		×		×			×												
22. Caprolactam solution		×			×		×					×										
30. Olefins		×	×																			
31. Paraffins																						
32. Aromatic hydrocarbons			×																			
33. Miscellaneous hydrocarbon mixtures			×																			
34. Esters		×	×																			
35. Vinyl halides			×																			×
36. Halogenated hydrocarbons		G			H		I															
37. Nitriles		×																				
38. Carbon disulfide							×	×														
39. Sulfolane																						
40. Glycol ethers		×										×										
41. Ethers		×	×																			
42. Nitrocompounds					×	×	×	×	×													
43. Miscellaneous water solutions		×										×										

Notes to compatibility chart: reactivity differences (deviations) within chemical groups

Acrolein (19), Crotonaldehyde (19), and 2-Ethyl-3-propyl acrolein (19) are not compatible with Group 1, Non-Oxidizing Mineral Acids.

A. Isophorone (18), and Mesityl Oxide (18) are not compatible with Group 8, Alkanolamines.
B. Acrylic Acid (4) is not compatible with Group 9, Aromatic Amines.
C. Allyl Alcohol (15) is not compatible with Group 12, Iso-cyanates.
D. Furfuryl Alcohol (20) is not compatible with Group 1, Non-oxidizing Mineral Acids.
E. Furfuryl Alcohol (20) is not compatible with Group 4, Organic Acids.
F. Dichloroethyl Ether (36) is not compatible with Group 2, Sulfuric Acid.
G. Trichloroethylene (36) is not compatible with Group 5, Caustics.
H. Ethylenediamine (7) is not compatible with Ethylene Di-chloride (36).

Table 1. Alphabetical Listing of Compounds

Name	Group No.
Acetaldehyde	19
Acetic Acid	4
Acetic Anhydride	11
Acetone	18
Acetonitrile	37
Acrolein. (inhibited)	19
Acrylic Acid (inhibited)	4
Acrylonitrile (inhibited)	15
Adiponitrile	37
Allyl Alcohol	15
Allyl Chloride	15
Aminoethylethanolanline	8
Ammonia, Anhydrous	6
Ammonium Hydroxide	6
Ammonium Nitrate, Urea,	6
Ammonium Nitrate, Urea,	43
Amyl Acetate	34
Amyl Alcohol	20
Amyl Tallate	34
Aniline	9
Asphalt	33
Asphalt Blending Stocks:	
Roofers Flux	33
Straight Run Residue	33
Benzene	32
Benzene, Toluene, Xylene	32
Butadiene (inhibited)	30
Butane	31
Butyl Acrylate (inhibited)	14
Butyl Acetate	34
Butyl Alcohol	20
Butylamine	7
Butyl Benzyl Phthalate	34
Butylene	30
1,3-Butylene Glycol	20
Butylene Oxide	16
Butyl Ether	41
Butyl Methacrylate (inhibited)	14
Butyraldehyde	19
Butyric Acid	4
Carbon Bisulfide	38
Carbon Tetrachloride	36
Caustic Potash Solution	5
Caustic Soda Solution	5
Chlorine	*
Chlorobenzene	36
Chloroform	36
Chlorosulfonic Acid	*
Corn Syrup	43
Creosote, Coal Tar	21
Cresols	21
Cresylate Spent Caustic	5
Crotonaldehyde	19
Cumene	32
Cycloaliphatic Resins	31
Cyclohexane	31
Cyclohexanol	20
Cyclohexanone	18
Cyclohexylamine	7
Cymene	32
Decaldehyde	19
Decane	31
Decene	30
Decyl Alcohol	20
Decyl Acrylate (inhibited)	14
Decylbenzene	32
Dextrose Solution	43
Di-acetone Alcohol	20
Dibutylamine	7
Di-butyl Phthalate	34

Table 1 Continued

Name	Group No.
Dichlorobenzene	36
Dichlorodifluoromethane	36
1,1-Dlchloroethane	36
Dichloroethyl Ether	41
Dichloroalethane	36
1,1-Dichloropropane	36
1,2-Dichloropropane	36
1,3-Dichloropropene	15
Dicyclopentadiene	30
Diethanolamine	8
Diethylene Glycol	40
Diethylene Glycol Monobutyl	40
Diethylene Glycol Monobutyl	34
Diethylene Glycol Monoethyl	40
Diethylene Glycol	40
Diethylenetriamine	7
Diethylethandamine	8
Diheptyl Phthalate	34
Dilsobutylene	30
Dilsobutyl Carbinol	20
Dilsobutyl Ketone	18
Diisodecyl Phthalate	34
Diisopropanolamine	8
Diisopropylamine	7
Dimethylamine	7
Dimethylethanolamine	8
Dimethylformamide	10
Dinonyl Phthalate	34
Dioctyl Phthalate	34
1,4-Dioxane	41
Diphenyl-Diphenyl Oxide	33
Diphenylmethane Diisocyanate	12
Di-n-propylamine	7
Dipropylene Glycol	40
Distillates:	
Straight Run	33
Flashed Feed Stocks	33
Diundecyl Phthalate	34
Dodecane	31
Dodecanol	20
Dodecene	30
Dodecylbenzene	32
Epichlorohydrin	17

Name	Group No.
Ethane	31
Ethanolamine	8
Ethoxylated Alcohols C_{11}-C_{15}	40
Ethoxy Triglycol	40
Ethyl Acetate	34
Ethyl Alcohol	20
Ethyl Acrylate (inhibited)	14
Ethylamine	7
Ethyl Benzene	32
Ethyl Butanol	20
Ethyl Chloride	36
Ethylene	30
Ethylene Chlorohydrin	20
Ethylene Cyanohydrin	20
Ethylenediamine	7
Ethylene Glycol Monobutyl	34
Ethylene Glycol Monoethtyl	40
Ethylene Glycol Monoethtyl	34
Ethylene Glycol Monomethtyl	40
Ethylene Oxide	*
Ethyl Ether	40
Ethylhexaldehyde	19
2-Ethyl Hexanol	20
2-Ethylhexyl Acrylate	14
Ethyl Hexyl Tallate	34
Ethyl Methacrylate (inhibited)	14
2-Ethyl-3-Propyl Acrolein	19
Formaldehyde Solution (37-	19
Formic Acid	4
Furfural	19
Furfuryl Alcohol	20
Gas Oil Cracked	33
Gasoline Blending Stocks:	
Alkylates	33
Reformates	33
Gasolihes:	
Casinghead (natural)	33
Automotive	33
Aviation (containing	33
Polymer	33
Straight Run	33
Glutaraldehyde Solution	19

Table 1 Continued

Name	Group No.
Glycerine	20
Glycol Diacetate	34
Glyoxal Solution	19
Heptane	31
Hexamethyleneimine	7
Hexane	31
Hexanol	20
Hexene	30
Hexylene Glycol	20
Hydrochloric Acid	1
Hydrofluoric Acid	1
Isophorone	18
Isoprene (inhibited)	30
Jet Fuel s:	
JP-l (Kerosene)	33
JP-3	33
JP-4	33
JP-5 (Kerosene,	33
Mesityl Oxide	18
Methane	31
Methyl Acetate	34
Methyl Acetylene, Propadiene	30
Methyl Acrylate (inhibited)	14
Methyl Alcohol	20
Methyl Amyl Acetate	34
Methyl Amyl Alcohol	20
Methyl Bromide	36
3-Methyl Butyraldehyde	19
Methyl Chloride	36
Methyl Ethyl Ketone	18
2-Methyls-Ethyl Pyridine	9
Methyl Formal (Dimethyl	41
Methyl Isobutyl Ketone	18
Methyl Isobutyl Carbinol	20
Methyl Methacrylate	14
(alpha-) Methyl Styrene	30
Mineral Spirits	33
Monochlorodifluoro -methane	36
Morpholine	7
Motor Fuel Antiknock	*

Name	Group No.
Naphtha:	
Coal Tar	33
Solvent	33
Stoddard Solvent	33
Varnish Markers' and	33
Naphthalene (molten)	32
Nitric Acid (70* or less)	3
Nitric Acid (95%)	*
Nitrobenzene	43
1- or 2-Nitropropane	43
Nitrotoluene	43
Nonane	31
Nonene	30
Nonyl Alcohol	20
Nonyl Phenol	21
Nonyl Phenol (ethoxylated)	40
Octane	31
Octene	30
Octyl Alcohol	20
Octyl Aldehyde	19
Octyl Epoxytallate	34
Oils:	
Clarified	33
Coal Oil	33
No. 1-D	33
No. 2	33
No. 2-D	33
No, it	33
No. 5	33
No. 6	33
Residual	33
Road	33
Transformer	33
Edible Oils, including:	
Castor	34
Coconut	34
Cotton Seed	34
Fish	34
Lard	34
Olive	34
Palm	34
Peanut	34
Safflower	34

Table 1 Continued

Name	Group No.	Name	Group No.
Soya Bean	34	Propanolamine	8
Tucum	34	Propionaldehyde	19
Vegetable	34	Propionic Acid	4
Miscellaneous Oils, including:		Propionic Anhydride	11
Absorption	33	Propyl Acetate	34
Aromatic	33	Propyl Alcohol	20
Coal Tar	33	Propylamine	7
Heartcut Distillate	33	Propylene	30
Linseed	33	Propylene Butylene Polymer	30
Lubricating	33	Propylene Glycol	20
Mineral	33	Propylene Oxide	16
Mineral Seal	33	Propylene Tetramer	30
Motor	33	Propyl Ether	41
Neatsfoot	33	Pyridine	9
Penetrating	33		
Range	33	Sodium Hydrosulfide Solution	5
Resin	33	Sorbitol	20
Resinous Petroleum	33	Styrene (inhibited)	30
Rosin	33	Sulfolane	39
Sperm	33	Sulfur (molten)	*
Spindle	33	Sulfuric Acid	2
Spray	33	Sulfuric Acid, Spent	2
Tall	34		
Tanner's	33	Tallow	34
Turbine	33	Tallow Fatty Alcohol	20
Oleum	*	1,1,2,2-Tetrachloroethane	36
		Tetradecanol	20
Pentadecanol	22	Tetradecene	30
Pentane	31	Tetradecylbenzene	32
Pentene	30	Tetraethylene Glycol	40
Pentyl Aldehyde	19	Tetraethylenepentamine	7
Perchloroethylene	36	Tetrahydrofuran	41
Phenol	21	Tetrahydronaphthalene	32
Pentachloroethane	36	Tetrasodium Salt of EDTA	43
Phosphoric Acid	1	Toluene	32
Phosphorus	*	Toluene Diisocyanate	12
Phthalic Anhydride (molten)	11	1,2,4-Trichlorobenzene	36
Polybutene	30	Trichloroethylene	36
Polyethylene Glycols	40	Tridecanol	20
Polymethylene Polyphenyl-	12	Triethanolamine	8
Polypropylene	30	Triethylamine	7
Polypropylene Glycol Methyl	40	Triethyl Benzene	32
Polypropylene Glycols	40	Triethylene Glycol	40
Propane	31	Triethylenetetramine	7

Table 1 Continued

Name	Group No.
Tripropylene Glycol	40
Turpentine	30
Undecanol	20
Undecene	30
Undecylbenzene	32
Valeraldehyde	19
Vinyl Acetate (inhibited)	13
Vinyl Chloride (inhibited)	35
Vinylidene Chloride	35
Vinyl Toluene (inhibited)	30
Xylene	32

* Because of very high reactivity or unusual conditions of carriage, this product is not included in the Compatibility Chart .

Table 2. Reactivity Groups

1. Non-Oxidizing Mineral Acids
Hydrochloric Acid
Hydrofluoric Acid
Phosphoric Acid

2. Sulfuric Acids
Spent Sulfuric Acid
Sulfuric Acid (98% or less)

3. Nitric Acid
Nitric Acid (70% or less)

4. Organic Acids
Acetic Acid
Butyric Acid
Formic Acid
Proplonic Acid
Acrylic Acid (inhibited)

5. Caustics
Caustic Potash Solution
Caustic Soda Solution
Cresylate Spent Caustic Solution
Sodium Hydrosulfide Solution (45% or less)

6. Ammonia
Ammonia, Anhydrous
Ammonium Hydroxide (28% or less)
Ammonium Nitrate, Urea, Water Solutions (containing Ammonia)

7. Aliphatic Amines
Butylamine
Cyclohexylamine
Dibutylamine
Diethylamine
Diethylenetriamine
Dilsopropylamine
Dimethylamine
Di-n-propylamine
Ethylamine
Ethylenediamine
Hexamethyleneimine
Methylamine
Morpholine
Propylamine
Tetraethylenepentamine
Triethylamine
Triethylenetetramine

8. Alkanolamines
Aminoethylethanolamine
Diethanolamine
Diethylethanolamine
Dimethylethanolamine
Ethanolamine
Propanolamine
Triethanolamine

9. Aromatic Amines
Aniline
Pyridine
2-Methyl-5-Ethylpyridine

10. Amides
Dimethyl formamide

11. Organic Anhydrides
Acetic Anhydride
Phthalic Anhydride
Propionic Anhydride

12. Isocyanates
Diphenylmethane Diisocyanate
Polyphenyl Polymethylene-isocyanate
Toluene Diisocyanate

13. Vinyl Acetate
Vinyl Acetate (inhibited)

Table 2 Continued

14. Acrylates
Butyl Acrylate (inhibited)
Butyl Methacrylate (inhibited)
Decyl Acrylate (inhibited)
Ethyl Acrylate (inhibited)
2-Ethylhexyl Acrylate (inhibited)
Ethyl Methacrylate (inhibited)
Methyl Acrylate (inhibited)
Methyl Methacrylate (inhibited)

15. Substituted Allyls
Acrylonitrile (inhibited)
Allyl Alcohol
Allyl Chloride
1,3-Dichloropropene

16. Alkylene Oxides
Propylene Oxide
Butylene Oxide

17. Epichlorohydrin
Epichlorohydrin

18. Ketones
Acetone
Camphor Oil
Cyclohexanone
Diisobutyl Ketone
Isophorone
Mesityl Oxide
Methyl Ethyl Ketone
Methyl Isobutyl Ketone

19. Aldehydes
Acetaldehyde
Acrolein (inhibited)
Butyraldehyde
Decaldehyde
Ethylhexald ehyde
Formaldehyde
Glutaraldehyde Solution
Glyoxal Solution
Methylbutyraldehyde
Octyl Aldehyde
Pentyl Aldehyde
Propionaldehyde
Valeraldehyde

20. Alcohols, Glycols
Amyl Alcohol
Butyl Alcohol
1,3-Butylene Glycol
Cyclohexanol
Decyl Alcohol
Diacetone Alcohol
Diisobutyl Carbinol
Dodecanol
Ethanol
Ethoxylated Alcohols C_{11} C_{15}
Ethyl Alcohol
Ethylbutanol
Ethylene Chlorohydrin
Ethylene Cyanohydrin
Ethylene Glycol
2-Ethyl Hexanol
Furfuryl Alcohol
Glycerin
Hexanol
Hexylene Glycol
Methanoi
Methyl Alcohol
Methylamyl Alcohol
Methylisobutyl Carbinol
Octyl Alcohol
Nonyl Alcohol
Pentadecanol
Propyl Alcohol
Propylene Glycol
Sorbitol
Tallow Fatty Alcohol
Tetradecanol
Tridecanol
Undecanol

21. Phenols and Cresols
Carbolic Oil
Creosote, Coal Tar
Cresols
Nonyl Phenol
Phenol

22. Caprolactam Solution
Caprolactam Solution

23 - 29. Unassigned

Table 2 Continued

30. Olefins
Butadiene (inhibited)
Butene
Butylene
Decene
Dicyclopentadiene
Diisobutylene
Dodecene
Ethylene
Hexene
Isoprene (inhibited)
Methyl Acetylene, Propadiene Mixture (stabilized)
(alpha-) Methyl Styrene (inhibited)
Nonene
Octene
Pentene
Polybutene
Polypropylene
Propylene
Propylene Butylene Polymer
Propylene Tetramer
Styrene (inhibited)
Vinyl Toluene (inhibited)
Tetradecene
Tridecene
Turpentine
Undecene

31. Paraffins
Butane
Cycloaliphatic Resins
Cyclohexane
Decane
Dodecane
Ethane
Heptane
Hexane
Methane
Nonane
Octane
Pentane
Propane

32. Aromatic Hydrocarbons
Benzene
Benzene, Toluene, Xylene (crude)
Cumene
Cymene
Decylbenzene
Diethylbenzene
Dodecylbenzene
Ethylbenzene
Naphthalene
Tetradecylbenzene
Tetrahydronaphthalene
Toluene
Tridecylbenzene
Triethylbenzene
Undecylbenzene
Xylene

33. Misc. Hydrocarbon Mixtures
Asphalt
Asphalt Blending Stocks
Diphenyl - Diphenyl Oxide
Distillates
Gas Oil, Cracked
Gasoline Blending Stocks
Gasolines
Jet Fuels
Kerosene
Mineral Spirits
Naphtha
Oils, Crude
Oils, Diesel
Oils, Coal
Oils, Fuel (No. 1 thru No. 6)
Oils, Residual
Oils, Road
Oils, Transformer
Petroleum
Petroleum Naphtha

34. Esters
Amyl Acetate
Amyl Tallate
Butyl Acetate
Butyl Benzyl Phthalate
Castor Oil
Coconut Oil
Cottonseed Oil
Dibutyl Phthalate
Diethylene Glycol Monobutyl Ether Acetate

Table 2 Continued

Diheptyl Phthalate
Diisodecyl Phthalate
Dinonyl Phthalate
Dioctyl Phthalate
Diundecyl Phthalate
Ethyl Acetate
Ethylene Glycol Monobutyl Ether Acetate
Ethylene Glycol Monoethyl Ether Acetate
Ethylhexyl Tallate
Fish Oil
Glycol Diacetate
Lard
Methyl Acetate
Methyl Amyl Acetate
Octyl Epoxy Tallate
Olive Oil
Palm Oil
Peanut Oil
Propyl Acetate
Safflower Oil
Soybean Oil
Tallow
Tucum Oil
Vegetable Oil

35. Vinyl Halides
Vinyl Chloride (inhibited)
Vinylidene Chloride (inhibited)

36. Halogenated Hydrocarbons
Carbon Tetrachloride
Chlorobenzene
Chloroform
Dichlorobenzene
1,1-Dichloroethane
Dichloroethyl Ether
Dichloromethane
1,1-Dichloropropane
1,2-Dichloropropane
Ethyl Chloride
Ethylene Dibromide
Ethylene Bichloride
Methyl Bromide
Methyl Chloride
Pentachloroethane
Perchloroethylene
1, 1,2,2-Tetrachloroethane
1,2,4-Trichlorobenzene
Trichloroethylene

37. Nitriles
Acetonitrile
Adiponitrile

38. Carbon Disulfide

39. Suit plane

40. Glycol Ethers
Diethylene Glycol
Diethylene Glycol Monobutyl Ether
Diethylene Glycol Monoethyl Ether
Diethylene Glycol Monomethyl Ether
Dipropylene Glycol
Ethoxy Triglycol
Ethylene Glycol Monobutyl Ether
Ethylene Glycol Monethyl Ether
Ethylene Glycol Monomethyl Ether
Nonylphenol, Ethoxylated
Polyethylene Glycols
Polypropylene Glycols
Polypropylene Glycol Methyl Ether
Soybean Oil, Epoxidized
Tetraethylene Glycol
Triethylene Glycol
Tripropylene Glycol

41. Ethers
Butyl Ether
1,4-Dioxane
Ethyl Ether
Methyl Formal (Dimethyl Formal)
Propyl Ether
Tetrahydrofuran

42. Nitrocompounds
(mono-) Nitrobenzene
1- or 2-Nitropropane
Nitrotoluene

43. Miscellaneous Water Solutions
Ammonium Nitrate, Urea, Water Solutions (not containing Ammonia)
Corn Syrup
Dextrose Solution
Latex Solutions
Tetrasodium Salt of EDTA Solution

Table 3. Combinations Not Dangerously Reactive

Acetone (8)	Caustic soda solution (3)
Acrylonitrile (inhibited) (14)	Methyl alcohol (6)
Acrylonitrile (inhibited) (14)	Niax polyol (6)*
Acrylonitrile (inhibited) (14)	Polyol 3030 (6)*
Acrylonitrile (inhibited) (14)	Propylene glycol (6)
Acrylonitrile (inhibited) (14)	Voranol CP 4100 (6)*
Benzene (10)	Phosphoric acid (1)
Butyl acetate (n-, iso-*) (13)	Caustic soda solution (3)
Butyl acrylate (inhibited) (14)	Methyl alcohol (6)
Butyl acrylate (inhibited) (14)	Voranol CP 4100 (6)*
n-Butyl alcohol (6)	Styrene (inhibited) (14)
n-Butyl alcohol (6)	Vinyl acetate (inhibited) (14)
Carbon tetrachloride (5)	Caustic soda solution (3)
Caustic soda solution (3)	Acetone (8)
Caustic soda solution (3)	Butyl acetate (iso-*, n-) (13)
Caustic soda solution (3)	Carbon tetrachloride (5)
Caustic soda solution (3)	Oils, edible: coconut (13)*
Caustic soda solution (3)	Oils, edible: cottonseed (13)
Caustic soda solution (3)	Dichloropropane (5)
Caustic soda solution (3)	Dichloropropene (5)
Caustic soda solution (3)	Diisodecyl phthalate (13)*
Caustic soda solution (3)	Di-normal-alkyl phthalate (13)*
Caustic soda solution (3)	Dioctyl phthalate (13)
Caustic soda solution (3)	Ethyl acetate (13)
Caustic soda solution (3)	Ethylene dichloride (5)
Caustic soda solution (3)	Oils, edible: fish (13)
Caustic soda solution (3)	Grease (inedible, yellow) (13)*
Caustic soda solution (3)	Lard (edible) (13)*
Caustic soda solution (3)	Linseed oil (raw) (13)*
Caustic soda solution (3)	Methylene chloride (5)*
Caustic soda solution (3)	Methyl ethyl ketone (8)
Caustic soda solution (3)	Methyl isobutyl ketone (8)
Caustic soda solution (3)	Palm oil (13)*
Caustic soda solution (3)	Perchloroethylene (5)*
Caustic soda solution (3)	Propyl acetate (iso-*, n-) (13)

Table 3 Continued

Caustic soda solution (3)	Oils, edible: soya bean (13)
Caustic soda solution (3)	Oils, miscellaneous: sperm
Caustic soda solution (3)	Styrene (inhibited) (14)
Caustic soda solution (3)	Tallow (13)
Caustic soda solution (3)	Trichloroethane (5)
Dichloropropane (5)	Caustic soda solution (3)
Dichloropropene (5)	Caustic soda solution (3)
Diisodecyl phthalate (13)*	Caustic soda solution (3)
Di-normal-alkyl phthalate (13)*	Caustic soda solution (3)
Dimethylformamide (4)	Furfural (7)
Dimethylformamide (4)	Phenol (15)
Dioctyl phthalate (13)	Caustic soda solution (3)
Dioctyl phthalate (13)	Ethylenediamine (4)
Diphenylmethanediisocyanate	Ethylene dichloride (5)
Ethyl acetate (13)	Caustic soda solution (3)
Ethyl acrylate (inhibited) (14)	Ethylene glycol (6)
Ethyl acrylate (inhibited) (14)	2-Ethyl hexanol (6)
Ethyl acrylate (inhibited) (14)	Voranol CP 4100 (6)*
Ethyl alcohol (6)	Methyl methacrylate (inhibited) (14)
Ethylenediamine (4)	Dioctyl phthalate (13)
Ethylene dichloride (5)	Caustic soda solution (3)
Ethylene dichloride (5)	Diphenylmethanediisocyanate
Ethylene glycol (6)	Ethyl acrylate (inhibited) (14)
Ethylene glycol (6)	Styrene (inhibited) (14)
Ethylene glycol (6)	Vinyl acetate (inhibited) (14)
2-Ethyl hexanol (6)	Ethyl acrylate (inhibited) (14)
2-Ethyl hexanol (6)	Styrene (inhibited) (14)
Furfural (7)	Dimethylformamide (4)
Furfural (7)	Isopropyl alcohol (6)
Furfural (7)	Methyl ethyl ketone (8)
Grease (inedible, yellow) (13)*	Caustic soda solution (3)
Isobutyl alcohol (6)	Styrene (inhibited) (14)
Isobutyl alcohol (6)	Vinyl acetate (inhibited) (14)
Isodecyl alcohol (6)	Vinyl acetate (inhibited) (14)
Isooctyl alcohol (6)	Methyl methacrylate (inhib.)(14)

Table 3 Continued

Isooctyl alcohol (6)	Styrene (inhibited) (14)
Isooctyl alcohol (6)	Vinyl acetate (inhibited) (14)
Isopropyl alcohol ((?)	Furfural (7)
Isopropyl alcohol (6)	Styrene (inhibited) (14)
Isopropyl alcohol (6)	Vinyl acetate (inhibited) (14)
Lard (edible) (13)*	Caustic soda solution (3)
Linseed oil (raw) (13)*	Caustic soda solution (3)
Methyl alcohol (6)	Acrylonitrile (inhibited) (14)
Methyl alcohol (6)	Butyl acrylate (inhibited) (14)
Methyl alcohol (6)	Styrene (inhibited) (14)
Methyl alcohol (6)	Vinyl acetate (inhibited) (14)
Methylene chloride (5)*	Caustic soda solution (3)
Methyl ethyl ketone (8)	Caustic soda solution (3)
Methyl ethyl ketone (8)	Furfural (7)
Methyl isobutyl ketone (8)	Caustic soda solution (3)
Methyl methacrylate (inhibited) (14)	Ethyl alcohol (6)
Methyl methacrylate (inhibited) (14)	Isooctyl alcohol (6)
Niax polyol (6)*	Acrylonitrile (inhibited) (14)
Niax polyol (6)*	Vinyl acetate (inhibited) (14)
Oils, edible: coconut (13)*	Caustic soda solution (3)
Oils, edible: cottonseed (13)	Caustic soda solution (3)
Oils, edible: fish (13)	Caustic soda solution (3)
Oils, edible: soya bean (13)	Caustic soda solution (3)
Oils, miscellaneous: sperm	Caustic soda solution (3)
Palm oil (13)*	Caustic soda solution (3)
Perchloroethylene (5)*	Caustic soda solution (3)
Phenol (15)	Dimethyl formamide (4)
Phosphoric acid (1)	Benzene (10)
Phosphoric acid (1)	Toluene (10)
Phosphoric acid (1)	Xylene (10)
Polyol 3030 (6)*	Acrylonitrile (inhibited) (14)
Propyl acetate (iso-*, n-) (13)	Caustic soda solution (3)
Propylene glycol (6)	Acrylonitrile (inhibited) (14)
Propylene glycol (6)	Styrene (inhibited) (14)
Styrene (inhibited) (14)	n-Butyl alcohol (6)

Table 3 Continued

Styrene (inhibited) (14)	Caustic soda solution (3)
Styrene (inhibited) (14)	Ethylene glycol (6)
Styrene (inhibited) (14)	2-Ethyl hexanol (6)
Styrene (inhibited) (14)	Isobutyl alcohol (6)
Styrene (inhibited) (14)	Isooctyl alcohol (6)
Styrene (inhibited) (14)	Isopropyl alcohol (6)
Styrene (inhibited) (14)	Methyl alcohol (6)
Styrene (inhibited) (14)	Propylene glycol (6)
Styrene (inhibited) (14)	Trichloroethylene (5)
Tallow (13)	Caustic soda solution (3)
Toluene (10)	Phosphoric acid (1)
Trichloroethane (5)	Caustic soda solution (3)
Trichloroethylene (5)	Styrene (inhibited) (14)
Vinyl acetate (inhibited) (14)	n-Butyl alcohol (6)
Vinyl acetate (inhibited) (14)	Ethylene glycol (6)
Vinyl acetate (inhibited) (14)	Isobutyl alcohol (6)
Vinyl acetate (inhibited) (14)	Isodecyl alcohol (6)
Vinyl acetate (inhibited) (14)	Isooctyl alcohol (6)
Vinyl acetate (inhibited) (14)	Isopropyl alcohol (6)
Vinyl acetate (inhibited) (14)	Methyl alcohol (6)
Vinyl acetate (inhibited) (14)	Niax polyol (6)*
Vinyl acetate (inhibited) (14)	VoranolCP4100(6)*
VoranolCP4100(6)*	Acrylonitrile (inhibited) (14)
VoranolCP 4100 (6)*	Butyl acrylate (inhibited) (14)
Voranol CP 4100 (6)*	Ethyl acrylate (inhibited) (14)
VoranolCP4100(6)*	Vinyl acetate (inhibited) (14)
Xylene (10)	Phosphoric acid (1)

Toluene 2,4-diisocyanate (TDI), diphenylmethanediisocyanate (MDI),and polymethylene polyphenyl isocyanate (PAPI)* are considered compatible with reactivity groups 9, 10, 11, 12, 18, and 21.
*Not presently included in CHRIS.

4.3 CHEMICAL SPECIFIC INFORMATION

A

Acetaldehyde — **Fire Hazards:** *Flash Point (deg. F)*: -36 CC; -59 OC; *Flammable Limits in Air (%)*: 4 - 60; *Fire Extinguishing Agents*: Dry chemical, alcohol foam, carbon dioxide; *Fire*

Extinguishing Agents Not To Be Used: Water may be ineffective; *Special Hazards of Combustion Products*: Produces irritating vapors when heated; *Behavior in Fire*: Vapors are heavier than air and may travel to a considerable distance for a source of ignition and flash back; *Ignition Temperature (deg. F)*: 365; *Electrical Hazard*: Class 1, Group C; *Burning Rate*: 3.3 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not Pertinent; *Polymerization*: May occur. Avoid contact with heat, dust, strong oxidizing and reducing agents, strong acids and bases; *Inhibitor of Polymerization*: None.

Acetic Acid — Fire Hazards: *Flash Point (deg. F)*: 112 OC; 104 CC; *Flammable Limits in Air* (%): 5.4 - 16.0; *Fire Extinguishing* Agents: Water, alcohol foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: None; *Special Hazards of Combustion Products*: Irritating vapors produced when heated; *Behavior in Fire*: Not Pertinent; *Ignition Temperature (deg. F)*: 800; *Electrical Hazard*: Not Pertinent; *Burning Rate*: 1.6 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Corrosive, particularly when diluted. Attacks most common metals, including most stainless steels. Excellent solvent for many synthetic resins or rubber; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Dilute with water, rinse with sodium bicarbonate solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acetic Anhydride — Fire Hazards: *Flash Point (deg. F)*: 136 OC; 120 CC; *Flammable Limits in Air* (%): 2.7 - 10.0; *Fire Extinguishing Agents*: Water spray, dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water and foam react, but heat liberated is not enough to create a hazard. Dry chemical forced below the surface can cause foaming and boiling; *Special Hazards of Combustion Products*: Irritating vapors generated upon heating; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 600; *Electrical Hazard*: Not pertinent; *Burning Rate*: 3.3 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Reacts slowly with water, but considerable heat is liberated when contacted with spray water; *Reactivity with Common Materials*: Corrodes iron, steel and other metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Dilute with water and use sodium bicarbonate solution to rinse; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acetone — Fire Hazards: *Flash Point (deg. F)*: 4 OC, 0 CC; *Flammable Limits in Air* (%): 2.6 - 12.8; *Fire Extinguishing Agents*: Alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water in straight hose streams will scatter fire and is not recommended; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 869; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 3.9 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acetone Cyanohydrin — Fire Hazards: *Flash Point (deg. F)*: 165 CC; *Flammable Limits in Air* (%): 2.2 - 12; *Fire Extinguishing Agents*: Water spray, dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic hydrogen cyanide is generated upon heating; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 1270; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions;

Stability During Transport: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acetonitrile — Fire Hazards: *Flash Point (deg. F)*: 42 OC; *Flammable Limits in Air* (%): 4.4 - 16; *Fire Extinguishing Agents*: Alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Toxic vapors generated during heating; *Behavior in Fire*: Vapor is heavier than air and may travel considerable distance to ignition source and flash back; *Ignition Temperature (deg. F)*: 975; *Electrical Hazard*: Not pertinent; *Burning Rate*: 2.7 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acetophenone — Fire Hazards: *Flash Point (deg. F)*: 180 OC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: None; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 1058; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acetylacetone — Fire Hazards: *Flash Point (deg. F)*: 105 OC, 93 CC; *Flammable Limits in Air* (%): 2.4 - 11.6; *Fire Extinguishing Agents*: Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: No information; *Behavior in Fire*: Vapor is heavier than air and may travel considerable distance to ignition source and flash back; *Ignition Temperature (deg. F)*: 644; *Electrical Hazard*: No information; *Burning Rate*: 3.6 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May dissolve some plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acetyl Bromide — Fire Hazards: *Flash Point (deg. F)*: Data not available; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Carbon dioxide,; *Fire Extinguishing Agents Not To Be Used*: Water; *Special Hazards of Combustion Products*: Toxic and irritating hydrogen bromide fumes may form in fires; *Behavior in Fire*: Do not apply water to adjacent fires. Reacts with water to produce toxic and irritating gases; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: Reacts violently, forming corrosive and toxic fumes of hydrogen bromide; *Reactivity with Common Materials*: Attacks and corrodes wood and most metals in the presence of moisture. Flammable hydrogen gas may collect in enclosed spaces; *Stability During Transport*: Stable if protected from moisture; *Neutralizing Agents for Acids and Caustics*: Flood with water, rinse with dilute sodium bicarbonate or soda ash solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acetyl Chloride — Fire Hazards: *Flash Point (deg. F)*: 40 CC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used*: Water, foam; *Special Hazards of Combustion* Products: When heated to decomposition, hydrogen chloride and phosgene, extremely poisonous gases, are involved; *Behavior in Fire*: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*:734; *Electrical Hazard*: Data not available; *Burning Rate: 2.6 mm/min*. **Chemical Reactivity:** *Reactivity with* Water: Reacts vigorously with water, involving hydrogen chloride fumes (hydrochloric acid); *Reactivity with Common Materials*: Is highly corrosive to most metals in the presence of moisture; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Following dilution with water, limestone or sodium bicarbonate can be used; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acetylene — Fire Hazards: *Flash Point (deg. F)*:Gas; *Flammable Limits in Air* (%): 2.5 - 80; *Fire Extinguishing Agents*: Stop flow of gas; *Fire Extinguishing Agents Not To Be Used*: Carbon dioxide, dry chemical and water spray are not generally recommended because the discharged gas or volatile liquid may create a more serious explosion hazard; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: May explode in fire; *Ignition Temperature (deg. F)*:581; *Electrical Hazard*: Class I Group A; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Under certain conditions forms spontaneously compounds with copper; *Stability During Transport*: Stable as shipped; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acetyl Peroxide Solution — Fire Hazards: *Flash Point (deg. F)*: 113 OC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: May explode. Burns with accelerating intensity; *Ignition Temperature (deg. F)*: Explodes; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May ignite combustible materials such as wood; *Stability During Transport*: Heat-and-shock-sensitive crystals may separate at very low temperature during transport; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acridine — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (combustible solid); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, foam, monoammonium phosphate, dry chemical; *Fire Extinguishing Agents Not To Be Used*: Carbon dioxide and other dry chemicals may not be effective; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fire; *Behavior in Fire*: Sublimes before melting; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Data not available; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Acrolein — Fire Hazards: *Flash Point (deg. F)*: <0 OC; -13 CC; *Flammable Limits in Air* (%): 2.8 - 31; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Poisonous vapor of acrolein is formed from hot liquid; *Behavior in Fire*: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back. Polymerization may take place, and containers may explode in fire; *Ignition Temperature (deg. F)*: 453; *Electrical Hazard*: Data not available; *Burning Rate*: 3.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction;

Reactivity with Common Materials: No reaction; *Stability During Transport*: Stable when inhibited; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Undergoes uncatalyzed polymerization reaction around 200°C. Light promotes polymerization; *Inhibitor of Polymerization*: Hydroquinone: 0.10 to 0.25 %.

Acrylamide — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fire; *Behavior in Fire*: Sealed containers may burst as a result of polymerization; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Data not available; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: May occur at temperature above 50°C (120° F); *Inhibitor of Polymerization*: Oxygen (air) plus 50 ppm of copper as copper sulfate.

Acrylic Acid — Fire Hazards: *Flash Point (deg. F)*: (Glacial) 118 OC; *Flammable Limits in Air* (%): (Tech.) 2.4 LEL; *Fire Extinguishing Agents*: Water spray, alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic vapor are generated when heated; *Behavior in Fire*: May polymerize and explode; *Ignition Temperature (deg. F)*: 374; *Electrical Hazard*: Not pertinent; *Burning Rate*: 1.6 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Normally unstable but will be detonate; *Neutralizing Agents for Acids and Caustics*: Wash with water, rinse with sodium bicarbonate solution; *Polymerization*: May occur in contact with acids, iron salts, or at elevated temperatures and release high energy rapidly; may cause explosion under confinement; *Inhibitor of Polymerization*: Monomethyl ether of hydroquinone 180-200 ppm; phenothiazine (for tech. grades) 1000 ppm; hydroquinone (0.1%); methylene blue (0.5 %); N, N'-diphenyl-p-phenylenediamine (0.05%).

Acrylonitrile — Fire Hazards: *Flash Point (deg. F)*: 30 CC; 31 OC; *Flammable Limits in Air* (%): 3.05 - 17.0; *Fire Extinguishing Agents*: Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water or foam may cause frothing; *Special Hazards of Combustion Products*: When heated or burned, ACN may evolve toxic hydrogen cyanide gas and oxides of nitrogen; *Behavior in Fire*: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back. May polymerize and explode; *Ignition Temperature (deg. F)*: 898; *Electrical Hazard*: Class I, Group D; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Attacks copper and copper alloys; these metals should not be used. Penetrates leather, so contaminated leather shoes and gloves should be destroyed. Attacks aluminum in high concentrations; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: May occur spontaneously in absence of oxygen or on exposure to visible light or excessive heat, violently in the presence of alkali. Pure ACN is subject to polymerization with rapid pressure development. The commercial product is inhibited and not subject to this reaction; *Inhibitor of Polymerization*: Methylhydroquinone (35 -45 ppm).

Adipic Acid — Fire Hazards: *Flash Point (deg. F)*: Combustible solid 300 OC; 376 CC; *Flammable Limits in Air*): (dust) 10 -15 mg/l; *Fire Extinguishing Agents*: Foam, water fog, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used*: Data not available; *Special*

Hazards of Combustion Products: Data not available; *Behavior in Fire*: Melts and may decompose to give volatile acetic vapors pf valeric acid and other substances. Dust may form explosive mixture with air; *Ignition Temperature (deg. F)*: 788; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Data not available; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Rinse with dilute sodium bicarbonate or soda ash solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Adiponitrile — Fire Hazards: *Flash Point (deg. F)*: 199 OC; *Flammable Limits in Air* (%): LFL= 1.0 at 200°C; *Fire Extinguishing Agents*: Water spray, dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic gases are generated in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: 2.7 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of* Polymerization: Not pertinent.

Aldrin — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water spray, dry chemical, foam or carbon dioxide for fire involving solutions of aldrin in hydrocarbon solvents; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating fumes of hydrochloric acid and chlorinated decomposition products are given off; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Alkylbenzenesulfonic Acids — Fire Hazards: *Flash Point (deg. F)*: 395 OC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: irritating sulfuric acid mist may form in fire; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May attack metals, causing accumulation of flammable hydrogen gas in enclosed spaces; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water, rinse with dilute sodium bicarbonate or soda ash solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Allyl Alcohol — Fire Hazards: *Flash Point (deg. F)*: 72 CC; 90 OC; *Flammable Limits in Air* (%): 2.5 - 18; *Fire Extinguishing Agents*: Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Toxic vapor is generated when heated; *Behavior in Fire*: Vapor heavier than air and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*:829; *Electrical Hazard*: Not pertinent; *Burning Rate*: 2.7 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable at ordinary temperatures and pressures; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of* Polymerization: Not pertinent.

Allyl Bromide — Fire Hazards: *Flash Point (deg. F)*: 30 CC; *Flammable Limits in Air* (%): 4.4 - 7.3; *Fire Extinguishing Agents*: Dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Toxic hydrogen bromide gas formed in fire; *Behavior in Fire*: Vapor heavier than air and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*: 563; *Electrical Hazard*: Data not available; *Burning Rate*: 3.5 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Allyl Chloride — Fire Hazards: *Flash Point (deg. F)*: -20; *Flammable Limits in Air* (%): 3.3 -11.1; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water fog; *Special Hazards of Combustion Products*: Releases irritating hydrogen chloride gas on combustion; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 737; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Allyl Chloroformate — Fire Hazards: *Flash Point (deg. F)*: 92 OC; 88 CC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: When heated to decomposition, emits highly toxic phosgene gas; *Behavior in Fire*: Vapor heavier than air and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: 4.9 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Reacts slowly generating hydrogen chloride; *Reactivity with Common Materials*: Corrosive metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water, rinse with sodium bicarbonate solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Allyltrichlorosilane — Fire Hazards: *Flash Point (deg. F)*: 100 OC; 95 CC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water; *Special Hazards of Combustion Products*: Irritating vapor of hydrogen chloride and phosgene may form; *Behavior in Fire*: Difficult to extinguish. Re-ignition may occur; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: 2.2 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously, generating hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials*: Corrodes metals because of hydrochloric acid formed; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water, rinse with sodium bicarbonate; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Aluminum Chloride — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing* Agents: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Do not use water on adjacent fires; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Reacts violently with water used in extinguishing adjacent fires; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Reacts violently with water, liberating hydrogen chloride gas and heat; *Reactivity with Common Materials*: None if dry. If wet it attacks metals because of hydrochloric acid formed; flammable hydrogen is formed; *Stability During Transport*: Stable if kept dry and protected from atmospheric moisture; *Neutralizing Agents for Acids and Caustics*: Hydrochloric acid formed by reaction with water can be flushed away with water. Rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Aluminum Fluoride — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: When heated to sublimation condition, emits toxic fumes of fluoride; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Aluminum Nitrate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fire; *Behavior in Fire*: May increase the intensity if fire when used with combustible material; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Dissolves and forms a weak solution if nitric acid. The reaction is not hazardous; *Reactivity with Common Materials*: May corrode metals in presence of moisture; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Aluminum Sulfate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*:Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May corrode metals in presence of moisture; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Aminoethylethanolamine — Fire Hazards: *Flash Point (deg. F)*: 265 OC; *Flammable Limits in Air* (%): 1 - 8 (calc.); *Fire Extinguishing Agents*: Alcohol foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 695; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Dilute with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonia, Anhydrous — Fire Hazards: *Flash Point (deg. F)*: Not flammable under condition likely to be encountered; *Flammable Limits in Air* (%): 15.50 - 27.00; *Fire Extinguishing Agents*:

Stop flow of gas or liquid. Let fire burn; *Fire Extinguishing Agents Not To Be Used*: None; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 1204; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 1 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Dissolves with mild heat effect; *Reactivity with Common Materials*: Corrosive to copper and galvanized surfaces; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Dilute with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Acetate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating vapors of ammonia and acetic acid may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Benzoate — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating and toxic ammonia gas may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Slowly releases ammonia gas, which may collect in closed container; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Bicarbonate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating and toxic ammonia gas may form in fires; *Behavior in Fire*: Decomposes, but reaction is not explosive. Ammonia gas is formed; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May attack copper, nickel and zinc; *Stability During Transport*: Decomposes above 34° C (91° F) with formation of ammonia gas, which may collect in closed containers; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Bifluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Do not apply water to adjacent fires; *Special Hazards of Combustion Products*: Toxic ammonia and hydrogen fluoride gases may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Dissolves and forms a weak solution of hydrofluoric acid; *Reactivity with Common Materials*: In presence of moisture will corrode glass, cement and most metals. Flammable hydrogen gas may collect in enclosed spaces; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water, rinse with dilute solution of sodium of sodium bicarbonate or soda ash; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Carbonate — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic ammonia gas will form in fires; *Behavior in Fire*: Decomposes, but reaction is not explosive. Ammonia gas is formed; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic and irritating ammonia and hydrogen chloride gases may form in fire; *Behavior in Fire*: May volatilize and condense on cool surfaces; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Citrate — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic ammonia gas may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Dichromate — Fire Hazards: *Flash Point (deg. F):* Flammable solid; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Greenish chromic oxide smoke may cause irritation of lungs and mucous membranes; *Behavior in Fire*: Decomposes at about 180° C with spectacular swelling and evolution of heat and nitrogen, leaving chromic oxide residue. Pressure of confined gases can burst closed containers explosively; *Ignition Temperature (deg. F)*: 437; *Electrical Hazard*: Data not available; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Can ignite combustible material such as wood shavings; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Fluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic ammonia and hydrogen fluoride gases are formed in fires; *Behavior in Fire*: May sublime when hot and condense on cool surfaces; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Dissolves and formes dilute solution of hydrofluoric acid; *Reactivity with Common Materials*: May corrode glass, cement and most metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Formate — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, foam; *Fire Extinguishing Agents Not To Be Used*: Data not available; *Special Hazards of Combustion Products*: Toxic and irritating ammonia and formic acid gases may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Gluconate — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During* Transport: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Hydroxide (< 20 % Aqueous Ammonia) — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Data not available; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Mild liberation of heat; *Reactivity with Common Materials*: Corrosive to copper, copper alloys, aluminum alloys, galvanized surfaces; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Dilute with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Iodide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic and irritating fumes of hydrogen iodide, iodine and oxides of nitrogen may form in fire; *Behavior in Fire*: Compound may sublime in fire and condense on cold surfaces; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Lactate — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, foam; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may be formed in a fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Lauryl Sulfate — Fire Hazards: *Flash Point (deg. F):* Not pertinent (non-combustible water solution); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen and sulfur may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Molybdate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Use flooding amount of water in early stages of fire. When large quantities are involved in massive fires, control efforts should be confined to protecting from explosion; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Decomposes, giving off extremely toxic oxides of nitrogen; *Behavior in Fire*: May explode in fires. Supports combustion of common organic fuel; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: If heated strongly, decomposes, giving off toxic gases which support combustion. Undergoes detonation if heated under confinement; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Nitrate—Phosphate Mixture — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Steam, inert gases, foam, dry chemical; *Special Hazards of Combustion Products*: Toxic and irritating oxides of nitrogen may form in fires; *Behavior in Fire*: Will increase intensity of fire when in contact with combustible material. Containers may explode; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Corrodes metals to same degree as ordinary fertilizer; the reaction is not hazardous; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Nitrate-Sulfate Mixture — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Steam, inert gases, foam, dry chemical; *Special Hazards of Combustion Products*: Toxic and irritating oxides of nitrogen may form in fires; *Behavior in Fire*: Will increase intensity of fire when in contact with combustible material. Containers may explode; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Corrodes metals to same degree as ordinary fertilizer; the reaction is not hazardous; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Nitrate-Urea Solution — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Water of solution may evaporate, and remaining solids may then explode; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Oleate — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, dry chemical; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Oxalate — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, foam; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Pentaborate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Perchlorate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Water (from protected location); *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic gases are produced in a fire; *Behavior in Fire*: May explode when involved in a fire or exposed to shock or friction; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: If contaminated with carbonaceous materials, can become an explosive which is sensitive to shock and friction. Ready detonates or explodes; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Persulfate — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Data not available; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen and sulfuric acid fumes are formed in fire; *Behavior in Fire*: Decomposes with loss of oxygen that increases intensity of fire; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Contact with grease, wood and other combustibles may result in fire; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Phosphate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic and irritating fumes of ammonia and oxides of nitrogen may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Silicofluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic and irritating hydrogen fluoride, silicon tetrafluoride, and oxides of nitrogen may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Stearate — Fire Hazards: *Flash Point (deg. F):* >140 CC (pure material only; solution not flammable); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Data not available; *Special Hazards of Combustion Products*: Toxic ammonia and oxides of nitrogen may form in fires; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*:

Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Sulfamate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Sulfide — Fire Hazards: *Flash Point (deg. F):* 72 CC; *Flammable Limits in Air* (%): 4 - 46 (hydrogen sulfide); *Fire Extinguishing Agents*: Water, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Data not available; *Special Hazards of Combustion Products*: Toxic hydrogen sulfide gas is released when solution is heated. If ignited, this will form irritating sulfur dioxide gas; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Severely corrodes copper, zinc and their alloys; *Stability During Transport*: Stable, but toxic hydrogen sulfide and ammonia gases may form in enclosed spaces; *Neutralizing Agents for Acids and Caustics*: Dilute with water. Do not attempt to neutralize with acid; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Sulfite — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic sulfur dioxide and oxides of nitrogen may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Dilute with water. Do not attempt to neutralize with acids; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Tartrate — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen or ammonia gas may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical**

Reactivity: *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Thiocyanate — Fire Hazards: *Flash Point (deg. F):* Solid may be combustible; solution is not flammable; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Data not available; *Special Hazards of Combustion Products*: Decomposes to form ammonia, hydrogen sulfide and hydrogen cyanide. Oxides of nitrogen may also form. All of these products are toxic; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Ammonium Thiosulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic ammonia, hydrogen sulfide, and oxides of nitrogen and sulfur may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable, but toxic ammonia gas may collect in enclosed spaces; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Amyl Acetate — Fire Hazards: *Flash Point (deg. F):* (iso-): 69 CC (n-); 91 CC; *Flammable Limits in Air* (%): 1.1 - 7.5; *Fire Extinguishing Agents*: alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water in straight hose stream will scatter and spread fire and should not be used; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 572 (n); *Electrical Hazard*: Not pertinent; *Burning Rate*: 4.1 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

n-Amyl Alcohol — Fire Hazards: *Flash Point (deg. F):* 77 CC; *Flammable Limits in Air* (%): 1.1 - 7.5; *Fire Extinguishing Agents*: Alcohol foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 680; *Electrical* Hazard: Not pertinent; *Burning Rate*: 3.6 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

n-Amyl Chloride — Fire Hazards: *Flash Point (deg. F):* 55 OC; 34 CC; *Flammable Limits in Air* (%): 1.4 - 8.6; *Fire Extinguishing Agents*: Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Irritating hydrogen chloride and toxic phosgene may be formed in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 500; *Electrical Hazard*: Data not available; *Burning Rate*: 4.9 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

n-Amyl Mercaptan — Fire Hazards: *Flash Point (deg. F):* 65 OC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Sulfur dioxide gas is formed; *Behavior in Fire*: Vapor is heavier than fire and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: 4.7 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

n-Amyl Methyl Ketone — Fire Hazards: *Flash Point (deg. F):* 117 OC; 102 CC; *Flammable Limits in Air* (%): 1.11 - 7.9; *Fire Extinguishing Agents*: Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Data not available; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Will attack some forms of plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

n-Amyl Nitrate — Fire Hazards: *Flash Point (deg. F):* 120 OC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Data not available; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in a fire; *Behavior in Fire*: Overheated material may detonate; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May form combustible mixture with wood or other combustibles. Liquid will attack some plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Iso-Amyl Nitrite — Fire Hazards: *Flash Point (deg. F):* 0 OC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen are formed; *Behavior in Fire*: Containers may explode; *Ignition Temperature (deg. F)*: 410; *Electrical Hazard*:; *Burning Rate*: 3.4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Decomposes on exposure to air, light or water, involving toxic oxides of nitrogen which are orange in color; *Reactivity with Common Materials*: May corrode metals if wet; *Stability During Transport*: Stable if kept sealed and not exposed to light; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

n-Amyltrichlorosilane — Fire Hazards: *Flash Point (deg. F):* 145 OC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water, foam; *Special Hazards of Combustion Products*: Irritating hydrogen chloride and toxic phosgene may be formed; *Behavior in Fire*: Difficult to extinguish. Re-ignition may occur; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: 2.5 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously to generate toxic hydrogen chloride gas (hydrochloric acid); *Reactivity with Common Materials*: Corrodes metal; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: After flushing with water, rinse with sodium bicarbonate solution on lime water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Aniline — Fire Hazards: *Flash Point (deg. F):* 168 OC; 158 CC; *Flammable Limits in Air* (%): 1.3 (LEL); *Fire Extinguishing Agents*: Water, foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic vapors are generated when heated; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 1418; *Electrical Hazard*: Not pertinent; *Burning Rate*: 3.0 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water and rinse with dilute acetic acid; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Anisoyl Chloride — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used*: Water, foam; *Special Hazards of Combustion Products*: Irritating hydrogen chloride fumes may be formed; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical* Hazard: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: Reacts slowly to generate hydrogen chloride (hydrochloric acid). The reaction is not hazardous; *Reactivity with Common Materials*: Corrodes metal slowly; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water, rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Anthracene — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Data not available; *Special Hazards of Combustion Products*: Data not available; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: 1004; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Antimony Pentachloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Do not use water or foam on adjacent fires; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Irritating fumes of hydrogen chloride given off when water or foam is used to extinguish adjacent fire; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts to form hydrogen chloride gas (hydrochloric acid); *Reactivity with Common Materials*: Causes corrosion on metal; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Soda ash or soda ash-lime mixture; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Antimony Pentafluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Do not use water or foam on adjacent fire; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Gives off toxic hydrogen fluoride fumes when water is used to extinguish adjacent fire; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously to form toxic hydrogen fluoride (hydrofluoric acid); *Reactivity with Common Materials*: When moisture is present, causes severe corrosion of metals (except steel) and glass. If confined and wet can cause explosion. May cause fire in contact with combustible material; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water, rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Antimony Potassium Tartrate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Antimony Trichloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Do not apply water on adjacent fires; *Special Hazards of Combustion Products*: Toxic and irritating antimony oxide and hydrogen chloride may form in fires; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously to form a strong solution of hydrochloric acid; *Reactivity with Common Materials*: Corrodes may metals in the presence of moisture and flammable hydrogen gas may collect in confined spaces; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Large amounts of water followed by sodium bicarbonate or soda ash solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Antimony Trifluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not flammable; *Behavior in Fire*: Not flammable; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Antimony Trioxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent;

Burning Rate: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Arsenic Acid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Will corrode metal and give off toxic arsine gas; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Arsenic Disulfide — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air (%)*: Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Poisonous fumes of the compound may be formed during fires. If ignited, will form sulfur dioxide gas; *Behavior in Fire*: May ignite at very high temperatures; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No data; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Arsenic Trichloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Avoid water on adjacent fires; *Special Hazards of Combustion Products*: Irritating and toxic hydrogen chloride formed when involved in fires; *Behavior in Fire*: Becomes gaseous and causes irritation. Forms hydrogen chloride (hydrochloric acid) by reaction with water used to fight adjacent fires; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts with water to form hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials*: Corrodes metal; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water, rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Arsenic Trioxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic fumes of arsenic trioxide and arsine may form in fire situations; *Behavior in Fire*: Can volatilize forming toxic fumes of arsenic trioxide; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Arsenic Trisulfide — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Poisonous fumes of compound may be formed in fire situations; *Behavior in Fire*: May ignite at very high temperatures; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Asphalt — Fire Hazards: *Flash Point (deg. F):* 300 - 350 OC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water spray, dry chemical, foam or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water or foam may cause foaming; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 400 - 700; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Asphalt Blending Stocks: Roofers Flux — Fire Hazards: *Flash Point (deg. F):* 300 - 350 CC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water or foam may cause foaming; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 400 - 700; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Asphalt Blending Stocks: Straight Run Residue — Fire Hazards: *Flash Point (deg. F):* 400 - 600 OC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, foam, carbon dioxide or dry chemical; *Fire Extinguishing Agents Not To Be Used*: Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 450 - 700; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Atrazine — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating hydrogen chloride and toxic oxides of nitrogen may be formed; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Azinphosmethyl — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be*

Used: Not pertinent; *Special Hazards of Combustion Products*: Oxides of sulfur and phosphorous may be formed when exposed to a fire situation; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

B

Barium Carbonate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Barium Chlorate — Fire Hazards: *Flash Point (deg. F):* Not flammable but may cause explosions when involved in fires; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: No data; *Special Hazards of Combustion Products*: Produces toxic fumes when involved in a fire; *Behavior in Fire*: May cause an explosion when involved in a fire; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Can form explosive mixtures with combustible materials such as wood, oil - these mixtures can be ignited readily by friction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Barium Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable but can aggravate fires; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Produces toxic gaseous oxides of nitrogen when involved in fires; *Behavior in Fire*: Mixtures with combustible materials are readily ignited and may burn fiercely. Containers may explode; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Fire can result by contact of this material with combustibles; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Barium Perchlorate — Fire Hazards: *Flash Point (deg. F):* Not flammable but can aggravate fire intensity; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Increases the intensity of fires. Containers may burst or explode; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: When mixed with combustible materials or finely divided metals, can become an explosive mixture; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Barium Permanganate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not Pertinent; *Behavior in Fire*: Can increase the intensity of fires; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: When mixed with combustible materials, can ignite by friction or in an acidic state and may become spontaneously combustible; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Barium Peroxide — Fire Hazards: *Flash Point (deg. F):* Not flammable but may cause fires upon contact with combustible materials; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Flood with water, dry powder (e.g., graphite or powdered limestone); *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Can increase the intensity of fires; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Decomposes slowly but the reaction is not hazardous; *Reactivity with Common Materials*: Corrodes metals slowly. If mixed with combustible materials or finely divided metals, mixture can spontaneously ignite or become unstable by friction; *Stability During Transport*: Sable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzaldehyde — Fire Hazards: *Flash Point (deg. F):* 148 CC, 163 OC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Water spray, foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 378; *Electrical Hazard*: Not pertinent; *Burning Rate*: 3.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzene — Fire Hazards: *Flash Point (deg. F):* 12 CC; *Flammable Limits in Air* (%): 1.3 - 7.9; *Fire Extinguishing Agents*: Dry chemical, foam and carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Vapor is heavier than air and can travel considerable distance to source of ignition and flash back; *Ignition Temperature (deg. F)*: 1,097; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 6.0 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzene Hexachloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic gases are generated when solid is heated or when solution exposed to intense heat; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzene Phosphorous Dichloride — Fire Hazards: *Flash Point (deg. F):* 215 OC; This value may be lower because of the presence of phosphorus; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Large amounts of water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic fumes include oxides of phosphorous and hydrogen chloride; *Behavior in Fire*: Containers may rupture. The hot liquid is spontaneously flammable because of the presence of dissolved phosphorus; *Ignition Temperature (deg. F)*: 319; *Electrical Hazard*: No data; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously to form hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials*: Corrodes metal except 316 stainless steel, nickel, and Hastelloy; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzene Phosphorous Thiodichloride — Fire Hazards: *Flash Point (deg. F):* 252 OC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic fumes generated include oxides of phosphorous and sulfur and hydrogen chloride; *Behavior in Fire*: Containers may rupture; *Ignition Temperature (deg. F)*: 338; *Electrical Hazard*: No data; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: Forms hydrogen chloride fumes (hydrochloric acid). Reaction is slow unless the water is hot; *Reactivity with Common Materials*: Corrodes metals slowly; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzoic Acid — Fire Hazards: *Flash Point (deg. F):* 250 CC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Dry chemical, carbon dioxide, water fog, chemical foam; *Fire Extinguishing Agents Not To Be Used*: None; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Vapor from molten benzoic acid may form explosive mixture with air. Concentrated dust may form explosive mixture in air; *Ignition Temperature (deg. F)*: 1,063; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzonitrile — Fire Hazards: *Flash Point (deg. F):* 167 CC, This material is combustible but burns with difficulty; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Toxic hydrogen cyanide and oxides of nitrogen form; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: Difficult to burn. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Will attack some plastics; *Stability During Transport*: Stable;

Neutralizing Agents for Acids and Caustics: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzophenone — Fire Hazards: *Flash Point (deg. F):* This is a combustible product; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Will attack some plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzoyl Chloride — Fire Hazards: *Flash Point (deg. F):* 162 OC; *Flammable Limits in Air* (%): 1.2 - 4.9; *Fire Extinguishing Agents*: Foam, carbon dioxide, dry chemical, water fog; *Fire Extinguishing Agents Not To Be Used*: Water spray. Do not allow water to enter containers; *Special Hazards of Combustion Products*: Highly poisonous phosgene gas forms during fires; *Behavior in Fire*: At fire temperature the compound may react violently with water or steam; *Ignition Temperature (deg. F)*: 185; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: Slow reaction with water to produce hydrochloric acid fumes. The reaction is more rapid with steam; *Reactivity with Common Materials*: Slow corrosion of metals but no immediate danger; *Stability During Transport*: Not pertinent; *Neutralizing Agents for Acids and Caustics*: Soda ash and water, lime; *Polymerization*: Does not occur; *Inhibitor of Polymerization*: Not pertinent.

Benzyl Alcohol — Fire Hazards: *Flash Point (deg. F):* 220 OC, 213 CC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Alcohol foam. dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water or foam may cause foaming; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: 817; *Electrical Hazard*: No data; *Burning Rate*: 3.74 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Will attack some plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzylamine — Fire Hazards: *Flash Point (deg. F):* 168 OC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Toxic nitrogen oxides form in fire situations; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: 4.13 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: In presence of moisture may severely corrode some metals. In liquid state this chemical will attack some plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzyl Bromide — Fire Hazards: *Flash Point (deg. F):* 174 CC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating and toxic hydrogen bromide gas is formed; *Behavior in Fire*: Forms vapor that is powerful tear gas; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: 2.6 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Reacts slowly generating hydrogen bromide (hydrobromic acid); *Reactivity with Common Materials*: Decomposes rapidly in the presence of all common metals except nickel and lead, liberating heat and hydrogen bromide; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Rinse with sodium bicarbonate or lime solution; *Polymerization*: Polymerizes with evolution of heat and hydrogen bromide when in presence with all common metals except nickel and lead; *Inhibitor of Polymerization*: None.

Benzyl n-Butyl Phthalate — Fire Hazards: *Flash Point (deg. F):* 390 OC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Dry chemical, carbon dioxide, foam; *Fire Extinguishing Agents Not To Be Used*: Water or foam may cause frothing; *Special Hazards of Combustion Products*: Irritating vapors of unburned chemical may form in fires; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzyl Chloride — Fire Hazards: *Flash Point (deg. F):* 165 OC, 140 CC; *Flammable Limits in Air* (%): 1.1 (LEL); *Fire Extinguishing Agents*: Water, dry chemical, foam, and carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating hydrogen chloride gas forms; *Behavior in Fire*: Forms vapor that is a powerful tear gas; *Ignition Temperature (deg. F)*: 1,161; *Electrical Hazard*: No data; *Burning Rate*: 4.2 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Undergoes slow hydrolysis, liberating hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials*: Decomposes rapidly in the presence of all common metals (with the exception of nickel and lead), liberating heat and hydrogen chloride; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Rinse with sodium bicarbonate or lime solution; *Polymerization*: Polymerizes with evolution of heat and hydrogen chloride when in contact with all common metals except nickel and lead; *Inhibitor of Polymerization*: Triethylamine, propylene oxide or sodium carbonate.

Benzyl Chloroformate — Fire Hazards: *Flash Point (deg. F):* 176 OC, 227 CC; Vigorous decomposition occurs at these temperatures. These values are anomalous due to the effect of the decomposition products of benzyl chloride and CO_2; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: No data; *Special Hazards of Combustion Products*: Toxic phosgene, hydrogen chloride, and benzyl chloride vapors may form; *Behavior in Fire*: Containers may explode; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: 4.0 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Forms hydrogen chloride (hydrochloric acid). Reaction not very vigorous in cold water; *Reactivity with Common Materials*: Slow corrosion of metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with and rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzyldimethyloctadecylammonium Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen and hydrochloric acid fumes may form in fire situations; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent;

Burning Rate: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Benzyltrimethylammonium Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen and hydrochloric acid fumes may form in fire situations; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Beryllium Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Do not use water on adjacent fires; *Special Hazards of Combustion Products*: Toxic and irritating beryllium oxide fumes and hydrogen chloride may form in fires; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously as an exothermic reaction. Forms beryllium oxide and hydrochloric acid solution; *Reactivity with Common Materials*: Corrodes most metals in the presence of moisture. Flammable and explosive hydrogen gas may collect in confined spaces; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water and rinse with dilute solution of sodium bicarbonate or soda ash; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Beryllium Fluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic and irritating vapors may form from unburned material in a fire situation; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity**: *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Beryllium Metallic — Fire Hazards: *Flash Point (deg. F):* Not pertinent. This is a combustible solid; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Graphite, sand, or any other inert dry powder; *Fire Extinguishing Agents Not To Be Used*: Water; *Special Hazards of Combustion Products*: Combustion results in beryllium oxide fumes which are toxic to inhalation; *Behavior in Fire*: Powder may form explosive mixture in air; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Beryllium Nitrate — Fire Hazards: *Flash Point (deg. F):* Not combustible; *Flammable Limits in Air* (%): Not combustible; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic and irritating beryllium oxide and oxides of nitrogen may form in fires; *Behavior in Fire*: May increase the intensity of fire when in contact with combustible materials; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts to form weak solution of nitric acid, however the reaction is usually not considered hazardous; *Reactivity with Common Materials*: In presence of moisture will attack and damage wood and corrode most metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Beryllium Oxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic beryllium oxide fume may form in fire situations; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Beryllium Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic beryllium oxide and sulfuric acid fumes may form in fire situations; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Bismuth Oxychloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating hydrogen chloride gas may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Bisphenol A — Fire Hazards: *Flash Point (deg. F):* 415 OC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: No data; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Nor pertinent; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Bisphenol A Diglycidyl Ether — Fire Hazards: *Flash Point (deg. F):* 175 OC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: No data; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Boiler Compound, Liquid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may burst; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Boric Acid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Born Tribromide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Do not use water or foam on adjacent fires; *Special Hazards of Combustion Products*: Toxic fumes of the compound and hydrogen bromide form in fires; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Vigorously reacts forming hydrobromic acid solution and fumes; *Reactivity with Common Materials*: Strongly attacks metals and wood. Flammable hydrogen gas may collect in closed vessels or containers; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water and rinse with sodium bicarbonate or soda ash solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Boron Trichloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Toxic fumes of hydrogen chloride are generated upon contact with water used to fight adjacent fires; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously, liberating heat and forming hydrogen chloride fumes (hydrochloric acid) and boric acid; *Reactivity with Common Materials*: Vigorously attacks elastomers and various packaging materials. Viton, Tygon, silastic elastomers, natural rubber, some synthetic rubbers are not recommended for service. Avoid lead and graphite impregnated asbestos. In the presence of moisture this chemical will aggressively attack most metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water and rinse with sodium bicarbonate and lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Bromine — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Use water spray to cool exposed containers and to wash spill away from a safe distance; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic and irritating gases are formed when heated or in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Reacts violently with aluminum. May cause fire on contact with common materials such as wood, cotton, straw. Iron, steel, stainless steel, and copper are corroded by bromine and will undergo severe corrosion when in contact with wet bromine. Plastics are also degraded/ attacked by bromine except for highly fluorinated plastics which resist attack; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Bromine Pentafluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable. This chemical is a strong oxidizer and may cause fire when in contact with organic materials including wood, cotton or straw; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Do not use water or foam on adjacent fires; *Special Hazards of Combustion Products*: Toxic fumes of hydrogen fluoride and bromine can form in fires; *Behavior in Fire*: Containers may burst when exposed to heat; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts violently with water generating hydrogen fluoride which is extremely irritating and corrosive; *Reactivity with Common Materials*: Reacts violently with many metals and materials of construction such as wood, glass and plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Bromine Trifluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable but can cause fire on contact with combustibles; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water, foam; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: Forms highly toxic and irritating fumes; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously generating toxic hydrogen fluoride gas (hydrofluoric acid); *Reactivity with Common Materials*: Causes severe corrosion of common metals and glass. May cause fire when in contact with organic materials such as wood, cotton or straw; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Bromobenzene — Fire Hazards: *Flash Point (deg. F):* 124 CC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating hydrogen bromide and other gases form in a fire situation; *Behavior in Fire*: Not pertinent; *Ignition*

Temperature (deg. F): 1,049; *Electrical Hazard*: No data; *Burning Rate*: 3.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Brucine — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fire situations; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Butadiane, Inhibited — Fire Hazards: *Flash Point (deg. F):* -105 (est.); *Flammable Limits in Air* (%): 2.0 - 11.5; *Fire Extinguishing Agents*: Stop flow of gas; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Vapor is heavier than air and can travel distances to ignition source and flash back. Containers may explode in a fire due to polymerization; *Ignition Temperature (deg. F)*: 788; *Electrical Hazard*: Class I, Group B; *Burning Rate*: 8.0 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Explosive decomposition when contaminated with peroxides formed by reaction with air; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Polymerization inhibited when stabilizer is used; *Inhibitor of Polymerization*: tert-Butylcatehol (0.01 - 0.02%).

Butane — Fire Hazards: *Flash Point (deg. F):* -100 (est.); *Flammable Limits in Air* (%): 1.8 - 8.4; *Fire Extinguishing Agents*: Stop flow of gas; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 807; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 7.9 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

1,4-Butanediol — Fire Hazards: *Flash Point (deg. F):* > 250 OC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Alcohol foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

1,4-Butenediol — Fire Hazards: *Flash Point (deg. F):* 263 OC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Alcohol foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Foam or water may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity* *with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

n-Butyl Acetate — Fire Hazards: *Flash Point (deg. F)*: 99 OC, 75 CC; *Flammable Limits in Air* (%): 1.7 - 7.6; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water in straight hose stream will scatter and spread fire and should be avoided; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 760; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 4.4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

sec-Butyl Acetate — Fire Hazards: *Flash Point (deg. F)*: 62 CC, 88 OC; *Flammable Limits in Air* (%): 1.7 - 9.8; *Fire Extinguishing Agents*: Foam, carbon dioxide or dry chemical; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4.4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

iso-Butyl Acrylate — Fire Hazards: *Flash Point (deg. F)*: 94 OC; *Flammable Limits in Air* (%): 1.9 - 8.0; *Fire Extinguishing Agents*: Dry chemical, foam or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 644; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Polymerizes upon exposure to heat; uncontrolled bulk polymerization can be explosive; *Inhibitor of Polymerization*: Methyl ether of hydroquinone: 10 - 100 ppm; Hydroquinone : 5 ppm.

n-Butyl Acrylate — Fire Hazards: *Flash Point (deg. F)*: 118 OC; *Flammable Limits in Air* (%): 1.4 - 9.4; *Fire Extinguishing Agents*: Dry chemical, foam or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 534; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4.7 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Polymerizes upon exposure to heat; uncontrolled bulk polymerization can be explosive; *Inhibitor of Polymerization*: Methyl ether of hydroquinone: 15 - 100 ppm. Store in contact with air.

n-Butyl Alcohol — Fire Hazards: *Flash Point (deg. F)*: 84 CC, 97 OC; *Flammable Limits in Air* (%): 1.4 - 11.2; *Fire Extinguishing Agents*: Carbon dioxide, dry chemicals; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 650; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 3.2 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity* *with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

sec-Butyl Alcohol — Fire Hazards: *Flash Point (deg. F)*: 75 CC; *Flammable Limits in Air* (%): 1.7 - 9.0; *Fire Extinguishing Agents*: Carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 763; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 3.1 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

tert-Butyl Alcohol — Fire Hazards: *Flash Point (deg. F)*: 52 CC, 61 OC; *Flammable Limits in Air* (%): 2.35 - 8.00; *Fire Extinguishing Agents*: Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 896; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 3.4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

n-Butylamine — Fire Hazards: *Flash Point (deg. F)*:30 OC, 10 CC; *Flammable Limits in Air* (%): 1.7 - 9.8; *Fire Extinguishing Agents*: Alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form during fires; *Behavior in Fire*: Vapor is heavier than air and can travel distances to ignition source and flash back. Containers may explode; *Ignition Temperature (deg. F)*: 594; *Electrical Hazard*: No data; *Burning Rate*: 5.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May corrode some metals in presence of water; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

sec-Butylamine — Fire Hazards: *Flash Point (deg. F)*: 16 CC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may be formed; *Behavior in Fire*: Vapor is heavier than air and can travel distances to ignition source and flash back. Containers may explode; *Ignition Temperature (deg. F)*: 712; *Electrical Hazard*: No data; *Burning Rate*: 6.2 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May corrode some metals in presence of water; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

tert-Butylamine — Fire Hazards: *Flash Point (deg. F)*: 16 CC; *Flammable Limits in Air* (%): 1.7 - 8.9 (at 212 of); *Fire Extinguishing Agents*: Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: 716; *Electrical Hazard*: No data; *Burning Rate*: 7 mm/min. **Chemical Reactivity:** *Reactivity* *with Water*: No reaction; *Reactivity with Common Materials*: Liquid will attack some plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Butylene — Fire Hazards: *Flash Point (deg. F)*: Not pertinent; *Flammable Limits in Air* (%): 1.6 - 10; *Fire Extinguishing Agents*: Stop flow of gas; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may explode in fires. Vapor is heavier than air and may travel considerable distance to ignition source and flash back; *Ignition Temperature (deg. F)*: 725; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Butylene Oxide — Fire Hazards: *Flash Point (deg. F)*:20 OC; *Flammable Limits in Air* (%): 1.5 - 18.3; *Fire Extinguishing Agents*: Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: Containers may explode in fires. Apply water to cool containers from a safe distance; *Ignition Temperature (deg. F)*: 959; *Electrical Hazard*: No data; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No data; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: May occur when the product is in contact with strong acids and bases; *Inhibitor of Polymerization*: No data.

tert-Butyl Hydroperoxide — Fire Hazards: *Flash Point (deg. F)*: 100 OC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Reacts vigorously with easily oxidized materials including wood and some metals; *Stability During Transport*: This is a shock and heat sensitive product. Displays self-accelerating decomposition at 200 °F; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

n-Butyl Mercaptan — Fire Hazards: *Flash Point (deg. F)*: 53 OC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water; *Special Hazards of Combustion Products*: Irritating sulfur dioxide; *Behavior in Fire*: Vapors are heavier than air and may travel considerable distance to ignition source and flash back; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: 7.4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

n-Butyl Methacrylate — Fire Hazards: *Flash Point (deg. F)*: 150 OC; *Flammable Limits in Air* (%): 2 - 8; *Fire Extinguishing Agents*: Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may explode; *Ignition Temperature (deg. F)*: 562; *Electrical Hazard*: No data; *Burning Rate*: 4.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing

Agents for Acids and Caustics: Not pertinent; *Polymerization*: May occur upon exposure to heat; *Inhibitor of Polymerization*: 9 - 15 ppm monomethyl ether of hydroquinone; 90 - 120 ppm hydroquinone.

p-tert-Butylphenol — Fire Hazards: *Flash Point (deg. F)*: 235 CC (liquid); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No data; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Butyltrichlorosilane — Fire Hazards: *Flash Point (deg. F)*: 130 OC, 126 CC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Dry chemical and carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water, foam; *Special Hazards of Combustion Products*: Hydrogen chloride, chlorine gas, or phosgene may be formed; *Behavior in Fire*: Difficult to extinguish because of reigniting; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: 2.2 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously forming hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials*: Reacts with common metals evolving hydrogen chloride and may cause severe corrosion; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

1,4-Butynediol — Fire Hazards: *Flash Point (deg. F)*: 263 OC (pure butynediol); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, alcohol foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

iso-Butyraldehyde — Fire Hazards: *Flash Point (deg. F)*: 13 OC, -40 CC; *Flammable Limits in Air* (%): 2.0 -10.0; *Fire Extinguishing Agents*: Foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Data not available; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Vapors are heavier than air and may travel considerable distances to a source of ignition and flash back. Fires are difficult to control because of reignition; *Ignition Temperature (deg. F)*: 385; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

n-Butyraldehyde — Fire Hazards: *Flash Point (deg. F)*: 15 OC, 20 CC; *Flammable Limits in Air* (%): 2.5 - 10.6; *Fire Extinguishing Agents*: Dry chemical, carbon dioxide, foam; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent;

Behavior in Fire: Vapors are heavier than air and may travel considerable distances to a source of ignition and flash back. Fires are difficult to control because of recognition; *Ignition Temperature (deg. F)*: 446; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4.4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: May occur in the presence of heat, acids or alkalis; *Inhibitor of Polymerization*: Not pertinent.

n-Butyric Acid — Fire Hazards: *Flash Point (deg. F):* 166 OC, 160 CC; *Flammable Limits in Air* (%): 2.19 - 13.4; *Fire Extinguishing Agents*: Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: 842; *Electrical Hazard*: No data; *Burning Rate*: 2.7 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May attack aluminum or other light metals with the formation of flammable hydrogen gas; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

C

Cacodylic Acid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: May form toxic oxides of arsenic when heated; *Ignition Temperature (deg. F)*:Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cadmium Acetate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic cadmium oxide fumes may form; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cadmium Bromide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic cadmium oxide fumes can form; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cadmium Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*:

Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cadmium Fluoroborate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic hydrogen fluoride and cadmium oxide fumes can form; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cadmium Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen and cadmium oxide fumes can form; *Behavior in Fire*: Can increase the intensity of fires when in contact with combustible materials; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Mixtures with wood and other combustibles are readily ignited; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cadmium Oxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic cadmium oxide fumes may form; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cadmium Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic cadmium oxide fumes may form; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Arsenate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic arsenic fumes may form; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction;

Reactivity with Common Materials: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Carbide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Dry powder; preferably allow fire to burn out; *Fire Extinguishing Agents Not To Be Used*: Water, vaporizing liquid or foam, carbon dioxide; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: When contacted with water, generates highly flammable acetylene gas; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously with water to form highly flammable acetylene gas which can spontaneously ignite; *Reactivity with Common Materials*: Reacts with copper and brass to form an explosive formulation; *Stability During Transport*: Stable but in absence of water; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Chlorate — Fire Hazards: *Flash Point (deg. F):* Not flammable but may cause fire with other materials; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Flood with water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: May cause an explosion. Irritating gases may also form upon exposure to heat; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Can form an explosive mixture with finely divided combustible materials. The mixture can ignite with application of friction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Anhydrous grade dissolves with evolution of some heat; *Reactivity with Common Materials*: Metals slowly corrode in aqueous solutions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Chromate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic chromium fumes are formed during fires; *Behavior in Fire*: The hydrated salt loses water when hot and changes color, however there is no increase in hazard; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Cyanide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Use dry chemical, sand or earth on adjacent fires;

Fire Extinguishing Agents Not To Be Used: Do not use water or carbon dioxide on adjacent fires; *Special Hazards of Combustion Products*: Decomposes in fires resulting in hydrogen cyanide and other toxic gases; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Releases poisonous hydrogen cyanide slowly on contact with water. If the water is acidic, the release is rapid; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable if kept dry; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Fluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Hydroxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Hypochlorite — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Poisonous gases released upon exposure to heat; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Can cause fire on contact with wood or straw, and is corrosive to most metals; *Stability During Transport*: The 70 % grade decomposes violently when exposed to heat or direct sunlight. Gives off chlorine and chlorine monoxide gases above 350 of, which are poisonous gases; *Neutralizing Agents for Acids and Caustics*: Dilute with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium, Metallic — Fire Hazards: *Flash Point (deg. F):* Not pertinent. This is a flammable solid; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Dry graphite, soda ash, powdered sodium chloride, or appropriate metal fire extinguishing dry powder; *Fire Extinguishing Agents Not To Be Used*: Water, halogenated hydrocarbons, dry chemical, carbon dioxide; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Burns violently, especially if finely divided or powder form; *Ignition Temperature (deg. F)*: 1454 +/- 18; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts to form flammable hydrogen gas which may ignite. The reaction is not violent; *Reactivity with Common Materials*: Reacts with moist air forming a skin of hydroxide. This reaction is not hazardous; *Stability*

During Transport: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable however may cause fires when in contact with flammables; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Flood with water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Produces toxic oxides of nitrogen when involved in fires; *Behavior in Fire*: Can greatly intensify the burning of all combustible materials; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Contact with combustible materials can result in fires; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Oxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Do not use water on adjacent fires; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Heat causes ignition of combustible materials. The material swells during the reaction; *Reactivity with Common Materials*: No reactions unless water is present; the principle effect is heat is liberated; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Peroxide — Fire Hazards: *Flash Point (deg. F):* Not flammable but may cause fires upon contact with combustible materials; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Flood with water or use dry powder such as graphite or powdered limestone; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Can increase the intensity and severity of fires; containers may explode; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts slowly with water at room temperature to form limewater and oxygen gas; *Reactivity with Common Materials*: Heavy metals and dirt can accelerate decomposition to lime and oxygen. The reaction is not explosive; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Phosphate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Some calcium phosphates can form acid solutions in water. These may attack metals, forming flammable hydrogen gas which can collect in confined spaces; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Phosphide — Fire Hazards: *Flash Point (deg. F):* Not flammable but can spontaneously ignite if in contact with water; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing*

Agents: Extinguish adjacent fires with dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water, foam; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Can cause spontaneous ignition if wetted. Generates dense smoke of phosphoric acid; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously with water, generating phosphine, which is a poisonous and spontaneously flammable gas; *Reactivity with Common Materials*: Can react with surface moisture to generate phosphine, which is toxic and spontaneously flammable; *Stability During Transport*: Stable if kept dry; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Calcium Resinate — Fire Hazards: *Flash Point (deg. F):* Not pertinent. This is a combustible solid; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: 480 (this chemical may ignite spontaneously); *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No data; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Camphene — Fire Hazards: *Flash Point (deg. F):* 108 OC, 92 CC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No data; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Camphor Oil — Fire Hazards: *Flash Point (deg. F):* 117 CC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: The solid often evaporates without first melting; *Ignition Temperature (deg. F)*: 466; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Caprolactam, Liquid — Fire Hazards: *Flash Point (deg. F):* 257 OC, 230 CC; *Flammable Limits in Air* (%): 1.84 (LEL); *Fire Extinguishing Agents*: Water, dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: 2.4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Captan — Fire Hazards: *Flash Point (deg. F):* Flammable solid; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, carbon dioxide, foam; *Fire Extinguishing Agents Not*

To Be Used: Not pertinent; *Special Hazards of Combustion Products*: Irritating and toxic vapors are generated in a fire. These vapors may include sulfur dioxide, hydrogen chloride, phosgene, and oxides of nitrogen; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Carbaryl — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: For solution fires apply water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Carbolic Oil — Fire Hazards: *Flash Point (deg. F):* 185 OC, 175 CC; *Flammable Limits in Air* (%): 1.7 - 8.6; *Fire Extinguishing Agents*: Water, dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: The unburned vapor is irritating and toxic; *Behavior in Fire*: Produces flammable vapors when heated, which will form explosive mixtures in air; *Ignition Temperature (deg. F)*:1,319; *Electrical Hazard*: Not pertinent; *Burning Rate*: 3.5 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Carbon Dioxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may explode when exposed to heat; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Carbon Bisulfide — Fire Hazards: *Flash Point (deg. F):* -22 CC; *Flammable Limits in Air* (%): 1.3 - 50; *Fire Extinguishing Agents*: Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic gases are generated. Self contained breathing apparatus (SCBA) are required in firefighting; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 212; *Electrical Hazard*: Contact of the liquid or vapor with the surface of a lighted electric light bulb can result in spontaneous ignition; *Burning Rate*: 2.7 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Carbon Monoxide — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air* (%): 12 - 75; *Fire Extinguishing Agents*: Allow fire to burn out; shut off the flow of gas and cool adjacent exposures with water. Extinguish (only if wearing a SCBA) with dry chemicals or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Asphyxiation due to carbon dioxide production is a major concern; *Behavior in Fire*: Flame has very little color. Containers may explode in fires; *Ignition Temperature (deg. F)*: 1,128; *Electrical Hazard*: No data; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Carbon Tetrachloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Forms poisonous phosgene gas when exposed to open flames; *Behavior in Fire*: Decomposes to chloride and phosgene; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Carene — Fire Hazards: *Flash Point (deg. F):* No data; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective on fire; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Will attack some plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Catechol — Fire Hazards: *Flash Point (deg. F):* 278 OC, 261 CC; *Flammable Limits in Air* (%): Not pertinent. This is a combustible solid; *Fire Extinguishing Agents*: Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water and foam may be ineffective; *Special Hazards of Combustion Products*: May form toxic fumes at high temperatures; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No data; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Caustic Potash Solution — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Nor flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Attacks wool, leather and some metals such as aluminum, tin, lead and zinc to produce flammable hydrogen gas. This product should be separated from easily ignitible materials; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*:

Dilute with water and rinse with dilute acid such as acetic acid; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Caustic Soda Solution — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Corrosive to aluminum, zinc and tin. Contact with some metals can generate flammable hydrogen gas; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Dilute with water and rinse with dilute acetic acid; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Charcoal — Fire Hazards: *Flash Point (deg. F):* This is a flammable solid. It may spontaneously ignite in air especially if finely divided; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Incomplete combustion produces toxic carbon monoxide; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 600 - 750; *Electrical Hazard*: Class I, Group F; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: In powder form may ignite spontaneously in air; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chlordane — Fire Hazards: *Flash Point (deg. F):* 225 OC, 132 CC. In solid form the product is not flammable; *Flammable Limits in Air* (%): 0.7 - 5 (kerosene solution); *Fire Extinguishing Agents*: Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective on solution fires; *Special Hazards of Combustion Products*: Produces irritating and toxic hydrogen chloride and phosgene gases when the kerosene solution of the compound burns; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 419 (kerosene solution); *Electrical Hazard*: No data; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Product is stable below 160 of; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chlorine — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic products are generated when combustibles burn in the presence of chlorine; *Behavior in Fire*: Most combustible materials will burn in the presence of chlorine even though chlorine itself is not flammable; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: No data; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Forms a corrosive solution; *Reactivity with Common Materials*: Reacts vigorously with most metals especially at high temperatures. Copper may burn spontaneously; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chlorine Trifluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable, but can cause fire when mixed or in contact with some materials; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Dry chemical; *Fire Extinguishing Agents Not To Be Used*: Do not use water on adjacent fires unless well protected against hydrogen fluoride gas; *Special Hazards of Combustion Products*: Fumes are highly toxic and irritating; *Behavior in Fire*: Can greatly increase the intensity of fires. Containers or vessels may explode; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts explosively with water, producing hydrogen fluoride (hydrofluoric acid) and chlorine; *Reactivity with Common Materials*: Causes ignition of all combustible materials and some inerts such as sand and concrete. The chemical is very similar to fluorine gas; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flood with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chloroacetophenone — Fire Hazards: *Flash Point (deg. F):* This is a combustible solid, but in solutions it has a flash point of 244 CC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating hydrogen chloride may form; *Behavior in Fire*: Unburned material may become volatile and cause severe skin and eye irritation; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts slowly, producing hydrogen chloride. The reaction is not hazardous; *Reactivity with Common Materials*: Reacts slowly with metals, causing mild corrosion; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chloroacetyl Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Do not apply water to fighting adjacent fires; *Special Hazards of Combustion Products*: Exposure to fire or extreme heat can cause decomposition of this product with the evolution of highly toxic and irritating hydrogen chloride and phosgene gases; *Behavior in Fire*: Highly irritating (tear gas) vapors are generated upon exposure to heat. Hydrogen chloride gas is released when the chemical is in contact with water; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously with water forming hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials*: Can react with surface moisture to generate hydrogen chloride which is corrosive to metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

p-Chloroaniline — Fire Hazards: *Flash Point (deg. F):* This os a combustible solid, > 220 OC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, dry chemical, foam or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating and toxic hydrogen chloride and oxides of nitrogen can form in fire situations; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chlorobenzene — Fire Hazards: *Flash Point (deg. F):* 84 CC, 97 OC; *Flammable Limits in Air* (%): 1.3 - 7.1; *Fire Extinguishing Agents*: Carbon dioxide, dry chemical, foam or water spray; *Fire*

Extinguishing Agents Not To Be Used: Not pertinent; *Special Hazards of Combustion Products*: Burning in open flame can result in the formation of toxic phosgene and hydrogen chloride gases; *Behavior in Fire*: Vapors are heavier than air and can travel considerable distances to a source of ignition and flash back; *Ignition Temperature (deg. F)*: 1,184; *Electrical Hazard*: No data; *Burning Rate*: 4.6 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

4-Chlorobutyronitrile — Fire Hazards: *Flash Point (deg. F):* No data; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Water, dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: No data; *Special Hazards of Combustion Products*: Toxic and irritating hydrogen cyanide, hydrogen bromide, and hydrogen chloride may form in fires; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May attack some plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chloroform — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Poisonous and irritating gases are generated upon heating; *Behavior in Fire*: Decomposes resulting in toxic vapors; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chlorohydrins (Crude) — Fire Hazards: *Flash Point (deg. F):* 92 OC, 100 CC; *Flammable Limits in Air* (%): 3.8 - 21; *Fire Extinguishing Agents*: Alcohol foam, dry chemical, carbon dioxide, water spray; *Fire Extinguishing Agents Not To Be Used*: Avoid the use of dry chemical if the fire occurs in containers with confined vents; *Special Hazards of Combustion Products*: Toxic and irritating vapors are generated upon heating; *Behavior in Fire*: Containers may explode in fire because of polymerization; *Ignition Temperature (deg. F)*: 804; *Electrical Hazard*: No data; *Burning Rate*: 2.6 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Reacts mildly with water, but generally the reaction is not considered to be hazardous; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Can polymerize in the presence of strong acids and bases, particularly at elevated temperatures; *Inhibitor of Polymerization*: None reported.

Chloromethyl Methyl Ether — Fire Hazards: *Flash Point (deg. F):* 0 OC; *Flammable Limits in Air* (%): No data; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Irritating and toxic hydrogen chloride and phosgene vapors can form; *Behavior in Fire*: Unburned material may form powerful tear gas. When wet, this chemical also forms irritating formaldehyde gas; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: 3.0 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Reacts to form formaldehyde and hydrogen chloride.

Reaction is slow and not violent; *Reactivity with Common Materials*: Can react with surface moisture to evolve hydrogen chloride which is corrosive to metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flood with water and rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

p-Chlorophenol — Fire Hazards: *Flash Point (deg. F):* 250 CC; *Flammable Limits in Air* (%): Not pertinent. This is a combustible solid; *Fire Extinguishing Agents*: Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: No data; *Special Hazards of Combustion Products*: Toxic and irritating hydrogen chloride and chlorine gases can form in fires; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions reported; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chloropicrin, Liquid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Recommended to cool containers that are exposed to fires with water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: This chemical forms a powerful tear gas when heated. Heated material may detonate under fire conditions; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chlorosulfonic Acid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Water; *Special Hazards of Combustion Products*: Decomposes into irritating and toxic vapors; *Behavior in Fire*: Although this chemical is nonflammable, it may ignite other combustibles. Contact with water and metal produces explosive hydrogen gas; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Reacts violently with water, generating hydrochloric acid vapor and sulfuric acid; *Reactivity with Common Materials*: Hydrogen, which is highly flammable and explosive, is formed by the action of this acid on most metals. May cause ignition by contact with combustible materials; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Even though this chemical reacts violently with water, flooding with water (from a safe distance) is recommended before neutralizing with lime water or sodium bicarbonate solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

4-Chloro-o-Toluidine — Fire Hazards: *Flash Point (deg. F):* This is a combustible solid; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water or dry chemical; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen and hydrochloric acid fumes may form; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chromic Anhydride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may explode. Water should be applied to cool container surfaces exposed to adjacent fires; *Ignition Temperature (deg. F)*: This product may ignite organic materials on contact; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Reacts with organic materials rapidly, generating sufficient heat to cause ignition. Prolonged contact on wood floors can result in a fire hazard; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flood with water and rinse with sodium bicarbonate solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Chromyl Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable, but may cause fire on contact with combustible materials; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Do not apply water on adjacent fires unless SCBA is used to protect against toxic vapors; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Vapors are extremely irritating to the eyes and mucous membranes. This product may increase the intensity of fires; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts violently with water forming hydrogen chloride (hydrochloric acid), chlorine gases, and chromic acid; *Reactivity with Common Materials*: Causes severe corrosion of common metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flood with water and rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Citric Acid — Fire Hazards: *Flash Point (deg. F):* Not pertinent. This is a combustible solid; *Flammable Limits in Air*: 0.28 - 2.29 kg/m^3 as dust; *Fire Extinguishing Agents*: Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: This product melts and decomposes as a hazardous reaction; *Ignition Temperature (deg. F)*: 1,850 as powder; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Corrodes copper, zinc, aluminum, and alloys of these metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cobalt Acetate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic cobalt oxide fumes form during fires; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions reported; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cobalt Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic cobalt oxide fumes can form in fire situations; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent;

Electrical Hazard: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No data; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cobalt Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen form in fires; *Behavior in Fire*: Can increase fire intensity; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Contact with wood or paper may result in fire; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cobalt Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic cobalt oxide fumes form in fire; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No data; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Collodion — Fire Hazards: *Flash Point (deg. F):* -49 CC (ether); *Flammable Limits in Air* (%): 1.9 - 36 (ether solution); *Fire Extinguishing Agents*: Dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: This chemical forms extremely toxic vapors, most notably oxides of nitrogen, hydrogen cyanide, and carbon monoxide; *Behavior in Fire*: Highly flammable solvent vapors are formed during fires. These vapors can travel considerable distances to a source of ignition and flash back; *Ignition Temperature (deg. F)*: 356 (ether); *Electrical Hazard*: Class I, Group C; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Acetate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating vapors of acetic acid form in fire situations; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No data; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Acetoarsenite — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Poisonous, volatile arsenic oxides may be formed in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Arsenite — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Poisonous, volatile arsenic oxides may be formed in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Bromide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating hydrogen bromide gas may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating hydrogen chloride gas may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: In presence of moisture may corrode metals; the reaction is not hazardous; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water, rinse with dilute solution of sodium bicarbonate or soda ash; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Cyanide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic hydrogen cyanide gas may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable, in presence of moisture, toxic hydrogen cyanide gas may collect in enclosed spaces; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Fluoroborate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating hydrogen fluoride gas may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent;

Electrical Hazard: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May corrode some metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water, rinse with dilute solution of sodium bicarbonate or soda ash; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Iodide — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Irritating hydrogen iodide or iodine vapors may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Naphthenate — Fire Hazards: *Flash Point (deg. F)*: 100 CC (typical); *Flammable Limits in Air* (%): 0.8 - 5.0 (mineral spirits); *Fire Extinguishing Agents*: Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 540 (mineral spirits); *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Nitrate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic and irritating oxides of nitrogen may form in fire; *Behavior in Fire*: Can increase intensity of fire if in contact with combustible material; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Mixtures with wood, paper, and other combustibles may catch fire; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Oxalate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Toxic carbon monoxide gas may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Copper Sulfate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning*

Rate: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Corn Syrup — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Coumaphos — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used*: Data not available; *Special Hazards of Combustion Products*: Toxic and irritating oxides of sulfur and phosphorus may form in fires; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Creosote, Coal Tar — Fire Hazards: *Flash Point (deg. F):* > 160 CC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Dry chemical, carbon dioxide, or foam; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Data not available; *Behavior in Fire*: Heavy, irritating black smoke is formed; *Ignition Temperature (deg. F)*: 637; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cresols — Fire Hazards: *Flash Point (deg. F):* 175 - 185 OC; 178 CC; *Flammable Limits in Air* (%): LEL: 1.4 (ortho); 1.1 (meta or para); *Fire Extinguishing Agents*: Water, dry chemical, carbon dioxide, and foam; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Flammable toxic vapors given off in a fire; *Behavior in Fire*: Sealed closed containers can build up pressure if exposed to heat (fire); *Ignition Temperature (deg. F)*: 1110 (o-cresol); 1038 (m-or p-cresol); *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cresyl Glycidyl Ether — Fire Hazards: *Flash Point (deg. F):* 200 OC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Data not available; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*:

Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May attack some forms of plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Crotonaldehyde — Fire Hazards: *Flash Point (deg. F):* 59 OC; *Flammable Limits in Air* (%): 2.1 - 15.5; *Fire Extinguishing Agents*: Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Vapors are very irritating; *Behavior in Fire*: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*: 450; *Electrical Hazard*: data not available; *Burning Rate*: 3.3 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: May polymerize; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: May polymerize or condense with evolution of heat in presence of alkalies, amines, or acids; *Inhibitor of Polymerization*: None used.

Cumene — Fire Hazards: *Flash Point (deg. F):* 111 CC; *Flammable Limits in Air* (%): 0.9 - 6.5; *Fire Extinguishing Agents*: Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 797; *Electrical Hazard*: Data not available; *Burning Rate*: 50 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cumene Hydroperoxide — Fire Hazards: *Flash Point (deg. F):* 147 OC; 120 CC; *Flammable Limits in Air* (%): 0.9 - 6.5; *Fire Extinguishing Agents*: Foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Toxic phenol vapors may form hot material; *Behavior in Fire*: May decompose violently when heated. Burning rate becomes more rapid as fire burns; *Ignition Temperature (deg. F)*: Decomposes violently at temperatures above 300; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Decomposition is catalyzed by metals such as aluminum, copper, brass, zinc, and lead. The reaction is not hazardous; *Stability During Transport*: Stable if kept below 125° F and out of direct sunlight; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cupriethylenediamine Solution — Fire Hazards: *Flash Point (deg. F):* Non-flammable solution; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Irritating vapors of ethylenediamine may be produced when heated; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Dissolves cotton, wood, and other cellulosic materials. Corrosive to copper, aluminum, zinc, and tin; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cyanoacetic Acid — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Data not available; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen and toxic and flammable acetonitrile vapors may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cyanogen — Fire Hazards: *Flash Point (deg. F):* Flammable gas; *Flammable Limits in Air* (%): 6.6 - 43; *Fire Extinguishing Agents*: Let fire burn, shut off flow of gas, cool exposed areas with water; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Unburned vapors are highly toxic; *Behavior in Fire*: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: data not available; *Burning Rate*:. **Chemical Reactivity:** *Reactivity with Water*: No reaction, but water, provides heat to vaporize liquid cyanogen; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cyanogen Bromide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Poison gases are produced in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Strong bleaching powder solution; let stand 24 hr; *Polymerization*: Does not occur; *Inhibitor of Polymerization*: Not pertinent.

Cyanogen Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air* (%): Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Overheated containers can explode; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Very slow reaction; *Reactivity with Common Materials*: Slow, not immediately hazardous; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cyclohexane — Fire Hazards: *Flash Point (deg. F):* - 4 CC; *Flammable Limits in Air* (%): 1.33 - 8.35; *Fire Extinguishing Agents*: Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 518; *Electrical Hazard*: Data not available; *Burning Rate*: 6.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cyclohexanol — Fire Hazards: *Flash Point (deg. F):* 160 OC; 154 CC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Water, foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 572; *Electrical Hazard*: Data not available; *Burning Rate*: 3.9 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cyclohexanone — Fire Hazards: *Flash Point (deg. F):* 129 OC; 111 CC; *Flammable Limits in Air* (%): 1.1 LEL; *Fire Extinguishing Agents*: Water, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 788; *Electrical Hazard*: Data not available; *Burning Rate*: 4.2 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cyclohexanone Peroxide — Fire Hazards: *Flash Point (deg. F):* Combustible solution 315 CC (dibutyl phthalate); *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Water foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: May explode; *Ignition Temperature (deg. F)*: 757 (dibutyl phthalate); *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cyclohexenyltrichlorosilane — Fire Hazards: *Flash Point (deg. F):* >150 OC; *Flammable Limits in Air* (%): Not pertinent; *Fire Extinguishing Agents*: Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water or foam; *Special Hazards of Combustion Products*: Irritating, toxic hydrogen chloride and phosgene may be generated in a fire; *Behavior in Fire*: Difficult to extinguish. Re-ignition may occur. Water applied to adjacent fires will produce hydrogen chloride upon contact with this material; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: Reacts to generate hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials*: Corrodes metals by reacting with surface moisture and generating hydrogen chloride; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Flush with water, rinse with sodium bicarbonate or lime solution; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cyclohexylamine — Fire Hazards: *Flash Point (deg. F):* 90 OC; *Flammable Limits in Air* (%): Data not available; *Fire Extinguishing Agents*: Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 560; *Electrical Hazard*: Data not available; *Burning Rate*: 5.0 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable;

Neutralizing Agents for Acids and Caustics: Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cyclopentane — Fire Hazards: *Flash Point (deg. F):* <20 CC; *Flammable Limits in Air* (%): (approx.) 1.1 - 8.7; *Fire Extinguishing Agents*: Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may explode; *Ignition Temperature (deg. F)*: 716; *Electrical Hazard*: Not pertinent; *Burning Rate*: 7.9 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Cyclopropane — Fire Hazards: *Flash Point (deg. F):* Flammable gas; *Flammable Limits in Air* (%): 2.4 - 10.3; *Fire Extinguishing Agents*: Shut off flow of gas; *Fire Extinguishing Agents Not To Be Used*: Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may explode; *Ignition Temperature (deg. F)*: 932; *Electrical Hazard*: Class I, Group D; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

p-Cumene — Fire Hazards: *Flash Point (deg. F):* 140 OC; 117 CC; *Flammable Limits in Air* (%): 0.7 - 5.6; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used*: Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 817; *Electrical Hazard*: Data not available; *Burning Rate*: 6.1 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics*: Not pertinent; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

D

Dalapon — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide, alcohol foam; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating fumes of hydrochloric acid may form in fire; *Behavior in Fire:* Volatilizes with steam; *Ignition Temperature (deg. F):* data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water:* Reacts slowly to form hydrochloric and pyruvic acids. The reaction is nor hazardous; *Reactivity with Common Materials:* Very corrosive to aluminum and copper alloys. Flammable and explosive hydrigen gas may form in enclosed spaces; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with dilute sodium bicarbonate or soda ash solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

DDD — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products:* Irritating hydrogen chloride fumes may form in fire; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

DDT — Fire Hazards: *Flash Point (deg. F):* 162 - 171 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating gases may be generated; *Behavior in Fire:* Melts and burns; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Decaborane — Fire Hazards: *Flash Point (deg. F):* (Flammable solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, and carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Halogenated extinguishing agents; *Special Hazards of Combustion Products:* May give toxic fumes of unburned material; *Behavior in Fire:* May explode when hot. Burns with green-colored flame; *Ignition Temperature (deg. F):* 300; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water:* Reacts slowly to form flammable hydrogen gas, which can accumulate in closed area; *Reactivity with Common Materials:* Corrosive to natural rubber, some synthetic rubbers, some greases and some lubricants; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with 3% aqueous ammonia solution, then with water. Methyl alcohol may also be used; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Decahydronaphthalene — Fire Hazards: *Flash Point (deg. F):* 134 OC; *Flammable Limits in Air (%):* 0.7 - 5.4; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 482; *Electrical Hazard:* Data not available; *Burning Rate:* 5.9 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Decaldehyde — Fire Hazards: *Flash Point (deg. F):* 185 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1-Decene — Fire Hazards: *Flash Point (deg. F):* 128 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Foam, dry chemical or carbon dioxide; *Fire Extinguishing*

Agents Not to be Used: Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 455; *Electrical Hazard:* Data not available; *Burning Rate:* 6.0 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

n-Decyl Alcohol — Fire Hazards: *Flash Point (deg. F):* 180 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

n-Decylbenzene — Fire Hazards: *Flash Point (deg. F):* 225 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* water or foam may cause frothing; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* January 26, 1998ata not available; *Electrical Hazard:* Data not available; *Burning Rate:* 5.04 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Demeton — Fire Hazards: *Flash Point (deg. F):* 113 CC; *Flammable Limits in Air (%):* 1.0 - 5.3; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective on fire; *Special Hazards of Combustion Products:* Irritating fumes of sulfur dioxide and phosphoric acid may form in fire; *Behavior in Fire:* Compound may volatilize and form toxic fumes. Vapor of solvent is heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 867 (xylene solvent); *Electrical Hazard:* (xylene) Class I, Group D; *Burning Rate:* 5.8 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2,4-D Esters — Fire Hazards: *Flash Point (deg. F):* >175 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, dry chemical , carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating hydrogen chloride vapor may form in fire; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dextrose Solution — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not* *to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diacetone Alcohol — Fire Hazards: *Flash Point (deg. F):* 142 OC; 125 CC; *Flammable Limits in Air (%):* 1.8 - 6.9; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 1118; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Di-n-Amyl Phthalate — Fire Hazards: *Flash Point (deg. F):* 245 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diazinon — Fire Hazards: *Flash Point (deg. F):* 82 - 105 CC (solutions only; pure liquid difficult to burn); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* (for solutions) Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Oxides of sulfur and phosphorus are generated in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Data not available; *Burning Rate:* (for solutions) 4 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dibenzoyl Peroxide — Fire Hazards: *Flash Point (deg. F):* Highly flammable solid; explosion-sensitive to shock, heat and friction; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Difficult to extinguish once ignited. Use water spray to cool surrounding area; *Fire Extinguishing Agents Not to be Used:* Do not use hand extinguishers; *Special Hazards of Combustion Products:* Suffocating smoke evolved; *Behavior in Fire:* May explode; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* Special care must be taken to avoid contamination with combustible materials (wood, paper, etc.), various inorganic and organic acids, alkalies, alcohols, amines, easily oxidizable materials such as ethers, or materials used as accelerators in polymerizations reactions; *Stability During Transport:* Extremely explosion-sensitive to shock (impact, blows), heat and friction. Has been reported to explode for apparently no specific reason. Self-reactive; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Di-n-Butylamine — Fire Hazards: *Flash Point (deg. F):* 125 OC; *Flammable Limits in Air (%):* 1.1 (LFL); *Fire Extinguishing Agents:* "Alcohol" foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fires; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 5.84 mm/min; **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May corrode some metals and attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Di-n-Butyl Ether — Fire Hazards: *Flash Point (deg. F):* 92 OC; *Flammable Limits in Air (%):* 1.5 - 7.6; *Fire Extinguishing Agents:* Dry chemical, "alcohol" foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel a considerable distance to source of ignition and flash back; *Ignition Temperature (deg. F):* 382; *Electrical Hazard:* Data not available; *Burning Rate:* 5.7 mm/min; **Chemical Reactivity:** *Reactivity with Water No reaction:*; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Di-n-Butyl Ketone — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dibutylphenol — Fire Hazards: *Flash Point (deg. F):* >200 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide, foam; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dibutyl Phthalate — Fire Hazards: *Flash Point (deg. F):* 355 OC; 315 CC; *Flammable Limits in Air (%):* 0.5 - 2.5 (calculated); *Fire Extinguishing Agents:* Dry powder, carbon dioxide, foam; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 757; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

o-Dichlorobenzene — Fire Hazards: *Flash Point (deg. F):* 165 OC; 155 CC; *Flammable Limits in Air (%):* 2.2 - 9.2; *Fire Extinguishing Agents:* Water, foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating vapors including hydrogen chloride gas, chlorocarbones, chlorine; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 1198; *Electrical Hazard:* Not pertinent; *Burning Rate:* 1.3 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

p-Dichlorobenzene — Fire Hazards: *Flash Point (deg. F):* 165 OC; 150 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Water, foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Vapors are irritating. Toxic chlorine, hydrogen chloride and phosgene gases may be generated in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* 1.3 mm/min (approx.); **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Di-(p-Chlorobenzoyl) Peroxide — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Flood with water, or use dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic chlorinated biphenyls are formed in fires; *Behavior in Fire:* Solid may explode. Burns very rapidly when ignited. Smoke is unusually heavy when paste form is involved; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May react vigorously with combustible materials; *Stability During Transport:* Stable (below 80° F); *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dichlorobutene — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* 1.5 - 4; *Fire Extinguishing Agents:* Water, foam, dry chemical ,or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Decomposition vapors contain phosgene and hydrogen chloride gases; both are toxic and irritating; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* January 26, 1998ata not available; *Electrical Hazard:* Data not available; *Burning Rate:* 2.6 mm/min; **Chemical Reactivity:** *Reactivity with Water :* Reacts slowly to form hydrochloric acid; *Reactivity with Common Materials:* Corrodes metal when wet; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dichlorodifluoromethane — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Although nonflammable, dissociation products generated in a fire may be irritating or toxic; *Behavior in Fire:* Helps extinguish fire; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing*

Agents for Acids and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1,2-Dichloroethylene — Fire Hazards: *Flash Point (deg. F):* 37CC; *Flammable Limits in Air (%):* 9.7 - 12.8; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Phosgene and hydrogenchoride fumes may form in fires; *Behavior in Fire:* Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 2.6 mm/min; **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Will not occur under ordinary conditions of shipment. The reaction is not vigorous; *Inhibitor of Polymerization:* None used.

Dichloroethyl Ether — Fire Hazards: *Flash Point (deg. F):* 180 OC; 131 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* May form phosgene or hydrogen chloride in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 696; *Electrical Hazard:* Data not available; *Burning Rate:* 2.4 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* V; *Inhibitor of Polymerization:* Not pertinent.

Dichloromethane — Fire Hazards: *Flash Point (deg. F):* Not flammable under conditions likely to be encountered; *Flammable Limits in Air (%):* 12 - 19; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Dissociation products generated in a fire may be irritating or toxic; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 1184; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity**: *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2,4-Dichlorophenol — Fire Hazards: *Flash Point (deg. F):* 200 OC, 237 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Water, foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Toxic gases can be evolved; *Behavior in Fire:* Solid melts and burns; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May react vigorously with oxidizing material; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2,4-Dichlorophenoxyacetic Acid — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating hydrogen chloride or phosgene gases may form; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Data not available;

Burning Rate: Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with sodium bicarbonate; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dichloropropane — Fire Hazards: *Flash Point (deg. F):* 70 OC; 60 CC; *Flammable Limits in Air (%):* 3.4 - 14.5; *Fire Extinguishing Agents:* Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating gases may be generated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 1035; *Electrical Hazard:* Not pertinent; *Burning Rate:* (est.) 3.2 mm/min; **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dichloropropene — Fire Hazards: *Flash Point (deg. F):* 95 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* water, dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating gases may be generated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* (est.) 3.4 mm/min; **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

4,4'-Dichloro-alpha-Trichloromethylbenzhydrol — Fire Hazards: *Flash Point (deg. F):* 75 OC (xylene); *Flammable Limits in Air (%):* 1.1 - 7.0 (For xylene solution); *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating hydrogen chloride fumes may form in fire; *Behavior in Fire:* Xylene solvent vapors may travel to source of ignition and flash back; *Ignition Temperature (deg. F):* 986; *Electrical Hazard:* (xylene) Class I, Group D; *Burning Rate:* (xylene) 5.8 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* Contact with steel at elevated temperature causes formation of toxic chlorine and hydrogen chloride gases. Liquid may attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dicyclopentadiene — Fire Hazards: *Flash Point (deg. F):* 90 OC; *Flammable Limits in Air (%):* 0.8 - 6.3; *Fire Extinguishing Agents:* Foam, carbon dioxide, dry chemical, or water spray; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 941; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* May occur in presence of acids, but not hazardous; *Inhibitor of Polymerization:* Not pertinent.

Dieldrin — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products:* Toxic and irritating hydrogen chloride fumes may form in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethanolamine — Fire Hazards: *Flash Point (deg. F):* 305 OC; *Flammable Limits in Air (%):* 1.6 (calc.)- 9.8 (est); *Fire Extinguishing Agents:* Water, alcohol foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Addition of water may cause frothing; *Special Hazards of Combustion Products:* Irritating vapors are generated when heated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 1224; *Electrical Hazard:* Not pertinent; *Burning Rate:* 0.74 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethylamine — Fire Hazards: *Flash Point (deg. F):* 5 OC; *Flammable Limits in Air (%):* 1.8 - 9.1; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide, or alcohol foam; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products:* Vapors are irritating; *Behavior in Fire:* Vapors are heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 594; *Electrical Hazard:* Data not available; *Burning Rate:* 6.7 mm/min; **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No hazardous reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethylbenzene — Fire Hazards: *Flash Point (deg. F):* 135 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, water, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 743 (ortho); *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethyl Carbonate — Fire Hazards: *Flash Point (deg. F):* 115 OC; 77 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Water; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* 3.4 mm/min; **Chemical Reactivity:** *Reactivity with Water :* Too slow to be hazardous; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethylene Glycol — Fire Hazards: *Flash Point (deg. F):* 255 CC; *Flammable Limits in Air (%):* 1.6 - 10.8; *Fire Extinguishing Agents:* Alcohol foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 444; *Electrical Hazard:* Not pertinent; *Burning Rate:* 1.5 mm/min; **Chemical Reactivity:** *Reactivity* *with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethylene Glycol Dimethyl Ether — Fire Hazards: *Flash Point (deg. F):* 158 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethyleneglycol Monobutyl Ether — Fire Hazards: *Flash Point (deg. F):* 230 OC; 172 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, "alcohol" foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 442; *Electrical Hazard:* Not pertinent; *Burning Rate:* 3.3 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethyleneglycol Monobutyl Ether Acetate — Fire Hazards: *Flash Point (deg. F):* 240 OC; *Flammable Limits in Air (%):* 0.8 - 5.0; *Fire Extinguishing Agents:* Water, alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 563; *Electrical Hazard:* Data not available; *Burning Rate:*; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethylene Glycol Monoethyl Ether — Fire Hazards: *Flash Point (deg. F):* 201 CC; 205 OC; *Flammable Limits in Air (%):* 1.2 - 8.5 (est.); *Fire Extinguishing Agents:* alcohol foam, dry liquid, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 400; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.5 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethylene Glycol Monomethyl Ether — Fire Hazards: *Flash Point (deg. F):* 200 OC; *Flammable Limits in Air (%):* LFL= 1.2; *Fire Extinguishing Agents:* Water, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During*

Transport: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethylenetriamine — Fire Fire Hazards: *Flash Point (deg. F):* 200 OC; *Flammable Limits in Air (%):* (calc.) 1 - 10; *Fire Extinguishing Agents:* Water spray, alcohol foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Irritating vapors are generated when heated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 676; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No hazardous reaction; *Stability During Transport :*Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Di-(2-Ethylhexyl) Phosphoric Acid — Fire Hazards: *Flash Point (deg. F):* 385 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Irritating phosphorus oxides may be released; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Mildly corrosive to most metals; may form flammable hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethyl Phthalate — Fire Hazards: *Flash Point (deg. F):* 305 OC; *Flammable Limits in Air (%):* LFL 0.75 (at 368° F); *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Irritating vapors of unburned chemical may form in fire; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* 855; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May attack some form of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diethylzinc — Fire Hazards: *Flash Point (deg. F):* Not pertinent (ignites spontaneously); *Flammable Limits in Air (%):* Not pertinent; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry chemical, sand, or powdered limestone; *Fire Extinguishing Agents Not to be Used:* Water, foam, halogenated agents, carbon dioxide; *Special Hazards of Combustion Products:* Yields zinc fumes when burning; can cause " metal fume fever" (see 5.2); *Behavior in Fire:* Reacts spontaneously with air or oxygen, and violently with water, evolving flammable ethane gas. Contact with water applied to adjacent fires will intensify the fire; *Ignition Temperature (deg. F):* Below 0; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :*Reacts violently to form flammable ethane gas; *Reactivity with Common Materials:* Will react with surface moisture, generating flammable ethane gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1,1-Difluoroethane — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air (%):* 3.7 - 18; *Fire Extinguishing Agents:* Shut off gas source; use water to cool adjacent combustibles; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products:* Irritating hydrogen fluoride fumes may form in fire; *Behavior in Fire:* Containers may explode. Vapors are heavier than air And may travel a considerable distance; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Difluorophosphoric Acid, Anhydrous — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not to be Used:* Do not use water on adjacent fires; *Special Hazards of Combustion Products:* Irritating and toxic fumes of hydrogen fluoride and phosphoric acid may be formed in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water:* Reacts vigorously to form corrosive and toxic hydrofluoric acid; *Reactivity with Common Materials:* In the presence of moisture, is corrosive to glass, other siliceous materials, and most metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diheptyl Phthalate — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May attack some form of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diisobutylcarbinol — Fire Hazards: *Flash Point (deg. F):* 162 OC; 165 CC; *Flammable Limits in Air (%):* 0.8 - 6.1; *Fire Extinguishing Agents:* Carbon dioxide, dry chemical, alcohol foam; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 494 (calc.); *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diisobutylene — Fire Hazards: *Flash Point (deg. F):* 35 (est.); *Flammable Limits in Air (%):* 0.9 LEL (est.); *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 788; *Electrical Hazard:* Not pertinent; *Burning Rate:* 7.9 mm/min; **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable;

Neutralizing Agents for Acids and Caustics: Not pertinent: *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diisobutyl Ketone — Fire Hazards: *Flash Point (deg. F):* 131 OC; 120 CC; *Flammable Limits in Air (%):* 0.81 - 7.1 at 200 ° F; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* 745; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diisodecyl Phthalate — Fire Hazards: *Flash Point (deg. F):* 450 OC; *Flammable Limits in Air (%):* LFL 0.27 at 508° F; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* 755; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diisopropanolamine — Fire Hazards: *Flash Point (deg. F):* 200 OC; *Flammable Limits in Air (%):* 1.1 (calc.) - 5.4 (est.); *Fire Extinguishing Agents:* Water, alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 580 (calc.); *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diisopropylamine — Fire Hazards: *Flash Point (deg. F):* 20 OC; 35 CC; *Flammable Limits in Air (%):* 0.8 - 7.1; *Fire Extinguishing Agents:* "Alcohol" foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* water may be ineffective; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fires; *Behavior in Fire:* Vapor is heavier than air and may travel to a source of ignition and flash back; *Ignition Temperature (deg. F):* 600; *Electrical Hazard:* Class I; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diisopropylbenzene Hydroperoxide — Fire Hazards: *Flash Point (deg. F):* 175; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Flammable alcohol and ketone gases are formed in fires; *Behavior in Fire:* Burns with a flare effect. Containers may explode; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* Aluminum, copper, brass, lead, zinc salts, mineral acids, oxidizing or reducing agents all can cause rapid decomposition; *Stability During Transport:* Unstable, slowly evolves oxygen; *Inhibitor of Polymerization:* Not pertinent..

Dimethylacetamide — Fire Hazards: *Flash Point (deg. F):* 158 OC; *Flammable Limits in Air (%):* 1.5 - 11.5; *Fire Extinguishing Agents:* Water, dry chemical, alcohol foam; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 914; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.8 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dimethylamine — Fire Hazards: *Flash Point (deg. F):* 20 CC; *Flammable Limits in Air (%):* 2.8 - 14.4; *Fire Extinguishing Agents:* Stop flow of gas. Use water spray, carbon dioxide, or dry chemical for fires in water solutions; *Fire Extinguishing Agents Not to be Used:* Do not use foam; *Special Hazards of Combustion Products:* Vapors are eye, skin and respiratory irritants; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 756; *Electrical Hazard:* Data not available; *Burning Rate:* 4.5 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No hazardous reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dimethyldichlorosilane — Fire Hazards: *Flash Point (deg. F):* 15 OC; *Flammable Limits in Air (%):* 1.4 - 9.5; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam; *Special Hazards of Combustion Products:* Hydrogen chloride and phosgene gases may form; both are toxic and irritating; *Behavior in Fire:* Difficult to extinguish. Re-ignition may occur. Contact with water applied to adjacent fires produces toxic and irritating fumes; *Ignition Temperature (deg. F):* Above 750; *Electrical Hazard:* Data not available; *Burning Rate:* 3.3 mm/min; **Chemical Reactivity:** *Reactivity with Water :* reacts vigorously with water to generate hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* Will react with surface moisture to generate hydrogen chloride, which is corrosive to most metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Sodium bicarbonate or lime; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dimethyl Ether — Fire Hazards: *Flash Point (deg. F):* Not pertinent (flammable gas); *Flammable Limits in Air (%):* 2 - 50; *Fire Extinguishing Agents:* Let fire burn; shut off gas flow; cool exposed surroundings with water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode. Vapors are heavier than air and may travel long distance to source of ignition and flash back; *Ignition Temperature (deg. F):* 662; *Electrical Hazard:* Data not available; *Burning Rate:* 6.6 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dimethylformamide — Fire Hazards: *Flash Point (deg. F):* 153 OC; 136 CC; *Flammable Limits in Air (%):* 2.2 - 15.2; *Fire Extinguishing Agents:* Water, foam carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:*

Vapors are irritating; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 833; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.2 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dimethylhexane Dihydroperoxide, Wet — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective on fire; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Decomposes violently when heated in fire. Can increase intensity of fire when in contact with combustible material. Containers may explode; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* Decomposes with contact with many metals and acids; *Stability During Transport:* Stable below 100 °F; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1,1-Dimethylhydrazine — Fire Hazards: *Flash Point (deg. F):* 34 CC; *Flammable Limits in Air (%):* 2 - 95; *Fire Extinguishing Agents:* Flood with water; *Fire Extinguishing Agents Not to be Used:* In large fires, water fog, carbon dioxide, and bicarbonate types may allow flash back and explosive re-ignition; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* Tends to re-ignite when dilutes with much water; *Ignition Temperature (deg. F):* 452 - 482; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 3.8 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* Dissolves, swells and disintegrates many plastics; *Stability During Transport:* Stable below 1112° F; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dimethylpolysiloxane — Fire Hazards: *Flash Point (deg. F):* 275 - 635 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 820 - 860; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dimethyl Sulfate — Fire Hazards: *Flash Point (deg. F):* 240 OC; 182 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Water, foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Flammable, toxic vapors generated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 370; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water:* Slow, non-hazardous reaction; *Reactivity with Common Materials:* Corrodes metal when wet; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Sodium bicarbonate or lime; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dimethyl Sulfide — Fire Hazards: *Flash Point (deg. F):* - 36 CC; *Flammable Limits in Air (%):* 2.2 - 19.7; *Fire Extinguishing Agents:* January 27, 1998ry chemical, foam, carbon dioxide, or alcohol foam; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic and irritating sulfur dioxide is formed; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to source of ignition and flash back; *Ignition Temperature (deg. F):* 403; *Electrical Hazard:* Data not available; *Burning Rate:* 4.8 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dimethyl Sulfoxide — Fire Hazards: *Flash Point (deg. F):* 203 OC; *Flammable Limits in Air (%):* 3 - 6.3; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Sulfur dioxide, formaldehyde, and methyl mercaptan may form; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 572; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.0 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dimethyl Terephthalate — Fire Hazards: *Flash Point (deg. F):* 298 OC (molten); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 1,058 (dust); *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dimethylzinc — Fire Hazards: *Flash Point (deg. F):* Not pertinent (ignites spontaneous); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry chemical, sand, powdered limestone; *Fire Extinguishing Agents Not to be Used:* Water, foam, halogenated agents, or carbon dioxide; *Special Hazards of Combustion Products:* Smoke contains zinc oxide, which can irritate lungs and cause metal fume fever; *Behavior in Fire:* Reacts spontaneously with air or oxygen and violently with water, evolving methane. Contact with water applied to adjacent fires will intensify fire; *Ignition Temperature (deg. F):* Below 0; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* Reacts vigorously, generating flammable methane gas; *Reactivity with Common Materials:* Will react with surface moisture to generate flammable methane; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2,4-Dinitroaniline — Fire Hazards: *Flash Point (deg. F):* 435 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* For small fires, use water, dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Vapors and combustion gases are irritating; *Behavior in Fire:* May explode; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* Reacts with oxidizing materials; *Stability During Transport:* May detonate when heated under confinement; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

m-Dinitrobenzene — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water from protected location; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* May explode; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dinitrocresols — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fire; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2,4-Dinitrophenol — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, dry chemical, carbon dioxide, foam; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Vapors are toxic; *Behavior in Fire:* Can detonate or explode when heated under confinement; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* Reacts with oxidizing materials and combustibles; *Stability During Transport:* May detonate when heated under confinement; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2,4- Dinitrotoluene — Fire Hazards: *Flash Point (deg. F):* 404 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, dry chemical, carbon dioxide from protected location; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products:* Nitrogen oxides and dense black smoke are produced in a fire; *Behavior in Fire:* Decomposition in self-sustaining at 280° C. Containers may explode in a fire; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable below 482°F (250° C); *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dioctyl Adipate — Fire Hazards: *Flash Point (deg. F):* 390 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Data not available; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing*

Agents for Acids and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dioctyl Phthalate — Fire Hazards: *Flash Point (deg. F):* 425 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry powder, carbon dioxide, foam; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water* : No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dioctyl Sodium Sulfosuccinate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Cause foaming and spreading of water; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water* : No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1,4-Dioxane — Fire Hazards: *Flash Point (deg. F):* 54 CC; 74 OC; *Flammable Limits in Air (%):* 1.9 - 22.5 by vol; *Fire Extinguishing Agents:* Alcohol foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic vapors are generated when heated; *Behavior in Fire:* Vapor is heavier than air and may travel to a source of ignition and flash back; *Ignition Temperature (deg. F):* 356; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water* : No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dipentene — Fire Hazards: *Flash Point (deg. F):* 115 CC; *Flammable Limits in Air (%):* 0.7 - 6.1; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* 458; *Electrical Hazard:* Data not available; *Burning Rate:* 5.5 mm/min; **Chemical Reactivity:** *Reactivity with Water* : No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diphenylamine — Fire Hazards: *Flash Point (deg. F):* (liquid) 307 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fire; *Behavior in Fire:* Dust may be explosive if mixed with air in critical proportions and in the presence of a source of ignition; *Ignition Temperature (deg. F):* 1.175; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water* : No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diphenyldichlorosilane — Fire Hazards: *Flash Point (deg. F):* 288 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water and foam; *Special Hazards of Combustion Products:* Hydrochloric acid and phosgene fumes may be formed; *Behavior in Fire:* Difficult to extinguish; re-ignition may occur. Contact with water of foam applied to adjacent fires will produce irritating hydrogen chloride fumes; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 2.7 mm/min; **Chemical Reactivity:** *Reactivity with Water :* Reacts with water to generate hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* Reacts with surface moisture to generate hydrogen chloride, which is corrosive to most metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flood with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diphenyl Ether — Fire Hazards: *Flash Point (deg. F):* 239 CC; *Flammable Limits in Air (%):* 0.8 - 1.5; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 1,148; *Electrical Hazard:* Data not available; *Burning Rate:* 3.2 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Diphenylmethane Diisocyanate— Fire Hazards: *Flash Point (deg. F):* 425 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Carbon dioxide or dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic vapors are generated when heated; *Behavior in Fire:* Solid melts and burns; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* Slow, non-hazardous. Form carbon dioxide gas; *Reactivity with Common Materials:* data not available; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* May occur slowly. Is not hazardous; *Inhibitor of Polymerization:* Not pertinent.

Di-n-Propylamine — Fire Hazards: *Flash Point (deg. F):* 45 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Water, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fires; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 6.1.mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dipropylene Glycol — Fire Hazards: *Flash Point (deg. F):* 280 OC; *Flammable Limits in Air (%):* LFL=2.2% (approx.); *Fire Extinguishing Agents:* Water fog, alcohol foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.0 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Distillates: Flashed Feed Stocks — Fire Hazards: *Flash Point (deg. F):* (a) <0 CC; (b) 0 - 73 CC; (3) 73 - 141 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Class I, Group D; *Burning Rate:* Approx. 4 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Distillates: Straight Run — Fire Hazards: *Flash Point (deg. F):* (a) <0 CC; (b) 0 - 73 CC; (3) 73 - 141 CC; *Flammable Limits in Air (%):* 1.1 - 8.7; *Fire Extinguishing Agents:* Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Class I, Group D; *Burning Rate:* Approx. 4 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dodecanol — Fire Hazards: *Flash Point (deg. F):* 260 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 527; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dodecene — Fire Hazards: *Flash Point (deg. F):* 120 CC; 134 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Water fog, foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 400 (est.); *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1-Dodecene — Fire Hazards: *Flash Point (deg. F):* 174 (approx.); *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire*

Extinguishing Agents Not to be Used: Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 491; *Electrical Hazard:* Not pertinent; *Burning Rate:* 5.8 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dodecylbenzene — Fire Hazards: *Flash Point (deg. F):* 275OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, foam; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 3.7 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dodecylbenzenesulfonic Acid, Calcium Salt — Fire Hazards: *Flash Point (deg. F):* > 100 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* ≈ 4 mm/min; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dodecylbenzenesulfonic Acid, Isopropylamine Salt — Fire Hazards: *Flash Point (deg. F):* (liquid) > 300 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fire; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dodecylbenzenesulfonic Acid, Triethanolamine Salt — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen and irritating oxides of sulfur may form in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dodecyl Sulfate, Diethanolamine Salt — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Not pertinent; *Fire*

Extinguishing Agents Not to be Used: Not pertinent; *Special Hazards of Combustion Products:* Toxic vapors of diethanolamine and nitrogen oxides may form in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dodecyl Sulfate, Magnesium Salt — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dodecyl Sulfate, Sodium Salt — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor oF Polymerization:* Not pertinent.

Dodecylsulfate, Triethanolamine Salt — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic vapors of triethanolamine and oxides of nitrogen may form in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dodecyltrichlorosilane — Fire Hazards: *Flash Point (deg. F):* >150 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water, foam; *Special Hazards of Combustion Products:* Hydrochloric acid and phosgene fumes may form in fires; *Behavior in Fire:* Difficult to extinguish; re-ignition may occur. Contact with water applied to adjacent fires produces irritating hydrogen chloride fumes; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* Generates hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* Reacts with surface moisture to generate hydrogen chloride, which is corrosive to most metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Dowtherm — Fire Hazards: *Flash Point (deg. F):* 255 OC; *Flammable Limits in Air (%):* At 500° F: 0.5 - 6.2; At 300°F: 0.8 - 3.3; *Fire Extinguishing Agents:* Water fog, foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products:* Irritating gases generated when heated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 1150; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available; **Chemical Reactivity:** *Reactivity with Water :* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

E

Endrin — Fire Hazards: *Flash Point (deg. F):* Non flammable sold or combustible solution >80 OC (xylene); *Flammable Limits in Air (%):* 1.1 - 7 (xylene); *Fire Extinguishing Agents:* (Solution) Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective on solution fire; *Special Hazards of Combustion Products:* Toxic hydrogen chloride and phosgene may be generated when solution burns; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* 4 mm/min (xylene);**Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization* Not pertinent.

Epichlorohydrin — Fire Hazards: *Flash Point (deg. F):* 92 OC; 100 CC; *Flammable Limits in Air (%):* 3.8 - 21.0; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, carbon dioxide, water spray; *Fire Extinguishing Agents Not To Be Used:* Avoid use of dry chemical if fire occurs in container with confined vent; *Special Hazards of Combustion Products:* Toxic irritating vapors are generated when heated; *Behavior in Fire:* Containers may explode in fire because of polymerization; *Ignition Temperature (deg. F):* 804; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.6 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Mild reaction; not likely to be hazardous; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Can polymerize in presence of strong acids and bases, particularly when hot; *Inhibitor of Polymerization:* None used.

Epoxidized Vegetable Oils — Fire Hazards: *Flash Point (deg. F):* 585 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethane — Fire Hazards: *Flash Point (deg. F):* -211; *Flammable Limits in Air (%):* 2.9 - 13.0; *Fire Extinguishing Agents:* Stop flow of gas; *Fire Extinguishing Agents Not To Be Used:* Data not available; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 940; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 7.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethoxydihydropyran — Fire Hazards: *Flash Point (deg. F):* 98 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 4.8 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of polymerization:* Not pertinent.

Ethoxylated Dodecanol — Fire Hazards: *Flash Point (deg. F):* 470 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide, or alcohol foam; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of polymerization:* Not pertinent.

Ethoxylated Nonylphenol — Fire Hazards: *Flash Point (deg. F):* (burns with difficulty) 338 - 600 OC; > 140 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Data not available; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of polymerization:* Not pertinent.

Ethoxylated Pentadecanol — Fire Hazards: *Flash Point (deg. F):* 470 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Carbon dioxide or dry chemical for small fires; alcohol foam and water for large fires; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethoxylated Tetradecanol — Fire Hazards: *Flash Point (deg. F):* 470 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Carbon dioxide or dry chemical for small fires; alcohol foam and water for large fires; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethoxylated Tridecanol — Fire Hazards: *Flash Point (deg. F):* 385 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Carbon dioxide or dry chemical for small fires; alcohol foam and water for large fires; *Fire Extinguishing Agents Not To Be Used:* Data not available; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* NO reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethoxy Triglycol — Fire Hazards: *Flash Point (deg. F):* 275 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide, or alcohol foam; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Acetate — Fire Hazards: *Flash Point (deg. F):* 24 CC; 55 OC; *Flammable Limits in Air (%):* 2.2 - 9.0; *Fire Extinguishing Agents:* Alcohol foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 800; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 3.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Acetoacetate — Fire Hazards: *Flash Point (deg. F):* 176 OC; 135 CC; *Flammable Limits in Air (%):* 1.4 - 9.5; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 563; *Electrical Hazard:* Data not available; *Burning Rate:* 2.4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Acrylate — Fire Hazards: *Flash Point (deg. F):* 44 OC; *Flammable Limits in Air (%):* 1.8 - 9.5; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating vapors are generated when heated; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. May polymerize and cause container to explode; *Ignition Temperature (deg. F):* 721; *Electrical Hazard:* Data not available; *Burning Rate:* 4.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* May occur; exclude moisture, light; avoid exposure to high temperatures; store in presence of air; *Inhibitor of Polymerization:* 13 - 17 ppm monomethyl ether of hydroquinone.

Ethyl Alcohol — Fire Hazards: *Flash Point (deg. F):* 55 CC; 64 OC; *Flammable Limits in Air (%):* 3.3 - 19; *Fire Extinguishing Agents:* Carbon dioxide, dry chemical, water spray, alcohol foam; *Fire Extinguishing Agents Not To Be Used:* None; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 689; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 3.9 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylaluminum Dichloride — Fire Hazards: *Flash Point (deg. F):* Not pertinent (ignites spontaneously); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry chemical, inert dry powders such as sand, limestone; *Fire Extinguishing Agents Not To Be Used:* Water, foam, halogenated agents, or carbon dioxide; *Special Hazards of Combustion Products:* Intense smoke may cause metal-fume fever. Irritating hydrogen chloride also formed; *Behavior in Fire:* Contact with water applied to adjacent fires will cause formation of irritating smoke containing aluminum oxide and hydrogen chloride; *Ignition Temperature (deg. F):* Ignites spontaneously in air at ambient temperature; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently to form hydrogen chloride fumes and flammable ethane gas; *Reactivity with Common Materials:* Reacts with surface moisture to generate hydrogen chloride, which is corrosive to most metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylaluminum Sesquichloride — Fire Hazards: *Flash Point (deg. F):* Not pertinent (ignites spontaneously); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry chemical, inert dry powders such as sand, limestone; *Fire Extinguishing Agents Not To Be Used:* Water, foam, halogenated agents, or carbon dioxide; *Special Hazards of Combustion Products:* Intense smoke may cause metal-fume fever. Irritating hydrogen chloride also formed; *Behavior in Fire:* Contact with water applied to adjacent fires will cause formation of irritating smoke containing aluminum oxide and hydrogen chloride; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently to form hydrogen chloride fumes and flammable ethane gas; *Reactivity with Common Materials:* Reacts with surface moisture to generate hydrogen chloride, which is corrosive to most metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylamine — Fire Hazards: *Flash Point (deg. F):* 0 OC; *Flammable Limits in Air (%):* 3.5 - 14; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide, alcohol foam; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating and toxic oxides of nitrogen may be formed; *Behavior in Fire:* Vapor is heavier than fire and may travel a considerable distance to a source of ignition and flash back. Containers may explode when heated; *Ignition Temperature (deg. F):* 724; *Electrical Hazard:* Data not available; *Burning Rate:* 5.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Will strip and dissolve paint; dissolves most plastic materials; can cause swelling of rubber by absorption. The reactions are not hazardous; *Stability During Transport:* Stable; *Neutralizing*

Agents for Acids and Caustics: Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylbenzene — Fire Hazards: *Flash Point (deg. F)*: 80 OC; 59 CC; *Flammable Limits in Air (%):* 1.0 - 6.7; *Fire Extinguishing Agents:* Foam(most effective), water fog, carbon dioxide or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating vapors are generated when heated; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 860; *Electrical Hazard:* Not pertinent; *Burning Rate:* 5.8 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Butanol — Fire Hazards: *Flash Point (deg. F)*: 128 OC; *Flammable Limits in Air (%):* 1.9 - 8.8; *Fire Extinguishing Agents:* Carbon dioxide or dry chemical for small fires, alcohol foam for large fires; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 580 (calc.); *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Butyrate — Fire Hazards: *Flash Point (deg. F)*: 85 OC; 75 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Vapor is heavier than fire and may travel considerable distance to a source of ignition and flash back. Containers may explode in fire; *Ignition Temperature (deg. F):* 865; *Electrical Hazard:* Data not available; *Burning Rate:* 4.72 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Chloride — Fire Hazards: *Flash Point (deg. F)*: -58 CC; -45 OC; *Flammable Limits in Air (%):* 3.6 - 12; *Fire Extinguishing Agents:* Water fog, carbon dioxide, dry chemical. For large fires it is best to allow material to burn while cooling surrounding equipment. Stop flow of ethyl chloride; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic ant irritating gases are generated in fires; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* 966; *Electrical Hazard:* Not pertinent; *Burning Rate:* 3.8 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Chloroacetate — Fire Hazards: *Flash Point (deg. F)*: 129 OC; 100 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Water fog, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating, toxic hydrogen chloride gas may be generated in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 2.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Very slow, not hazardous;

Reactivity with Common Materials: Slow hydrolysis to acidic products; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Chloroformate — Fire Hazards: *Flash Point (deg. F):* 82 OC; 61 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Water, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic chlorine and phosgene gas may be formed in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 932; *Electrical Hazard:* Data not available; *Burning Rate:* **Chemical Reactivity:** *Reactivity with Water:* Slow reaction with water, evolving hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* Slow evolution of hydrogen chloride from surface moisture reaction can cause slow corrosion; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyldichlorosilane — Fire Hazards: *Flash Point (deg. F):* 30 OC; *Flammable Limits in Air (%):* 2.9; *Fire Extinguishing Agents:* Dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water, foam; *Special Hazards of Combustion Products:* Toxic hydrogen chloride and phosgene gases may be formed; *Behavior in Fire:* Difficult to extinguish; re-ignition may occur. Contact with water applied to adjacent fire, produces irritating hydrogen chloride fumes and flammable hydrogen gas; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 3.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts vigorously, evolving hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* Reaction with surface moisture will generate hydrogen chloride, which corrodes common metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flood with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene — Fire Hazards: *Flash Point (deg. F):* -213 (approx.) CC; *Flammable Limits in Air (%):* 2.75 - 28.6; *Fire Extinguishing Agents:* Stop flow of gas if possible. Use carbon dioxide, dry chemical, water fog; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Vapors are anesthetic; *Behavior in Fire:* Container may explode; *Ignition Temperature (deg. F):* 842; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 7.4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Chlorohydrin — Fire Hazards: *Flash Point (deg. F):* 139 OC; *Flammable Limits in Air (%):* 4.9 - 15.9; *Fire Extinguishing Agents:* Water, alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic hydrogen chloride and phosgene fumes may be formed; *Behavior in Fire:* Vapors are heavier than air and may flash back to a source of ignition; *Ignition Temperature (deg. F):* 797; *Electrical Hazard:* Data not available; *Burning Rate:* 1.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Cyanohydrin — Fire Hazards: *Flash Point (deg. F)*: 265 OC; *Flammable Limits in Air (%)*: 2.3 (calc.) - 12.1 (est.); *Fire Extinguishing Agents:* Carbon dioxide or dry chemical for small fires; alcohol-type foam for large fires; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Toxic gases are generated when heated; *Behavior in Fire:* Decomposes, generating toxic fires; *Ignition Temperature (deg. F):* 922; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylenediamine — Fire Hazards: *Flash Point (deg. F)*: 99 OC; 150 CC; *Flammable Limits in Air (%)*: 5.8 - 11.1; *Fire Extinguishing Agents:* Carbon dioxide, dry chemical, water or foam; *Fire Extinguishing Agents Not To Be Used:* Do not use water in case of drum or tank fires; *Special Hazards of Combustion Products:* Irritating vapors are generated when heated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 715; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Gives off heat, but reaction is not hazardous; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylenediamine Tetracetic Acid — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%)*: Not pertinent; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Dibromide — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Decomposition gases are toxic and irritating; *Behavior in Fire:* Decomposes into toxic irritating gases. Reacts with hot metals such as aluminum and magnesium; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Dichloride — Fire Hazards: *Flash Point (deg. F)*: 60 OC; 55 CC; *Flammable Limits in Air (%)*: 6.2 - 15.6; *Fire Extinguishing Agents:* Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic and irritating gases (hydrogen chloride and phosgene) are generated; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 775; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 1.6 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common*

Materials: No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Glycol — Fire Hazards: *Flash Point (deg. F):* 240 OC; 232 CC; *Flammable Limits in Air (%):* LEL=3.2; UEL not listed; *Fire Extinguishing Agents:* Water fog, alcohol foam; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 775; *Electrical Hazard:* Not pertinent; *Burning Rate:* 1.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Glycol Diacetate — Fire Hazards: *Flash Point (deg. F):* 205 OC; 191 CC; *Flammable Limits in Air (%):* 1.6 - 8.4; *Fire Extinguishing Agents:* Water, dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 900; *Electrical Hazard:* Data not available; *Burning Rate:* 2.9 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Glycol Diethyl Ether — Fire Hazards: *Flash Point (deg. F):* 90 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide, alcohol foam; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 406; *Electrical Hazard:* Data not available; *Burning Rate:* 4.1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Glycol Dimethyl Ether — Fire Hazards: *Flash Point (deg. F):* 104 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode in fires; *Ignition Temperature (deg. F):* 1373; *Electrical Hazard:* Not pertinent; *Burning Rate:* 4.9 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Glycol Monobutyl Ether — Fire Hazards: *Flash Point (deg. F):* 165 OC; 155 CC; *Flammable Limits in Air (%):* 1.1 - 10.6; *Fire Extinguishing Agents:* Carbon dioxide or dry chemical for small fires; alcohol-type foam for large fires; *Fire Extinguishing Agents Not To Be Used:* Data not available; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 472; *Electrical Hazard:* Not pertinent; *Burning Rate:* 6.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Glycol Monobutyl Ether Acetate — Fire Hazards: *Flash Point (deg. F)*: 190 OC; 160 CC; *Flammable Limits in Air (%)*: 0.9 - 8.5; *Fire Extinguishing Agents:* Dry chemical, alcohol foam,or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F)*: 645; *Electrical Hazard:* Data not available; *Burning Rate:* 4.1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Glycol Monoethyl Ether — Fire Hazards: *Flash Point (deg. F)*: 120 OC; 202 CC; *Flammable Limits in Air (%)*: 1.8 - 14,0; *Fire Extinguishing Agents:* Alcohol foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F)*: 455; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Glycol Monoethyl Ether Acetate — Fire Hazards: *Flash Point (deg. F)*: 135 OC; *Flammable Limits in Air (%)*: 1.7 - 6.7; *Fire Extinguishing Agents:* Alcohol foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F)*: 715; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data no available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylene Glycol Monomethyl Ether — Fire Hazards: *Flash Point (deg. F)*: 120 OC; 107 CC; *Flammable Limits in Air (%)*: 2.5 - 19 8; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide or alcohol foam; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F)*: 551; *Electrical Hazard:* Not pertinent; *Burning Rate:* 1.8 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent .

Ethyleneimine — Fire Hazards: *Flash Point (deg. F)*: 1 OC; 12 CC; *Flammable Limits in Air (%)*: 3.3 - 54.8; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating vapor generated when heated; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*: 608; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* Mild reaction, non-hazardous; *Reactivity with Common Materials:* Contact with silver or aluminum may cause polymerization; *Stability During Transport:* Stable unless heated under pressure; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Explosive polymerization can occur when in contact with acids; *Inhibitor of Polymerization:* None used.

Ethylene Oxide — Fire Hazards: *Flash Point (deg. F):* > 0 OC; *Flammable Limits in Air (%):* 3 - 100; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Stop flow of gas. Use water, carbon dioxide, dry chemical or alcohol foam; *Special Hazards of Combustion Products:* Irritating vapors are generated when heated; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. Containers may explode when heated; *Ignition Temperature (deg. F):* 804; *Electrical Hazard:* Class I, Group B; *Burning Rate:* 3.5 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Slow reaction, not hazardous; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* May polymerize violently if contaminated with alkaline or acidic materials and metal oxides or chlorides; *Inhibitor of Polymerization:* None used.

Ethyl Ether — Fire Hazards: *Flash Point (deg. F):* -40 OC; -49 CC; *Flammable Limits in Air (%):* 1.85 - 36.5; *Fire Extinguishing Agents:* Carbon dioxide, dry chemical or foam; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. Decomposes violently when heated; *Ignition Temperature (deg. F):* 356; *Electrical Hazard:* Class I, Group C; *Burning Rate:* 6.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Formate — Fire Hazards: *Flash Point (deg. F):* 10 OC; -4 CC; *Flammable Limits in Air (%):* 2.8 - 16.0; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 851; *Electrical Hazard:* Data not available; *Burning Rate:* 3.6 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylhexaldehyde — Fire Hazards: *Flash Point (deg. F):* 127 OC; 112 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* 387; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May ignite spontaneously when spilled on clothing, paper or other absorbent material; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2-Ethyl Hexanol — Fire Hazards: *Flash Point (deg. F):* 85 OC; 175 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 581; *Electrical Hazard:* Not pertinent; *Burning Rate:* 4.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable;

Neutralizing Agents for Acids and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2-Ethylhexyl Acrylate, Inhibited — Fire Hazards: *Flash Point (deg. F):* 195 OC; *Flammable Limits in Air (%):* 0.8 - 6.4; *Fire Extinguishing Agents:* Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Heat can result in a severe polymerization with rapid release of energy. Sealed containers may rapture explosively if hot; *Ignition Temperature (deg. F):* 496; *Electrical Hazard:* data not available; *Burning Rate:* 4.6 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Will polymerize in the absence of inhibitor and when heated; *Inhibitor of Polymerization:* Monomethyl ether of hydroquinone, 13 - 20 ppm. Hydroquinone, 90 - 120 ppm.

Ethyl Hexyl Tallate — Fire Hazards: *Flash Point (deg. F):* 395 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Data not available; *Fire Extinguishing Agents Not To Be Used:* Data not available; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylidenenorbornene — Fire Hazards: *Flash Point (deg. F):* 98 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Lactate — Fire Hazards: *Flash Point (deg. F):* 1.58 OC; 115 CC; *Flammable Limits in Air (%):* 1.5 - 11.4; *Fire Extinguishing Agents:* Water, dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 752; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Mercaptan — Fire Hazards: *Flash Point (deg. F):* <0 OC; *Flammable Limits in Air (%):* 2.8 - 18; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating fumes of sulfur dioxide are generated; *Behavior in Fire:* Vapor is heavier than air and may travel long distance to a source of ignition and flash back; containers may explode in a fire; offensive fumes are released when heated; *Ignition Temperature (deg. F):* 572; *Electrical Hazard:* Data not available; *Burning Rate:* 5.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stability; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Methacrylate — Fire Hazards: *Flash Point (deg. F):* 85 OC; 80 CC; *Flammable Limits in Air (%):* 1.8 (LFL); *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Sealed container may rupture explosively if hot. Heat can cause a violent polymerization reaction with rapid release of energy. Vapors are heavier than air and can travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 740; *Electrical Hazard:* Data not available; *Burning Rate:* 4.56 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* If proper concentration of inhibitor is not present or when material is hot, a violent polymerization reaction may occur; *Inhibitor of Polymerization:* Oxygen in the air inhibits polymerization.

Ethyl Nitrite — Fire Hazards: *Flash Point (deg. F):* -31 CC; *Flammable Limits in Air (%):* 3 - >50; *Fire Extinguishing Agents:* Water dry chemical, carbon dioxide, water, foam; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen are generated; *Behavior in Fire:* Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back; can decompose violently above 194° F; containers may explode in a fire; *Ignition Temperature (deg. F):* 194; *Electrical Hazard:* Data not available; *Burning Rate:* 2.6 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable if stored in a cool place and not exposed to strong light; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethylphenyldichlorosilane — Fire Hazards: *Flash Point (deg. F):* >150 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water, foam; *Special Hazards of Combustion Products:* Toxic hydrogen chloride and phosgene fumes may be formed; *Behavior in Fire:* Difficult to extinguish; re-ignition may occur. Contact with water applied to adjacent fires will generate irritating hydrogen chloride gas; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 3.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts with water to generate hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* Will react with surface moisture to evolve hydrogen chloride; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Phosphonothioic Dichloride, Anhydrous — Fire Hazards: *Flash Point (deg. F):* 203 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam; *Special Hazards of Combustion Products:* Oxides of sulfur, phosphorus; hydrogen chloride and phosgene; *Behavior in Fire:* Contact with water applied to adjacent fire will produce irritating fumes of hydrogen chloride; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* Reacts with water to evolve hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* Will react with surface moisture to evolve hydrogen chloride, which is corrosive to common metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flood with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Phosphorodichloridate — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam; *Special Hazards of Combustion Products:* Irritating fumes of hydrogen chloride and phosphoric acid may be formed; *Behavior in Fire:* Contact with water applied to adjacent fires produces irritating fumes of hydrogen chloride; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* Reacts with water to evolve hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* Will react with surface moisture to evolve hydrogen chloride, which is corrosive to common metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flood with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2- Ethyl-3-Propylacrolein — Fire Hazards: *Flash Point (deg. F):* 155 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Alcohol foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 200; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyl Silicate — Fire Hazards: *Flash Point (deg. F):* 125 OC; 99 CC; *Flammable Limits in Air (%):* 1.3 - 23; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Data not available; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 4.4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts slowly, forming non-toxic silica and ethyl alcohol; *Reactivity with Common Materials:* Causes swelling and hardening of some plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ethyltrichlorosilane — Fire Hazards: *Flash Point (deg. F):* 57 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic hydrogen chloride and phosgene gases may form; *Behavior in Fire:* Vapors are heavier than fire and may travel a considerable distance to a source of ignition and flash back. Difficult to extinguish; re-ignition may occur. Contact with water applied to adjacent fires will produce irritating hydrogen chloride fumes; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 2.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts vigorously, evolving hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* Reacts with surface moisture to form hydrogen chloride, which is corrosive to common metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flood with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent.

F

Ferric Ammonium Citrate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen or ammonia gas may be formed in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ferric Ammonium Oxalate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen, ammonia , and carbon monoxide may form in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ferric Chloride — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating hydrogen chloride fumes may form in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Water solutions are acidic and corrosive to most metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with dilute sodium bicarbonate or soda ash solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ferric Glycerophosphate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ferric Nitrate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen and nitric acid vapor may form in fires; *Behavior in Fire:* In contact with combustible materials, will increase the intensity of a fire; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent;

Burning Rate: Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Solutions are corrosive to most metals. Contact of solid with wood or paper may cause fire; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ferric Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Corrosive to copper, copper alloys, mild steel. and galvanized steel; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ferrous Ammonium Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating and toxic ammonia and oxides of nitrogen may form in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ferrous Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating hydrogen chloride fumes may form in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Solution may corrode metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with dilute solution of sodium bicarbonate or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ferrous Fluoroborate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ferrous Oxalate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids*

and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Ferrous Sulfate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Fluorine — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Do not direct water onto fluorine leaks; *Special Hazards of Combustion Products:* Toxic gases generated in fires involving fluorine; *Behavior in Fire:* Dangerously reactive gas. Ignites most combustibles; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts with water to form hydrogen fluoride, oxygen and oxygen difluoride; *Reactivity with Common Materials:* Reacts violently with all combustible materials, except the metal cylinders in which it is shipped; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Fluosilicic Acid — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating fumes of hydrogen fluoride may form in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Will corrode most metals, producing flammable hydrogen gas which can collect in confined spaces; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and rinse with dilute solution of sodium carbonate or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Fluosulfonic Acid — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Do not use water or foam on adjacent fires; *Special Hazards of Combustion Products:* Toxic and irritating fumes of hydrogen fluoride and sulfuric acid may form in fires; *Behavior in Fire:* Contact with water or chemical foam used to fight adjacent fires can result in the formation of toxic hydrogen fluoride gas; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently with water forming hydrogen fluoride and sulfuric acid mists; *Reactivity with Common Materials:* Reacts with metals forming flammable hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flood with water and rinse with sodium bicarbonate solution or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Formaldehyde Solution — Fire Hazards: *Flash Point (deg. F)*: 182 CC (based on solution of 37 % formaldehyde and Methanol free), 122 CC (based on solution with 15 % Methanol); *Flammable*

Limits in Air (%): 7.0 - 73; *Fire Extinguishing Agents:* Water, dry chemical, carbon dioxide, or alcohol foam; *Fire Extinguishing Agents Not To Be Used:* No data or recommendations found; *Special Hazards of Combustion Products:* Toxic vapors form; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 806; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Formic Acid — Fire Hazards: *Flash Point (deg. F):* 138 OC; *Flammable Limits in Air (%):* 18 - 57; *Fire Extinguishing Agents:* Water, carbon dioxide, dry chemical, or alcohol foam; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic vapors are generated in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 1,114; *Electrical Hazard:* Not pertinent; *Burning Rate:* 0.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and neutralize with lime; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Fumaric Acid — Fire Hazards: *Flash Point (deg. F):* Not pertinent. This is a combustible solid which can present a dust explosion problem; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water spray, dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating fumes of maleic anhydride may form in fires; *Behavior in Fire:* Dust presents significant explosion hazard. Dust should be knocked down with water fog when fighting fires; *Ignition Temperature (deg. F):* 1,364 (powder); *Electrical Hazard :*Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:*; *Inhibitor of Polymerization:* Not pertinent.

Furfural — Fire Hazards: *Flash Point (deg. F):* 153 OC, 140 CC; *Flammable Limits in Air (%):* 2.1 - 19.3; *Fire Extinguishing Agents:* Water, foam, carbon dioxide, dry chemical, or alcohol foam; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating vapors are generated when exposed to heat; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 739; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.6 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common* Materials: No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Furfuryl Alcohol -Fire Hazards: *Flash Point (deg. F):* 167 OC, 149 CC; *Flammable Limits in Air (%):* 1.8 - 16.3; *Fire Extinguishing Agents:* Water, dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 736; *Electrical Hazard:* No data; *Burning Rate:* 2.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* The product darkens and forms water insoluble material on exposure to air or acids. This reaction is accelerated at elevated temperatures; *Neutralizing Agents for Acids and* Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

G

Gallic Acid — Fire Hazards: *Flash Point (deg. F):* Not pertinent. This is a combustible solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* No data; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Gas Oil: Cracked — Fire Hazards: *Flash Point (deg. F):* 150 CC; *Flammable Limits in Air (%):* 6.0 - 13.5; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 640; *Electrical Hazard:* Not pertinent; *Burning Rate:* 4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Gasolines: Automotive — Fire Hazards: *Flash Point (deg. F):* -36 CC; *Flammable Limits in Air (%):* 1.4 - 7.4; *Fire Extinguishing Agents:* Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to source of ignition and flash back; *Ignition Temperature (deg. F):* 853; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Gasolines: Aviation — Fire Hazards: *Flash Point (deg. F):* -50 CC; *Flammable Limits in Air (%):* 1.2 - 7.1; *Fire Extinguishing Agents:* Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to source of ignition and flash back; *Ignition Temperature (deg. F):* 824; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Gasoline Blending Stocks: Alkylates — Fire Hazards: *Flash Point (deg. F):* < 0 CC; *Flammable Limits in Air (%):* 1.1 - 8.7; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to source of ignition and flash back; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Class I, Group D; *Burning* Rate: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Gasoline Blending Stocks: Reformates — Fire Hazards: *Flash Point (deg. F)*: < 0 CC; *Flammable Limits in Air (%):* 1.1 - 8.7; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to source of ignition and flash back; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Class I, Group D; *Burning* Rate: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Glutaraldehyde Solution — Fire Hazards: *Flash Point (deg. F)*: Non flammable solution; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Glycerine — Fire Hazards: *Flash Point (deg. F)*: 350 OC, 320 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, carbon dioxide, water fog; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 698; *Electrical Hazard:* Not pertinent; *Burning Rate:* 0.9 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Glycidyl Methacrylate — Fire Hazards: *Flash Point (deg. F)*: 183 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* No data; *Fire Extinguishing Agents Not To Be Used:* No data; *Special Hazards of Combustion Products:* Irritating vapors generated when exposed to heat; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Heat, peroxides, and caustics cause polymerization, however the reaction is slow and generally considered non hazardous; *Inhibitor of Polymerization:* 50 ppm of Hydroquinone Monomethyl Ether.

Glyoxal: 40 % Solution — Fire Hazards: *Flash Point (deg. F)*: Non flammable solution; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Exposure to heat can cause polymerization to a combustible, viscous material; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Corrosive to most metals. Reactions are slow but accelerated at high temperatures; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

H

Heptachlor — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating and toxic hydrogen chloride fumes may form in fires; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Heptane — Fire Hazards: *Flash Point (deg. F)*: 25 CC; *Flammable Limits in Air (%):* 1.0 - 7.0; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 433; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 6.8 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Heptanol — Fire Hazards: *Flash Point (deg. F)*: 170 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* 3.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1-Heptene — Fire Hazards: *Flash Point (deg. F)*: 25 CC; *Flammable Limits in Air (%):* 1.0 (LEL); *Fire Extinguishing Agents:* Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 500; *Electrical Hazard:* Not pertinent; *Burning Rate:* 3.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hexachlorocyclopentadiene — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* If water is used on adjacent fires, do not allow water to enter drums or storage tanks containing this product; *Special Hazards of Combustion Products:* Toxic hydrogen chloride, chlorine, and phosgene gases form in fires; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts slowly forming hydrochloric acid. Since the reaction is slow, it is generally considered non hazardous; *Reactivity with Common Materials:* In the presence of moisture, this material will corrode iron and other metals. Flammable and explosive hydrogen gas may also form and collect in confined spaces; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Rinse with dilute solution of sodium bicarbonate or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hexadecyl Sulfate, Sodium Salt — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hexadecyltrimethylammonium Chloride — Fire Hazards: *Flash Point (deg. F):* 69 CC (for isopropyl alcohol solutions); *Flammable Limits in Air (%):* 2 - 12 (isopropyl alcohol); *Fire Extinguishing Agents:* Dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating fumes of hydrogen chloride may form in fires; *Behavior in Fire:* Solvent vapors are heavier than air and may travel to a source of ignition and flash back; *Ignition Temperature (deg. F):* 750 (isopropyl alcohol solutions); *Electrical Hazard:* Class I, Group D; *Burning Rate:* 2.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

n-Hexaldehyde — Fire Hazards: *Flash Point (deg. F):* 90 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distances to a source of ignition and flash back; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* 5.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May attack some plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hexamethylenediamine — Fire Hazards: *Flash Point (deg. F):* 160 OC; *Flammable Limits in Air (%):* 0.7 - 6.3; *Fire Extinguishing Agents:* Carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used:* No data; *Special Hazards of Combustion Products:* No data; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hexamethyleneimine — Fire Hazards: *Flash Point (deg. F):* 99 OC; *Flammable Limits in Air (%):* 1.6 - 2.3; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fires; *Behavior in Fire:* Vapor is heavier than air and may travel to a source of ignition and flash back; *Ignition Temperature (deg. F):* No data; *Electrical*

Hazard: No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hexamethylenetetramine — Fire Hazards: *Flash Point (deg. F):* 482 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Formaldehyde gas and ammonia may be given off when exposed to heat; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* > 700; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hexane — Fire Hazards: *Flash Point (deg. F):* -7 CC; *Flammable Limits in Air (%):* 1.2 - 7.7; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapors may explode; *Ignition Temperature (deg. F):* 437; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 7.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hexanol — Fire Hazards: *Flash Point (deg. F):* 149 OC, 145 CC; *Flammable Limits in Air (%):* 1.2 - 7.7; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 580; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1-Hexene — Fire Hazards: *Flash Point (deg. F):* - 15 CC; *Flammable Limits in Air (%):* 1.2 (LEL); *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 521; *Electrical Hazard:* Not pertinent; *Burning Rate:* 8.1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hexylene Glycol — Fire Hazards: *Flash Point (deg. F):* 126 OC; *Flammable Limits in Air (%):* 4.7 - 100; *Fire Extinguishing Agents:* Water, alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic vapors are generated upon exposure to heat; *Behavior in Fire:* May explode if vapors are confined; *Ignition Temperature (deg. F):* May ignite spontaneously; *Electrical Hazard:* Not pertinent; *Burning Rate:* 1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with*

Common Materials: Can catch fire when in contact with porous materials such as wood, asbestos, cloth, soil, or rusty metals; *Stability During Transport:* Stable at ordinary temperatures, however when heated this material can decompose to nitrogen and ammonia gases. The decomposition is not generally hazardous unless it occurs in confined spaces; *Neutralizing Agents for Acids and Caustics:* Flush with water and neutralize the resulting solution with calcium hypochlorite; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydrazine — Fire Hazards: *Flash Point (deg. F):* 100 OC; *Flammable Limits in Air (%):* 4.7 - 100; *Fire Extinguishing Agents:* Water, alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic vapors are generated when heated; *Behavior in Fire:* May explode if confined; *Ignition Temperature (deg. F):* May ignite spontaneously, 518; *Electrical Hazard:* Not pertinent; *Burning Rate:* 1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Can catch fire when in contact with porous materials such as wood, asbestos, cloth, soil, or rusty metals; *Stability During Transport:* Stable at ordinary temperatures, however when heated this material can decompose to nitrogen and ammonia gases. The decomposition is not generally hazardous unless it occurs in confined spaces; *Neutralizing Agents for Acids and Caustics:* Flush with water and neutralize the resulting solution with calcium hypochlorite; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydrochloric Acid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating vapors are generated upon heating; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Corrosive to most metals with the evolution of flammable and explosive hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and apply powdered limestone, slaked lime, soda ash, or sodium bicarbonate; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydrofluoric Acid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating vapors are generated upon heating; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Will attack glass, concrete and certain metals containing silica, such as cast iron. Will attack natural rubber, leather, and many organic materials. Can generate flammable and explosive hydrogen when in contact with some metals; *Stability During Transport:* Stable but requires special packaging; *Neutralizing Agents for Acids and Caustics:* Flush with water and apply powdered limestone, slaked lime, soda ash, or sodium bicarbonate; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydrogen Bromide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent;*Behavior in Fire:* Pressurized containers may explode and release toxic and irritating vapors; *Ignition Temperature* *(deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Moderate reaction with the evolution of heat; *Reactivity with Common Materials:* Rapidly absorbs moisture , forming hydrobromic acid . Highly corrosive to most metals, with the evolution of flammable and explosive hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and apply powdered limestone, slaked lime, soda ash, or sodium bicarbonate; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydrogen Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not flammable; *Fire Extinguishing Agents Not To Be Used:* Not flammable; *Special Hazards of Combustion Products:* Not flammable; *Behavior in Fire:* Pressurized containers may explode releasing toxic and irritating vapors; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:*; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* Moderate reaction with the evolution of heat; *Reactivity with Common Materials:* Rapidly absorbs moisture forming hydrochloric acid. Very corrosive to metals with the evolution of flammable and explosive hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and apply powdered limestone, slaked lime, soda ash, or sodium bicarbonate; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydrogen Cyanide — Fire Hazards: *Flash Point (deg. F):* 0 CC; *Flammable Limits in Air (%):* 5.6 - 40; *Fire Extinguishing Agents:* Stop flow of gas if practical; *Fire Extinguishing Agents Not To Be Used:* None; *Special Hazards of Combustion Products:* Extremely toxic vapors are generated even at ordinary temperatures; *Behavior in Fire:* Containers may explode and contents spontaneously ignite; *Ignition Temperature (deg. F):* 1,004; *Electrical Hazard:* No data; *Burning Rate:* 1.8 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Dissolves with a moderate reaction; *Reactivity with Common Materials:* None; *Stability During Transport:* May become unstable and subject to explosion if stored for extended periods of time or is exposed to high temperatures and pressures; *Neutralizing Agents for Acids and Caustics:* The weak acidity can be neutralized by slaked lime, however this does not destroy the hazardous properties of the material; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydrogen Fluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating vapors are generated when exposed to hear; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* Dissolves with liberation of heat; *Reactivity with Common Materials:* Will attack glass, concrete and certain metals containing silica, such as cast iron. Will attack natural rubber, leather, and many organic materials. Can generate flammable and explosive hydrogen when in contact with some metals; *Stability During Transport:* Stable but requires special packaging; *Neutralizing Agents for Acids and Caustics:* Flush with water and apply powdered limestone, slaked lime, soda ash, or sodium bicarbonate; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydrogen, Liquefied — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air (%):* 4.0 - 75.0; *Fire Extinguishing Agents:* Let fire burn; shut off gas supply; *Fire Extinguishing Agents Not To Be Used:* Carbon dioxide; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Burns with an almost invisible flame; *Ignition Temperature (deg. F):* 1,065;

Electrical Hazard: Class I, Group B; *Burning Rate:* 9.9 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Ambient temperature of water will cause vigorous vaporization of hydrogen; *Reactivity with Common Materials:* No chemical reaction, but low temperature causes most materials to become very brittle; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydrogen Peroxide — Fire Hazards: *Flash Point (deg. F):* Not flammable but may cause fire and violent reactions on contact with combustibles and metals; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Water for fires resulting from spillage; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* May explode in fires; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Dirt and metals can cause rapid decomposition with the liberation of oxygen gas; *Stability During Transport:* Pure grades are stable, but contamination by dirt and metals can cause rapid or violent decomposition; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydrogen Sulfide - Fire Hazards: *Flash Point (deg. F):* This is a flammable gas; *Flammable Limits in Air (%):* 4.3 - 45; *Fire Extinguishing Agents:* Stop the flow of gas; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic gases are generated in fires; *Behavior in Fire:* Vapor is heavier than air and can travel to a source of ignition and flash back; *Ignition Temperature (deg. F):* 500; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydroquinone — Fire Hazards: *Flash Point (deg. F):* 350 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* No data; *Special Hazards of Combustion Products:* No data; *Behavior in Fire:* Dust explosion is high probability; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2-Hydroxyethyl Acrylate, Inhibited — Fire Hazards: *Flash Point (deg. F):* 220 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Water, dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* 2.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:*; *Polymerization:* In the absence of inhibitor, polymerization will occur especially at elevated temperature; *Inhibitor of Polymerization:* Monomethyl Ether of Hydroquinone (400 ppm).

Hydroxylamine Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Sulfuric acid fumes may form when exposed to heat or fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Can be corrosive to metals in the presence of moisture; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Hydroxypropyl Acrylate — Fire Hazards: *Flash Point (deg. F):* 212 OC; *Flammable Limits in Air (%):* 1.8 (LEL); *Fire Extinguishing Agents:* Dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* No data; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Polymerization may occur. Avoid exposure to high temperatures, ultraviolet light, and free-radical catalysts; *Inhibitor of Polymerization:* 200 ppm Hydroquinone.

Hydroxypropyl Methacrylate — Fire Hazards: *Flash Point (deg. F):* 250 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* No data; *Behavior in Fire:* This product may polymerize when hot and burst containers; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Can polymerize when exposed to heat, ultraviolet light, or free-radical catalysts; *Inhibitor of Polymerization:* 200 ppm Hydroquinone.

I

Isoamyl Alcohol — Fire Hazards: *Flash Point (deg. F):* 114 OC; *Flammable Limits in Air (%):* 1.2 - 9.0 (212 of); *Fire Extinguishing Agents:* Water spray, dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 662; *Electrical Hazard:* Class I, Group C; *Burning Rate:* 3.6 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isobutane — Fire Hazards: *Flash Point (deg. F):* -117 CC; *Flammable Limits in Air (%):* 1.8 - 8.4; *Fire Extinguishing Agents:* Stop the flow of gas; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 890; *Electrical Hazard:* Not pertinent; *Burning Rate:* 9.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isobutyl Acetate — Fire Hazards: *Flash Point (deg. F):* 62 CC, 85 OC; *Flammable Limits in Air (%):* 2.4 - 10.5; *Fire Extinguishing Agents:* Foam, carbon dioxide, and dry chemical; *Fire*

Extinguishing Agents Not To Be Used: Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 793; *Electrical Hazard:* Class I, Group D; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Softens and dissolves many types of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isobutyl Alcohol — Fire Hazards: *Flash Point (deg. F):* 82 CC, 90 OC; *Flammable Limits in Air (%):* 1.6 - 10.9; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 800; *Electrical Hazard:* Not pertinent; *Burning Rate:* 3.5 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isobutylamine — Fire Hazards: *Flash Point (deg. F):* 15 CC; *Flammable Limits in Air (%):* 3.4 - 9; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen form in fires; *Behavior in Fire:* Vapor is heavier than air and may travel to source of ignition and flash back. Containers may explode; *Ignition Temperature (deg. F):* 712; *Electrical Hazard:* No data; *Burning Rate:* 6.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isobutylene — Fire Hazards: *Flash Point (deg. F):* -105 CC; *Flammable Limits in Air (%):* 1.8 - 9.6; *Fire Extinguishing Agents:* Recommended to allow fire to burn. Stop the flow of gas if feasible. Water fog, dry chemical, or carbon dioxide may be used on small firs; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode in fires. Vapors are heavier than air and can travel to source of ignition and flash back; *Ignition Temperature (deg. F):* 869; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isobutyric Acid — Fire Hazards: *Flash Point (deg. F):* 170 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* 935; *Electrical Hazard:* No data; *Burning Rate:* 2.6 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Corrosive to aluminum and other metals. Flammable hydrogen gas may accumulate in enclosed spaces; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isobutyronitrile — Fire Hazards: *Flash Point (deg. F)*: 47 CC; *Flammable Limits in Air (%)*: No data; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:*; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isooctaldehyde — Fire Hazards: *Flash Point (deg. F)*: 104 CC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* No data; *Fire Extinguishing Agents Not To Be Used:* No data; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* 320; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isodecaldehyde — Fire Hazards: *Flash Point (deg. F)*: 185 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isodecyl Acrylate, Inhibited — Fire Hazards: *Flash Point (deg. F)*: 240 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* May polymerize to form a gummy material, but the reaction is not violent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable if inhibited; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* In the absence of inhibitor, polymerization will occur, especially when heated; *Inhibitor of Polymerization:* Monomethyl Ether of Hydroquinone (25 ppm).

Isodecyl Alcohol — Fire Hazards: *Flash Point (deg. F)*: 220 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isohexane — Fire Hazards: *Flash Point (deg. F)*: -20 CC; *Flammable Limits in Air (%)*: 1.2 - 7.7; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 585; *Electrical Hazard:* Not pertinent; *Burning Rate:* 8.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isooctyl Alcohol — Fire Hazards: *Flash Point (deg. F)*: 180 OC; *Flammable Limits in Air (%)*: 0.9 - 5.7; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 530; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isopentane — Fire Hazards: *Flash Point (deg. F)*: -70 CC; *Flammable Limits in Air (%)*: 1.4 - 8.3; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* This is a highly volatile liquid. The vapors are explosive when mixed with air; *Ignition Temperature (deg. F):* 800; *Electrical Hazard:* Not pertinent; *Burning Rate:* 7.4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isophorone — Fire Hazards: *Flash Point (deg. F)*: 205 OC, 184 CC; *Flammable Limits in Air (%)*: 0.84 - 3.8; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 864; *Electrical Hazard:* No data; *Burning Rate:* 4.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isophthalic Acid — Fire Hazards: *Flash Point (deg. F)*: Not pertinent. This is a combustible solid; *Flammable Limits in Air (%)*: Not pertinent; *Fire Extinguishing Agents:* Water, dry powder, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* None; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* Dust forms explosive mixture in air; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isoprene — Fire Hazards: *Flash Point (deg. F)*: -65 CC; *Flammable Limits in Air (%)*: 2 - 9; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be

Used: Water may be ineffective; *Special Hazards of Combustion Products:* Toxic vapors are generated upon heating; *Behavior in Fire:* May polymerize in containers and explode; *Ignition Temperature (deg. F):* 428; *Electrical Hazard:* Class I, Group C; *Burning Rate:* 8.6 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Polymerization is accelerated by heat and exposure to oxygen, as well as the presence of contamination such as iron rust. Iron surfaces should be treated with an appropriate reducing agent such as sodium nitrate, before being placed into isoprene service; *Inhibitor of Polymerization:* Tertiary butyl catechol (0.06 %). Di-n-butylamine, phenyl-beta-naphthylamine and phenyl-alpha-naphthylamine are also recommended.

Isopropyl Acetate — Fire Hazards: *Flash Point (deg. F):* 37 CC, 60 CC; *Flammable Limits in Air (%):* 1.8 - 8.0; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 860; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isopropyl Alcohol — Fire Hazards: *Flash Point (deg. F):* 65 OC, 53 CC; *Flammable Limits in Air (%):* 2.3 - 12.7; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 750; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 2.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isopropylamine — Fire Hazards: *Flash Point (deg. F):* -15 OC; *Flammable Limits in Air (%):* 2.3 - 12; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen form in fires; *Behavior in Fire:* Burning product is difficult to control because of the ease of reigniting of vapors. Vapors are heavier than air and may travel to a source of ignition and flash back. There is danger of container explosion; *Ignition Temperature (deg. F):* 756; *Electrical Hazard:* No data; *Burning Rate:* 6.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isopropyl Ether — Fire Hazards: *Flash Point (deg. F):* -15 OC, -18 CC; *Flammable Limits in Air (%):* 1.4 - 7.9; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel to a source of ignition and flash back. Containers may explode; *Ignition Temperature (deg. F):* 830; *Electrical Hazard:* No data; *Burning Rate:* 5.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Unstable peroxides may form if the product contacts air for long time periods. These may explode spontaneously or when heated; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isopropyl Mercaptan — Fire Hazards: *Flash Point (deg. F)*: -30 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating sulfur dioxide gas is formed in fires; *Behavior in Fire:* Vapor is heavier than air and may travel to a source of ignition and flash back. Containers may explode; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isopropyl Percarbonate — Fire Hazards: *Flash Point (deg. F)*: Not pertinent. This is a combustible solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water; *Fire Extinguishing Agents Not To Be Used:* All extinguishing agents may be ineffective; *Special Hazards of Combustion Products:* Flammable and toxic vapors are formed in fires, including acetone, isopropyl alcohol, acetaldehyde, and ethane; *Behavior in Fire:* This product undergoes auto-accelerated decomposition and can self-ignite. Fires are very difficult to extinguish because air is not needed for combustion; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May decompose with the formation of oxygen when in contact with metals; *Stability During Transport:* Unstable at temperatures above 0 of with the formation of oxygen gas; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Isovaleraldehyde — Fire Hazards: *Flash Point (deg. F)*: 55 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* 5.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

K

Kerosene — Fire Hazards: *Flash Point (deg. F)*: 100 CC; *Flammable Limits in Air (%): 0.7 - 5*; *Fire Extinguishing Agents*: Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 444; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: *Stable*; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

L

Lactic Acid — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (not flammable); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Slowly corrodes most metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Dilute with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Latex, Liquid Synthetic — Fire Hazards: *Flash Point (deg. F)*: Not flammable unless coagulated; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* If the latex dries out and the burns, hydrochloric acid, hydrogen cyanide and styrene gases may be evolved. All are irritating and poisonous; *Behavior in Fire:* Heat may coagulate the latex and form sticky plastic lumps which may burn; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Data not available; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Coagulated by heat and acids to gummy, flammable material; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lauroyl Peroxide — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (oxidizing combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Can increase the severity of fire. Becomes sensitive to shock when hot. Containers may explode in a fire. May ignite or explode spontaneously if mixed with flammable materials; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May ignite or explode spontaneously when mixed with combustible materials; *Stability During Transport:* Stable if not overheated; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lauryl Mercaptan — Fire Hazards: *Flash Point (deg. F)*: 262 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Poisonous and irritating gases (e.g. sulfur dioxide) are generated in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lead Acetate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be

Used: Not pertinent; *Special Hazards of Combustion Products:* Irritating acid fumes may be formed in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lead Arsenate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lead Fluoroborate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating hydrogen fluoride gas may form in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Solution is acidic and will corrode most metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; rinse with dilute solution of sodium bicarbonate of soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lead Fluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lead Iodide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lead Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fire;

Behavior in Fire: Increases the intensity of a fire when in contact with burning material. Use plenty of water to cool containers or spilled material; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Contact with wood or paper may cause fire; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lead Tetraacetate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Can increase the intensity of a fire when in contact with combustible material. Cool containers with plenty of water; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Forms lead dioxide and acetic acid in a reaction that is not violent; *Reactivity with Common Materials:* May corrode metals when moist; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Dilute with water, rinse with dilute sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lead Thiocyanate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating sulfur dioxide gas may form in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Linear Alcohols — Fire Hazards: *Flash Point (deg. F):* 180 - 285 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Liquefied Natural Gas — Fire Hazards: *Flash Point (deg. F):* Flammable gas; *Flammable Limits in Air (%):* 5.3 - 14.0; *Fire Extinguishing Agents:* Do not extinguish large spill fires. Allow to burn while cooling adjacent equipment with water spray. Shut off leak if possible. Extinguish small fires with dry chemicals; *Fire Extinguishing Agents Not To Be Used:* Water; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 999; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 12.5 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Liquefied Petroleum Gas — Fire Hazards: *Flash Point (deg. F)*: Propane: -156 CC; butane: -76 CC; *Flammable Limits in Air (%):* Propane: 2.2 - 9.5; butane: 1.8 - 8.4; *Fire Extinguishing Agents:* Allow to burn while cooling adjacent equipment with water spray. Extinguish small fires with dry chemical. Shut off leak if possible; *Fire Extinguishing Agents Not To Be Used:* Water (let fire burn); *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode. Vapor is heavier than air and may travel a long distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Litharge — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lithium Aluminum Hydride — Fire Hazards: *Flash Point (deg. F)*: Solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Powdered graphite, powdered salt, or powdered limestone; *Fire Extinguishing Agents Not To Be Used:* Do not use water, soda acid, carbon dioxide or dry chemical; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Decomposes at 257 °F to form hydrogen gas. The heat generated may cause ignition and/or explosion; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Class I, Group B; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently with water as a dry solid or when dissolved in ether. The hydrogen produced by the reaction with water is a major hazard and necessitates adequate ventilation; *Reactivity with Common Materials:* Can burn in heated or moist air; *Stability During Transport:* Normally stable; unstable at high temperatures; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lithium Hydride — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry nitrogen, graphite, or lithium chloride; *Fire Extinguishing Agents Not To Be Used:* Never use water, foam, halogenated hydrocarbons, soda acid, dry chemical, or carbon dioxide; *Special Hazards of Combustion Products:* Irritating alkali fumes may form in fire; *Behavior in Fire:* May decompose when hot to form flammable hydrogen gas. Reacts violently with water to produce hydrogen, which may explode in air; *Ignition Temperature (deg. F):* 392; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently with water to produce flammable hydrogen gas and strong caustic solution; ignition may occur, especially with powder; *Reactivity with Common Materials:* May ignite combustible materials if they are damp; *Stability During Transport:* Stable, if air and moisture are excluded; *Neutralizing Agents for Acids and Caustics:* Residues should be washed well with water, then rinsed with dilute acetic acid; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Lithium, Metallic — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Graphite, lithium chloride; *Fire Extinguishing Agents Not To Be Used:* Water, sand, halogenated hydrocarbons, carbon dioxide, soda-acid , or dry chemical; *Special Hazards of Combustion Products:* Strong alkali fumes are formed in fire; *Behavior in Fire:* Molten lithium is quite easily ignited and is then difficult to extinguish. Hot or burning lithium will react with all gases except those of the helium-argon group. It also reacts violently with concrete, wood, asphalt, sand, asbestos, and in fact, nearly everything except metal. Do not apply water to adjacent fires. Hydrogen explosion may result; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently to form flammable hydrogen gas and strong caustic solution. Ignition usually occurs; *Reactivity with Common Materials:* May ignite combustible materials if they are damp; *Stability During Transport:* Stable, if air and moisture are excluded; *Neutralizing Agents for Acids and Caustics:* Residues should be flushed with water, then rinsed with dilute acetic acid; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

M

Magnesium — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (solid). Flammable when in the form of turnings or powder; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Inert dry powders (e.g. graphite, limestone, salt); *Fire Extinguishing Agents Not To Be Used:* Water, foam, halogenated agents, carbon dioxide; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Forms dense white smoke. Flame is very bright; *Ignition Temperature (deg. F):* 883; *Electrical Hazard:* Class I, Group E; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* In finely divided form, reacts with water and acids to release flammable hydrogen gas; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Magnesium Perchlorate — Fire Hazards: *Flash Point (deg. F)*: Not flammable, but may cause or increase the intensity of a fire; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Can form explosive mixture with combustible material or finely powdered metals. Increases the intensity of fires; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Dissolves with liberation of heat. May cause spattering; *Reactivity with Common Materials:* Contact with wood, paper, oils, grease, or finely divided metals may cause fires and explosions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Malathion — Fire Hazards: *Flash Point (deg. F)*: >325; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide, foam, water spray; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Vapors and fumes from fires are hazardous. They include sulfur dioxide and phosphoric acid; *Behavior in Fire:* Gives off hazardous fumes. Area surrounding fire should be diked to prevent water runoff; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* None; *Reactivity with Common Materials:* No hazardous reaction; *Stability During Transport:* Not pertinent; *Neutralizing*

Agents for Acids and Caustics: Liquid bleach solution for decontamination; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Maleic Acid — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating smoke containing maleic anhydride may form in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May corrode metals when wet; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with dilute solution of sodium bicarbonate or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Maleic Anhydride-Fire Hazards: *Flash Point (deg. F):* (liquid) 215 CC; 230 OC; *Flammable Limits in Air (%):* 1.4-7.1; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* When heated above 300°F in the presence of various materials may generate heat and carbon dioxide. Will explode if confined; *Ignition Temperature (deg. F):* 878; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 1.4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Hot water may cause frothing. Reaction with cold water is slow and non-hazardous; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Solid spills can usually be recovered before any significant reaction with water occurs. Flush area of spill with water; *Polymerization:* Very unlikely at ordinary temperatures, even in the molten state; *Inhibitor of Polymerization:* None.

Maleic Hydrazide— Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, dry chemical, carbon dioxide, foam; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic nitrogen oxides are produced; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mercuric Acetate— Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Smoke may contain toxic mercury or mercury oxide fumes; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mercuric Ammonium Chloride— Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Smoke may contain toxic mercury compounds; *Behavior in Fire:* Not pertinent; *Ignition Temperature* *(deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mercuric Chloride— Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Heat of fire may cause material to form fumes of mercuric chloride, which are toxic; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mercuric Cyanide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Fumes from fire may contain toxic mercury and hydrogen cyanide; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Contact with any acidic material will form poisonous hydrogen cyanide gas, which may collect in enclosed spaces; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mercuric Iodide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Fumes from fire may contain toxic mercury vapor; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mercuric Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable, but may intensify fire; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Vapors from fire may contain toxic mercury and oxides of nitrogen; *Behavior in Fire:* May increase intensity of fire if in contact with burning material; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Dissolves, then form cloudy acid solution. The reaction is not hazardous; *Reactivity with Common Materials:* Solution will corrode most metals. Solid in contact with wood or paper may cause fire; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush well with water, rinse with dilute solution of sodium bicarbonate or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mercuric Oxide — Fire Hazards: *Flash Point (deg. F):* Not flammable, but may intensify fire; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire*

Extinguishing Agents Not To Be Used: Not pertinent; *Special Hazards of Combustion Products:* Fumes from fire may contain poisonous mercury vapor; *Behavior in Fire:* Decomposes at 500°C into mercury and oxygen which can increase intensity of fire. Solid changes color when hot; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mercuric Sulfide — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, sand; *Fire Extinguishing Agents Not To Be Used:* Other agents may be ineffective; *Special Hazards of Combustion Products:* Smoke from fire contains poisonous mercury vapor and irritating sulfur dioxide gas; *Behavior in Fire:* Changes color when hot. Decomposes at burning temperature. The black form may soften, and molten sulfur may flow out and burn; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mercurous Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Fumes from fire may contain toxic vapors of substance; *Behavior in Fire:* Vaporizes and escapes as a sublimate; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mercurous Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable, but may intensify fire; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Smoke from fire may contain toxic mercury vapor and oxides of nitrogen; *Behavior in Fire:* May increase intensity of fire; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Dissolves, then forms cloudy acid solution. The reaction is not hazardous; *Reactivity with Common Materials:* Solution may corrode most metals. Solid in contact with wood or paper may cause fire; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with dilute solution of sodium bicarbonate or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mecuric Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids*

and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Mesityl Oxide — Fire Hazards: *Flash Point (deg. F):* 84 OC; 73 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 652; *Electrical Hazard:* Data not available; *Burning Rate:* 4.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methallyl Chloride — Fire Hazards: *Flash Point (deg. F):* 14 OC; *Flammable Limits in Air (%):* 2.3 - 9.3; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating and toxic hydrogen chloride and phosgene vapors may be formed; *Behavior in Fire:* Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 4.4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methane — Fire Hazards: *Flash Point (deg. F):* Flammable gas; *Flammable Limits in Air (%):* 5.0 - 15.0; *Fire Extinguishing Agents:* Stop flow of gas; *Fire Extinguishing Agents Not To Be Used:* Water; *Special Hazards of Combustion Products:* None; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 1004; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 12.5 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Metanearsonic Acid, Sodium Salts — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic gases may be generated in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* None; *Reactivity with Common Materials:* None; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methoxychlor — Fire Hazards: *Flash Point (deg. F):* Burns only at high temperatures. For liquid forms, see Kerosene; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating and toxic hydrogen chloride gas may be formed in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:*

No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Acetate — Fire Hazards: *Flash Point (deg. F):* 22 OC; 14 CC; *Flammable Limits in Air (%):* 3.1 - 16; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than fire and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 935; *Electrical Hazard:* Data not available; *Burning Rate:* 3.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts slowly to form acetic acid and methyl alcohol; the reaction is not violent; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Acetylene-Propadiene Mixture — Fire Hazards: *Flash Point (deg. F):* Not pertinent (flammable liquefied compressed gas); *Flammable Limits in Air (%):* 3-11; *Fire Extinguishing Agents:* Let fire burn; shut off gas supply; cool adjacent exposures; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* 850; *Electrical Hazard:* Data not available; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction, except forms explosive compounds in contact with alloys containing more than 67% copper at high pressures; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Acrylate — Fire Hazards: *Flash Point (deg. F):* 2.7 CC; 44 OC; *Flammable Limits in Air (%):* 2.8 - 25; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating vapors are generated in fires; *Behavior in Fire:* May polymerize. Vapor is heavier than fire and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Heat may cause an explosive polymerization. Strong ultraviolet light can also initiate polymerization; *Inhibitor of Polymerization:* Hydroquinone and its methyl ether, in presence of air .

Methyl Alcohol — Fire Hazards: *Flash Point (deg. F):* 54 CC; 61 OC; *Flammable Limits in Air (%):* 6.0 - 36; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* 867; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 1.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methylamine — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (flammable liquefied compressed gas); *Flammable Limits in Air (%)*: 4.3 - 21; *Fire Extinguishing Agents:* Let gas fire burn; stop flow of gas. Extinguish solution fires with dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic nitrogen oxides may be formed; *Behavior in Fire:* Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 806; *Electrical Hazard:* Data not available; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Dissolves completely; *Reactivity with Common Materials:* Corrosive to copper, copper alloys, zinc alloys, aluminum, and galvanized surfaces; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Amyl Acetate — Fire Hazards: *Flash Point (deg. F)*: 113 CC; 110 OC; *Flammable Limits in Air (%):* 0.9 - 5.7 (calc.); *Fire Extinguishing Agents:* Alcohol foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 510 (calc.); *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Amyl Alcohol — Fire Hazards: *Flash Point (deg. F)*: 120 - 130 OC; 106 CC; *Flammable Limits in Air (%):* 1.0 - 5.5; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 583 (calc.); *Electrical Hazard:* Not pertinent; *Burning Rate:* 4.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

N-Methylaniline — Fire Hazards: *Flash Point (deg. F)*: 175 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic vapors are generated when heated; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 3.65 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May attack some forms of plastic; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Bromide — Fire Hazards: *Flash Point (deg. F)*: Practically not flammable; *Flammable Limits in Air (%):* 10 - 15; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating gases are generated when exposed to fire or heat; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* 999; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction;

Stability During Transport: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl n-Butyl Ketone — Fire Hazards: *Flash Point (deg. F):* 83 OC; 77 CC; *Flammable Limits in Air (%):* 1.3 - 8.0; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* 795; *Electrical Hazard:* Data not available; *Burning Rate:* 4.8 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Chloride — Fire Hazards: *Flash Point (deg. F):* < 32 CC; *Flammable Limits in Air (%):* 8.1 - 17.2; *Fire Extinguishing Agents:* Dry chemical or carbon dioxide. Stop flow of gas; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating gases are generated in fires; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* 1170; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Reacts with zinc, aluminum, magnesium, and their alloys; reaction is not violent; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Chloroformate — Fire Hazards: *Flash Point (deg. F):* 76 OC; 73 CC; *Flammable Limits in Air (%):* LEL = 6.7; *Fire Extinguishing Agents:* Water, dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating and toxic hydrogen chloride and phosgene may be formed; *Behavior in Fire:* Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 2.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts slowly, evolving hydrogen chloride (hydrochloric acid). Reaction can be hazardous if water is hot; *Reactivity with Common Materials:* Corrodes rubber; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methylcyclopentadienylmanganese Tricarbonyl — Fire Hazards: *Flash Point (deg. F):* >200 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, foam, water spray, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic vapors are formed in a fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Data not available; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Cyclopentane — Fire Hazards: *Flash Point (deg. F):* < 0 CC; *Flammable Limits in Air (%):* 1.1 - 8.7; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 624; *Electrical Hazard:* Data not available; *Burning Rate:* 7.1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyldichlorosilane — Fire Hazards: *Flash Point (deg. F):* - 14 OC; *Flammable Limits in Air (%):* 6 - 55; *Fire Extinguishing Agents:* Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water, foam; *Special Hazards of Combustion Products:* Toxic hydrogen chloride and phosgene gases may be formed; *Behavior in Fire:* Difficult to extinguish; re-ignition may occur. Contact with water, applied to adjacent fires will generate irritating hydrogen chloride gas; *Ignition Temperature (deg. F):* >600; *Electrical Hazard:* Data not available; *Burning Rate:* 3.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently to form hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* Reacts with surface moisture to evolve hydrogen chloride, which is corrosive to common metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flood with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Ethyl Ketone — Fire Hazards: *Flash Point (deg. F):* 20 CC; 22 OC; *Flammable Limits in Air (%):* 1.8 - 11.5; *Fire Extinguishing Agents:* Alcohol foam dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 961; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 4.1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methylethylpyridine — Fire Hazards: *Flash Point (deg. F):* 155 OC; *Flammable Limits in Air (%):* 1.1 - 6.6; *Fire Extinguishing Agents:* Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating vapors are generated when heated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 939; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, neutralize with dilute acetic acid; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Formal — Fire Hazards: *Flash Point (deg. F):* 0 OC; *Flammable Limits in Air (%):* 1.6 - 17.6; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating formaldehyde smoke may be present in smoke; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 459; *Electrical Hazard:* Data not available; *Burning Rate:* 5.5 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Formate — Fire Hazards: *Flash Point (deg. F)*: - 26 CC; *Flammable Limits in Air (%)*: 5 - 22.7; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide, alcohol foam; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel a considerable distance to source of ignition and flash back; *Ignition Temperature (deg. F):* 853; *Electrical Hazard:* Data not available; *Burning Rate:* 2.5 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Slow reaction to form formic acid and methyl alcohol; reaction is not hazardous; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methylhydrazine — Fire Hazards: *Flash Point (deg. F)*: 62 OC; *Flammable Limits in Air (%)*: 2.5 - 98; *Fire Extinguishing Agents:* Water or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating nitrogen oxides are produced; *Behavior in Fire:* May explode; *Ignition Temperature (deg. F):* 382; *Electrical Hazard:* Data not available; *Burning Rate:* 2.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Reacts slowly with air, but heat may cause ignition of rags, rust or other combustibles; *Stability During Transport:* Stable if not in contact with iron, copper or their alloys; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Isobutyl Carbinol — Fire Hazards: *Flash Point (deg. F)*: 120 -130 OC; 106 CC; *Flammable Limits in Air (%)*: 1.0 - 5.5; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* .

Methyl Isobutyl Ketone — Fire Hazards: *Flash Point (deg. F)*: 73 CC; 75 OC; *Flammable Limits in Air (%)*: 1.4 - 7.5; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating vapors are generated when heated; *Behavior in Fire:* Vapors may travel a considerable distance and ignite; *Ignition Temperature (deg. F):* 854; *Electrical Hazard:* Class I, Group D; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Isopropenyl Ketone, Inhibited — Fire Hazards: *Flash Point (deg. F)*: < 73 CC; *Flammable Limits in Air (%)*: 1.8 - 9.0; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* May polymerize and explode; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 4.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and*

Caustics: Not pertinent; *Polymerization:* Will polymerize in the absence of inhibitor, especially when heated; *Inhibitor of Polymerization:* Up to 1% hydroquinone.

Methyl Mercaptan — Fire Hazards: *Flash Point (deg. F):* Not pertinent (flammable, liquefied compressed gas); *Flammable Limits in Air (%):* 3.9 - 21.8; *Fire Extinguishing Agents:* Preferably let fire burn, stop gas flow. Fires may be extinguished with dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating sulfur dioxide is produced; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* 3.8 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Methacrylate — Fire Hazards: *Flash Point (deg. F):* 50 OC; *Flammable Limits in Air (%):* 2.1 - 12.5; *Fire Extinguishing Agents:* Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back. Containers may explode in fire or when heated because of polymerization; *Ignition Temperature (deg. F):* 790; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.5 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Heat, oxidizing agents, and ultraviolet light may cause polymerization; *Inhibitor of Polymerization:* Hydroquinone, 22 - 65 ppm; hydroquinone methyl ether, 22 - 120 ppm; dimethyl tert-butylphenol, 45 - 65 ppm.

Methyl Parathion — Fire Hazards: *Flash Point (deg. F):* 115 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic gases are produced in fires; *Behavior in Fire:* Drums may rupture violently; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* Half decomposed in 8 days at 40° C; *Reactivity with Common Materials:* Is absorbed in wood, etc., which must be replaced to eliminate poison hazard; *Stability During Transport:* Decomposes above 50 °C with possible explosive force; *Neutralizing Agents for Acids and Caustics:* Apply caustic or soda ash slurry until yellow stains disappear; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Phosphonothioic Dichloride (Anhydrous) — Fire Hazards: *Flash Point (deg. F):* >122 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam; *Special Hazards of Combustion Products:* Irritating hydrogen chloride, sulfur dioxide and other fumes may be formed in fire; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* Reacts with water to form hydrochloric acid and/or hydrogen chloride vapor. The reaction may be violent; *Reactivity with Common Materials:* Corrosive to metals because of its high acidity; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with dilute sodium bicarbonate or soda ash solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1-Methylpyrrolidone — Fire Hazards: *Flash Point (deg. F)*: 204 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Dry chemical, "alcohol foam", or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may be formed in fire; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

alpha-Methylstyrene — Fire Hazards: *Flash Point (deg. F)*: 137 CC; *Flammable Limits in Air (%):* 1.9 - 6.1; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* 1,066; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and* Caustics: Not pertinent; *Polymerization:* Hazardous polymerization unlikely to occur except when in contact with alkali metals or metallo-organic compounds; *Inhibitor of Polymerization:* 10 -20 ppm tert-butylcatechol.

Methyltrichlorosilane — Fire Hazards: *Flash Point (deg. F)*: 45 OC; 15 CC; *Flammable Limits in Air (%):* 5.1 - >20; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water, foam; *Special Hazards of Combustion Products:* Toxic hydrogen chloride and phosgene gases may form in fires; *Behavior in Fire:* Difficult to extinguish; re-ignition may occur. Contact with water applied to adjacent fires produces irritating hydrogen chloride; *Ignition Temperature (deg. F):* >760; *Electrical Hazard:* Data not available; *Burning Rate:* 1.9 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently to form hydrogen chloride, which is corrosive to metals; *Reactivity with Common Materials:* Reacts with surface moisture to evolve hydrogen chloride, which is corrosive to metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Methyl Vinyl Ketone — Fire Hazards: *Flash Point (deg. F)*: 30 OC; 20 CC; *Flammable Limits in Air (%):* 2.1 - 15.6; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back. At elevated temperatures (fire conditions) polymerization may take place in containers, causing violent rupture. Unburned vapors are very irritating; *Ignition Temperature (deg. F):* 915; *Electrical Hazard:* Data not available; *Burning Rate:* 4.5 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Polymerize spontaneously upon exposure to heat or sunlight; *Inhibitor of Polymerization:* Up to 1% hydroquinone.

Mineral Spirits — Fire Hazards: *Flash Point (deg. F)*: 105 - 140 CC, depending on grade; *Flammable Limits in Air (%):* 0.8 - 5.0; *Fire Extinguishing Agents:* Foam, carbon dioxide, dry chemical; *Fire Extinguishing Agents Not To Be Used:* Do not use straight hose water stream; *Special*

Hazards of Combustion Products: Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 540; *Electrical Hazard:* Not pertinent; *Burning Rate:* 4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Molybdic Trioxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Monochloroacetic Acid — Fire Hazards: *Flash Point (deg. F):* (almost nonflammable); *Flammable Limits in Air (%):* 8 (LEL); *Fire Extinguishing Agents:* Dry chemical, carbon dioxide, water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* hydrogen chloride and phosgene may be generated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Cause mild corrosion to common metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Monochlorodifluoromethane — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Decomposition gases are toxic and irritating; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Monoethanolamine - Fire Hazards: *Flash Point (deg. F):* 185 CC; 200 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Water spray, alcohol foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating vapors generated when heated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Monoisopropanolamine — Fire Hazards: *Flash Point (deg. F):* 165 OC; 171 CC; *Flammable Limits in Air (%):* 2.2 (calc.) - 12 (est.); *Fire Extinguishing Agents:* Dry chemical, water spray, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special*

Hazards of Combustion Products: Irritating vapors generated when heated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 706 (est.); *Electrical Hazard:* Not pertinent; *Burning Rate:* 1.1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Morpholine — Fire Hazards: *Flash Point (deg. F):* 100 OC; *Flammable Limits in Air (%):* 1.8 - 10.8; *Fire Extinguishing Agents:* Water fog, alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating vapors are generated when heated; *Behavior in Fire:* Vapor is heavier than air and may travel some distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 590; *Electrical Hazard:* Not pertinent; *Burning Rate:* 1.9 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Motor Fuel Anti-knock Compounds Containing Lead Alkyls— Fire Hazards: *Flash Point (deg. F):* 89 -265 OC; *Flammable Limits in Air (%):* None established; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic lead-containing gases are generated in fires; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* Begins to decompose above 212° F; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Reacts with oxidizing materials, active metals and rust, but not considered hazardous; *Stability During Transport:* A self-sustaining decomposition occurs if the temperature of the bulk liquid is above 212 °F and a flame or hot metal surface serves to ignite the mass. The presence of ethylene dibromide makes the compound stable at 300 °F for 15 hrs; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

N

Nabam — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* If water solution boils, poisonous hydrogen sulfide and highly flammable carbon disulfide vapors form; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction unless water is boiling hot, when poisonous hydrogen sulfide and flammable carbon disulfide vapors form; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Naphtha: Coal Tar — Fire Hazards: *Flash Point (deg. F):* 107 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents:* Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 900 - 950; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable;

Neutralizing Agents for Acids and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Naphthalene, Molten — Fire Hazards: *Flash Point (deg. F):* 174 CC; 190 OC; *Flammable Limits in Air (%):* 0.9 - 5.9; *Fire Extinguishing Agents:* Water fog, carbon dioxide, dry chemical, or foam; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic vapors given off in a fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 979; *Electrical Hazard:* Not pertinent; *Burning Rate:* 4.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Molten naphthalene spatters and foams in contact with water. No chemical reaction. No chemical reaction is involved; *Reactivity with Common Materials:* None; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Naphtha: Solvent — Fire Hazards: *Flash Point (deg. F):* >100 CC; *Flammable Limits in Air (%):* 0.8 - 5.0; *Fire Extinguishing Agents:* Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 444; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Naphtha: Stoddard Solvent — Fire Hazards: *Flash Point (deg. F):* 110 CC; *Flammable Limits in Air (%):* 0.8 - 5.0; *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 540 (est.); *Electrical Hazard:* Class I, Group D; *Burning Rate:* 4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Naphtha: VM & P (75 % Naphtha) — Fire Hazards: *Flash Point (deg. F):* 20 -55 CC; *Flammable Limits in Air (%):* 0.9 - 6.7; *Fire Extinguishing Agents:* Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and travel a long distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 450; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Naphthenic Acids — Fire Hazards: *Flash Point (deg. F):* 300 OC; *Flammable Limits in Air (%):* 1.0 (LEL); *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Data not available; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During*

Transport: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1-Naphthylamine — Fire Hazards: *Flash Point (deg. F):* (combustible solid) 315 CC (molten solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, dry chemical, carbon dioxide, foam; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Toxic nitrogen oxides are produced in a fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Neohexane — Fire Hazards: *Flash Point (deg. F):* -54 CC; *Flammable Limits in Air (%):* 1.2 - 7.7; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 787; *Electrical Hazard:* Data not available; *Burning Rate:* 9.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nickel Acetate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nickel Ammonium Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may be formed in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nickel Bromide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating hydrogen bromide vapors may form in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During

Transport: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nickel Carbonyl — Fire Hazards: *Flash Point (deg. F)*: < -4 CC; *Flammable Limits in Air (%):* 2 (LEL); *Fire Extinguishing Agents:* Water; *Fire Extinguishing Agents Not To Be Used:* Data not available; *Special Hazards of Combustion Products:* Unusually toxic gases formed by incomplete combustion; *Behavior in Fire:* Containers may explode when heated; *Ignition Temperature (deg. F):* <200° F (vapor); *Electrical Hazard:* Data not available; *Burning Rate:* 2.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable below 100° C; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nickel Chloride — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nickel Cyanide — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nickel Fluoroborate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nickel Formate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nickel Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable, but may intensify fire; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fire. May increase intensity of fire if in contact with combustible material; *Behavior in Fire:* May increase intensity of fire if in contact with combustible material; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Contact of solid with wood or paper may cause fires; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nickel Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nicotine — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* 0.7 - 4.0; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Smoke may contain toxic vapors of unburned compound; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 471; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nicotine Sulfate — Fire Hazards: *Flash Point (deg. F):* Nonflammable as solid or water solution; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic decomposition products are released in a fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nitralin — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water; *Fire Extinguishing Agents Not To Be Used:* Data not available; *Special Hazards of Combustion Products:* Irritating oxides of sulfur and nitrogen are formed in fire; *Behavior in Fire:* Decomposes vigorously in a self-sustaining reaction at or above 225° C; *Ignition Temperature (deg. F):* 435; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nitric Acid — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents:* Use water on adjacent fires; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* May give off poisonous oxides of nitrogen and acid fumes when heated in fires; *Behavior in Fire:* Decomposes and gives off poisonous oxides of nitrogen and acid fumes when heated in fires; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* May heat up on mixing,, but explosion or formation of steam unlikely; *Reactivity with Common Materials:* Very corrosive to wood, paper, cloth and most metals. Toxic red oxides of nitrogen are formed; *Stability During Transport:* When heated may give off toxic red oxides of nitrogen; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nitric Oxide — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (nonflammable compressed gas); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Supports combustion, so all fires burn more vigorously; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts with water to form nitric acid. The reaction is not violent; *Reactivity with Common Materials:* Reacts rapidly with air to form nitrogen tetroxide; see this compound; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flood with water, rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nitrilotriacetic Acid and Salts — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2-Nitroaniline — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fire; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 970; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

4-Nitroaniline — Fire Hazards: *Flash Point (deg. F)*: 329 OC (molten solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* No data; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fire; *Behavior in Fire:* Melts and burns; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction;

Stability During Transport: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nitrobenzene — Fire Hazards: *Flash Point (deg. F)*: 171 OC; 190 CC; *Flammable Limits in Air (%):* 1.8 LEL; *Fire Extinguishing Agents:* Water, foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 924; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.9 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nitroethane — Fire Hazards: *Flash Point (deg. F)*: 105 OC; 87 CC; *Flammable Limits in Air (%):* 3.4 (LEL); *Fire Extinguishing Agents:* Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; "alcohol" foam is not effective; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fire; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* 778; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nitrogen, Liquefied — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (nonflammable compressed gas); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode when heated; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Heat of water will vigorously vaporize liquid nitrogen; *Reactivity with Common Materials:* No chemical reaction. Low temperature may cause brittleness in rubber and plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nitrogen Tetroxide— Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Stop flow of gas; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Produces toxic gas when heated; *Behavior in Fire:* Does not burn but supports combustion of combustible materials such as wood. May cause fire or explode on contact with other materials; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Data not available; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* Dissolves to form nitric acid and nitric oxide. Nitric oxide reacts with air to form more nitrogen tetroxide; *Reactivity with Common Materials:* Very corrosive to metals when wet. Reacts vigorously with combustible materials such as wood; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, then use soda ash or lime; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nitromethane — Fire Hazards: *Flash Point (deg. F)*: 110 OC, 95 CC; *Flammable Limits in Air (%):* 7.3 LEL; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* 785; *Electrical Hazard:* Not pertinent; *Burning Rate:* 1.1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Wet material corrodes steel and copper, but the reaction is slow; *Stability During Transport:* Considered stable, but may become sensitized by organic bases (amines) and some metal oxides, such as led pigments; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2-Nitrophenol — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Data not available; *Special Hazards of Combustion Products:* Toxic and irritating fumes of unburned materials and oxides of nitrogen can form in fire; *Behavior in Fire:* Data not available; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

4-Nitrophenol — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* No data; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen and fumes of unburned material may form in fire; *Behavior in Fire:* Decomposes violently at 279° C and will burn even in absence of air; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* NO reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2-Nitropropane — Fire Hazards: *Flash Point (deg. F):* 100 OC; 82 CC; *Flammable Limits in Air (%):* 2.6 (LEL); *Fire Extinguishing Agents:* Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* "Alcohol" foam; water may be ineffective; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fire; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* 802; *Electrical Hazard:* Data not available; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nitrosyl Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Very toxic gases are generated when heated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* Dissolves and reacts to form acid solution and toxic red oxides of nitrogen; *Reactivity with Common Materials:* Corrosive to most metals, but reaction is not hazardous; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water. Residual acid may be neutralized with soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nitrous Oxide — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (nonflammable compressed gas); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Will support combustion, and may increase intensity of fire. Containers may explode when heated; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Supports combustion but does not cause spontaneous combustion; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nonane — Fire Hazards: *Flash Point (deg. F)*: 88 CC; *Flammable Limits in Air (%):* 0.87 - 2.9; *Fire Extinguishing Agents:* Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 401; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 5.8 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nonanol — Fire Hazards: *Flash Point (deg. F)*: 210 OC; 165 CC; *Flammable Limits in Air (%):* 0.8 - 6.1; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nonene — Fire Hazards: *Flash Point (deg. F)*: 78 OC; *Flammable Limits in Air (%):* 0.7 - 3.9; *Fire Extinguishing Agents:* Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* 6.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1-Nonene — Fire Hazards: *Flash Point (deg. F)*: Data not available; *Flammable Limits in Air (%):* 0.8 (LEL); *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* 6.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Nonylphenol — Fire Hazards: *Flash Point (deg. F)*: 300 OC; 285 CC; *Flammable Limits in Air (%)*: Approx 1% (calc. LEL); *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Data not available; *Electrical Hazard:* Not pertinent; *Burning Rate:* Data not available. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

O

Octane — Fire Hazards: *Flash Point (deg. F):* 56 CC; *Flammable Limits in Air (%):* 1.0 - 6.5; *Fire Extinguishing Agents*: Dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Vapor is heavier than fire and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*: 428; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 6.3 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Octanol — Fire Hazards: *Flash Point (deg. F):* 178 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: 3.7 mm/min (approx.). **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; Neutralizing Agents for Acids and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

1-Octene — Fire Hazards: *Flash Point (deg. F):* 70 OC; *Flammable Limits in Air (%):* 0.9 (LEL); *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 493; *Electrical Hazard*: Not pertinent; *Burning Rate*: 6.5 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Octyl Epoxy Tallate — Fire Hazards: *Flash Point (deg. F):* 450 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Data not available; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May attack some forms of plastics; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils: Clarified — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils: Crude — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils: Diesel — Fire Hazards: *Flash Point (deg. F):* (1 -D) 100 CC; (2 - D) 125 CC; *Flammable Limits in Air (%):* 1.3 - 6.0 vol; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: (1 - D) 350 -625; (2 - D) 490 - 545; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible: Castor — Fire Hazards: *Flash Point (deg. F):* 445 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 840; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible: Coconut — Fire Hazards: *Flash Point (deg. F):* 420 CC (crude); 580 CC (refined); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible: Cottonseed — Fire Hazards: *Flash Point (deg. F):* 486 CC (refined oil); 610 CC (cooking oil); *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 650 (refined oil); *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible: Fish — Fire Hazards: *Flash Point (deg. F):* 420 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible: Lard — Fire Hazards: *Flash Point (deg. F):* 395 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 833; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible: Olive — Fire Hazards: *Flash Point (deg. F):* 437 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 650; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible — Fire Hazards: *Flash Point (deg. F):* 373 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 600; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible: Peanut Fire Hazards: *Flash Point (deg. F):* 640 OC; 540 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 833; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible: Safflower — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible: Soya bean — Fire Hazards: *Flash Point (deg. F):* 540 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 833; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible: Tucum — Fire Hazards: *Flash Point (deg. F):* 398 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Edible: Vegetable — Fire Hazards: *Flash Point (deg. F):* 610 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Fuel: 6 — Fire Hazards: *Flash Point (deg. F):* >150 CC; *Flammable Limits in Air (%):* 1 -5; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not* *to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 765; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Fuel: 2 — Fire Hazards: *Flash Point (deg. F):* 136 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 494; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Fuel: 4 — Fire Hazards: *Flash Point (deg. F):* >130 CC; *Flammable Limits in Air (%):* 1 -5; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 505; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Fuel: 5 - Fire Hazards: *Flash Point (deg. F):* >130 CC; *Flammable Limits in Air (%):* 1 -5; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Fuel: 1-D - Fire Hazards: *Flash Point (deg. F):* 100 CC; *Flammable Limits in Air (%):* 1.3 - 6; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 350 - 625; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Fuel: 2-D — Fire Hazards: *Flash Point (deg. F):* 125 CC; *Flammable Limits in Air (%):* 1.3 - 6; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 490 - 545; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Fuel: No. 1 — Fire Hazards: *Flash Point (deg. F):* 100 CC; *Flammable Limits in Air (%):* 0.7 - 5; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 444; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Absorption — Fire Hazards: *Flash Point (deg. F):* 255; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 300; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Coal Tar — Fire Hazards: *Flash Point (deg. F):* 60 - 77 CC; *Flammable Limits in Air (%):* 1.3 - 8; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Croton — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Linseed — Fire Hazards: *Flash Point (deg. F):* 535 OC; 403 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 650; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common

Materials: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Lubricating — Fire Hazards: *Flash Point (deg. F):* 300 - 450 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 500 - 700; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Mineral — Fire Hazards: *Flash Point (deg. F):* 380 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 500 - 700; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Mineral Seal — Fire Hazards: *Flash Point (deg. F):* 170 - 275 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Motor — Fire Hazards: *Flash Point (deg. F):* 275 - 600 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 325 - 625; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Neatsfoot — Fire Hazards: *Flash Point (deg. F):* 430 OC; 470 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 828; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Penetrating — Fire Hazards: *Flash Point (deg. F):* 295; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Range — Fire Hazards: *Flash Point (deg. F):* 100 CC; *Flammable Limits in Air (%):* 0.7 - 5; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 400; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Resin — Fire Hazards: *Flash Point (deg. F):* 255 - 390 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 648; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Road — Fire Hazards: *Flash Point (deg. F):* 300 -550; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 400 - 700; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Rosin — Fire Hazards: *Flash Point (deg. F):* 255 - 390 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 648; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Sperm — Fire Hazards: *Flash Point (deg. F):* 428 CC(No.1); 460 CC (No.2); 500 - 510 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*:

Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 586 (No.1); *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Spindle — Fire Hazards: *Flash Point (deg. F):* 169 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 478; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Spray — Fire Hazards: *Flash Point (deg. F):* 140 (min.)CC; *Flammable Limits in Air (%):* 0.6 - 4.6; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 475; *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Tall — Fire Hazards: *Flash Point (deg. F):* 255; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Tanner's — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Transformer — Fire Hazards: *Flash Point (deg. F):* 295 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of*

Combustion Products: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oils, Miscellaneous: Turbine — Fire Hazards: *Flash Point (deg. F):* 390 - 485 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide, water fog; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 700; *Electrical Hazard*: Not pertinent; *Burning Rate*: (approx.) 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oleic Acid — Fire Hazards: *Flash Point (deg. F):* 390 - 425 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Data not available; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: 685; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oleic Acid, Potassium Salt — Fire Hazards: *Flash Point (deg. F):* 140 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Data not available; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oleic Acid, Sodium Salt — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid:) *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical, foam, water, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products*: Data not available; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oleum — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Avoid use of water on adjacent air; *Special Hazards of Combustion Products*: Toxic and irritating vapors are generated; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable;

Electrical Hazard: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Vigorous reaction with water; spatters; *Reactivity with Common Materials*: May react with cast iron with explosive violence. Attack many metals, releasing flammable hydrogen gas. Capable of igniting finely divided combustible material on contact. Extremely hazardous in contact with many materials; *Stability During Transport*: Normally stable; *Neutralizing Agents for Acids and Caustics:* Cautious dilution with water, with protection against violent spattering. Diluted acid may be neutralized with lime or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oxalic Acid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Generates poisonous gases; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Lime or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Oxygen, Liquefied — Fire Hazards: *Flash Point (deg. F):* Not flammable, but supports combustion; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Increases intensity of any fire. Mixtures of liquid oxygen and any fuel are highly explosive; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Heat of water will vigorously vaporize liquid oxygen; *Reactivity with Common Materials*: Avoid organic and combustible materials, such as oil, grease, coal dust, etc. If ignited, such mixtures can explode. Low temperature may cause brittleness in some materials; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

P

Paraformaldehyde — Fire Hazards: *Flash Point (deg. F):* 199 OC; 160 CC; *Flammable Limits in Air (%):* (formaldehyde gas) 7.0 - 73.0; *Fire Extinguishing Agents*: Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Changes to formaldehyde gas which is highly flammable; *Ignition Temperature (deg. F)*: 572 (approx.); *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Forms water solution of formaldehyde gas; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Slowly decomposes to formaldehyde gas; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Parathion, Liquid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Water o adjacent fires; *Fire Extinguishing Agents Not to be Used:* High pressure water hoses may scatter parathion from broken containers, increasing contamination hazard; *Special Hazards of Combustion Products*: Fumes from decomposing material may contain oxides of sulfur and nitrogen; *Behavior in Fire*: Containers may explode when heated;

Ignition Temperature (deg. F): Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Slow reaction, not considered hazardous; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Pentaborane — Fire Hazards: *Flash Point (deg. F):* Not pertinent (ignites spontaneously in air); *Flammable Limits in Air (%):* 0.42 - 98; *Fire Extinguishing Agents*: Preferable let fire burn and shut off leak; extinguish with dry chemical or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Halogenated hydrocarbons, water; *Special Hazards of Combustion Products*: Toxic fumes may be formed; *Behavior in Fire*: Tends to re-ignite. Contact with water applied to adjacent fires produces flammable hydrogen gas; *Ignition Temperature (deg. F)*: Spontaneously flammable if impure. Approx. 35° C when pure; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts slowly to form flammable hydrogen gas. The reaction is not hazardous unless water is hot or unless confined; *Reactivity with Common Materials*: Corrosive to natural rubber, some synthetic rubbers, some greases and some lubricants; *Stability During Transport*: Stable below 302° F; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Pentacholrophenol Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Generates toxic and irritating vapors; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Pentadecanol — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Pentaerythritol — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Water, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 842 (dust cloud); *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Pentane — Fire Hazards: *Flash Point (deg. F):* -57 CC; *Flammable Limits in Air (%):* 1.4 - 8.3 (by vol.); *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may explode; *Ignition Temperature (deg. F)*: 544; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 8.6 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

1-Pentene — Fire Hazards: *Flash Point (deg. F):* - 60 CC; 0 OC; *Flammable Limits in Air (%):* 1.4 - 8.7; *Fire Extinguishing Agents*: Foam, dry chemical, or carbon dioxide. Stop flow of vapor; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may explode; *Ignition Temperature (deg. F)*: 527; *Electrical Hazard*: Data not available; *Burning Rate*: 9.1 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Peracetic Acid — Fire Hazards: *Flash Point (deg. F):* 104 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Vapors are very flammable and explosive. Liquid will detonate if concentration rises above 56% because of evaporation of acetic acid; *Ignition Temperature (deg. F)*: 392; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May cause fire in contact with organic materials such as wood, cotton or straw. Corrosive to most metals including aluminum; *Stability During Transport*: Stable if kept cool and out of contact with most metals. At 30°C concentration decreases about 0.4% each month; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Perchloric Acid — Fire Hazards: *Flash Point (deg. F):* Not flammable , but may explode in fire; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Water from protected area; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products*: Data not available; *Behavior in Fire*: Above 160°C (320° F) will react with combustible material and increase intensity of fire. Containers may explode; *Ignition Temperature (°F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Contact with most combustible materials may cause fires and explosions. Corrosive to most metals with formation of flammable hydrogen gas, which may collect in enclosed spaces; *Stability During Transport*: Unstable if heated; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with dilute sodium bicarbonate or soda ash solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Perchloromethyl — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Very irritating vapors formed from hot material. May form toxic phosgene gas, hydrogen chloride and sulfur dioxide; *Behavior in Fire*:

At elevated temperatures will decompose to carbon tetrachloride, sulfur chloride, and heavy oily polymers; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts only when hot to give carbon dioxide, hydrochloric acid, and sulfur; *Reactivity with Common Materials*: Reacts with iron or steel, evolving carbon tetrachloride. Corrosive to most metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with dilute sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Petrolatum — Fire Hazards: *Flash Point (deg. F):* 360 - 430 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Petroleum Naphtha — Fire Hazards: *Flash Point (deg. F):* 20 (approx.); *Flammable Limits in Air (%):* 0.9 - 6.0; *Fire Extinguishing Agents*: Foam carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 450 (approx.); *Electrical Hazard*: Not pertinent; *Burning Rate*: 4 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phenol — Fire Hazards: *Flash Point (deg. F):* 185 OC; 175 CC; *Flammable Limits in Air (%):* 1.7 - 8.6; *Fire Extinguishing Agents*: Water fog, dry chemical, carbon dioxide, foam; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Toxic and irritating vapors are generated when heated; *Behavior in Fire*: Yields flammable vapors when heated which form explosive mixtures with air; *Ignition Temperature (deg. F)*: 1319; *Electrical Hazard*: Not pertinent; *Burning Rate*: 3.5 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phenyldichloroarsine, Liquid — Fire Hazards: *Flash Point (deg. F):* Data not available; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Highly toxic arsenic fumes are formed when hot; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Data not available; *Burning Rate*: 1.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Very slow reaction, considered non-hazardous. Hydrochloric acid is formed; *Reactivity with Common Materials*: Corrodes metals because of acid formed; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phenylhydrazine Hydrochloride — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Water, foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products*: Toxic and irritating oxides of nitrogen and hydrogen chloride may form in fire; *Behavior in Fire*: The solid may sublime without melting and deposit on cool surfaces; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May be corrosive to metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phosgene — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Water to cool containers; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Toxic gas is generated when heated; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Decomposes, but not vigorously; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Can be absorbed in caustic soda solution. One ton of phosgene requires 2,480 lbs. of caustic soda dissolved in 1000 gal. of water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phosphoric Acid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Mild evolution of heat; *Reactivity with Common Materials*: Reacts with metals to liberate flammable hydrogen gas; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, neutralize with lime; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phosphorus Oxychloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Sand and carbon dioxide on adjacent fires; *Fire Extinguishing Agents Not to be Used:* Water; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Poisonous, corrosive, irritating gases are generated when heated or when in contact with water; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Vigorous reaction with evolution of hydrogen chloride fumes; *Reactivity with Common Materials*: Corrosive to most metals except nickel and lead. Products of its reaction with water rapidly corrode steel and most metals with formation of flammable hydrogen gas; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, neutralize acids formed with lime or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phosphorus Pentasulfide — Fire Hazards: *Flash Point (deg. F):* Flammable solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Sand and carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water; *Special Hazards of Combustion Products*: Products of combustion include sulfur dioxide and phosphorus pentoxide, which are irritating, toxic and corrosive; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 527 (liquid); *Electrical*

Hazard: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts with liquid water or atmospheric moisture to liberate toxic hydrogen sulfide gas; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Can be ignited by friction; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phosphorus, Red — Fire Hazards: *Flash Point (deg. F):* Flammable solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Heat may cause reversion to yellow phosphorus which is toxic and spontaneously flammable upon contact with air. Burning yields toxic oxides of phosphorus; *Behavior in Fire*: Refer to 6.5; *Ignition Temperature (deg. F)*: 395; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Avoid uncontrolled contact with oxidizing agents (chlorates, nitrates, halogens, etc.) or with strong alkaline hydroxides. Can react violently with oxidizing agent in presence of air and moisture, liberating phosphorus acids and toxic, spontaneously flammable phosphine gas; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phosphorus Tribromide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Do not use water on adjacent fire; *Special Hazards of Combustion Products*: Irritating hydrogen bromide and phosphoric acid vapors may form in fire; *Behavior in Fire*: Acids formed by reaction with water will attack metals and generate flammable hydrogen gas, which may form explosive mixtures in enclosed spaces; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts violently with water, evolving hydrogen bromide, an irritating and corrosive gas apparent as white fumes; *Reactivity with Common Materials*: In the presence of moisture, highly corrosive to most metals except lead and nickel; *Stability During Transport*: Unstable if heated; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with dilute aqueous sodium bicarbonate or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phosphorus Trichloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Sand, carbon dioxide and dry chemicals on adjacent fires; *Fire Extinguishing Agents Not to be Used:* Water; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Generates toxic, irritating gases; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Reacts violently and may cause flashes of fire. Hydrochloric acid fumes are formed in the reaction; *Reactivity with Common Materials*: Corrodes most common construction materials. Reacts with water to form hydrochloric acid, which reacts with most metals to form flammable hydrogen gas; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; neutralize acids formed with lime or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phosphorus White — Fire Hazards: *Flash Point (deg. F):* Ignites spontaneously in air; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Fumes from burning phosphorus are highly irritating; *Behavior in Fire*: Intense white smoke is formed; *Ignition*

Temperature (deg. F): 86; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Ignites when exposed to air; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Phthalic Anhydride — Fire Hazards: *Flash Point (deg. F):* 329 OC; 305 CC; *Flammable Limits in Air (%):* 1.7 - 10.5; *Fire Extinguishing Agents*: Water fog, dry chemical, carbon dioxide, or foam; *Fire Extinguishing Agents Not to be Used:* Water may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 1058; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: Solid has very slow reaction; no hazard. Liquid spatters when in contact with water; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Water and sodium bicarbonate; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Piperazine — Fire Hazards: *Flash Point (deg. F):* 225 OC (molten solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Water, dry chemical, "alcohol" foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may cause frothing; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fires; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: 851; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: May be corrosive to aluminum, magnesium and zinc; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Polybutene — Fire Hazards: *Flash Point (deg. F):* 215 - 470 OC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Carbon dioxide, dry chemical, or foam; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Polychlorinated Biphenyl — Fire Hazards: *Flash Point (deg. F):* >286; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Irritating gases are generating in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Polymethylene Polyphenyl Isocyanate — Fire Hazards: *Flash Point (deg. F):* 425 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may explode; *Ignition Temperature (deg. F)*:

Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: Reacts slowly, forming heavy scum and liberating carbon dioxide gas. Dangerous pressure can build up if container is sealed; *Reactivity with Common Materials*: No hazardous reaction unless confined and wet; *Stability During Transport*: Stable if kept sealed and dry; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Polyphosphoric Acid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Reacts with water to generate heat and form phosphoric acid. The reaction is not violent; *Reactivity with Common Materials*: Reacts with metals to liberate flammable hydrogen gas; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, neutralize acid with lime or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Polypropylene — Fire Hazards: *Flash Point (deg. F):* Not pertinent (combustible solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Foam, dry chemical, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Data not available; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity**: *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Polypropylene Glycol — Fire Hazards: *Flash Point (deg. F):* 390 - 495 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Water, dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Potassium, Metallic — Fire Hazards: *Flash Point (deg. F):* Not pertinent. This is a combustible solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Graphite, sand, sodium chloride; *Fire Extinguishing Agents Not to be Used:* Water, foam, carbon dioxide, or halogenated hydrocarbons; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: Reacts violently with water, forming flammable and explosive hydrogen gas. This product may spontaneously ignite in air; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts violently forming flammable hydrogen gas and a strong caustic solution; *Reactivity with Common Materials*: May ignite combustible materials if they are damp or moist; *Stability During Transport*: Stable if protected from air and moisture; *Neutralizing Agents for Acids and Caustics:* Caustic that is formed by the reaction with water should be flushed with water and then can be rinsed with dilute acetic acid solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Potassium Arsenate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Potassium Binoxalate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Below 50 °C product dissolves in water and reacts to form the precipitate potassium tetraoxalate; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Potassium Cyanide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not flammable; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: When potassium cyanide dissolves in water, a mild reaction occurs and poisonous hydrogen cyanide gas is released. The gas readily dissipates, however if it collects in a confined space, then workers may be exposed to toxic levels. If the water is acidic, toxic amounts of the gas will form instantly; *Reactivity with Common Materials*: Contact with even weak acids will result in the formation of deadly hydrogen cyanide gas; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Potassium Dichloro-s-Triazinetrione — Fire Hazards: *Flash Point (deg. F):* Not flammable but may cause fires upon contact with ordinary combustibles; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: May form toxic chlorine and other gases in fires; *Behavior in Fire*: Decomposition can be initiated with a heat source and can propagate throughout the mass with the evolution of dense fumes. Containers may also explode when exposed to the heat from adjacent fires; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: A non violent reaction occurs resulting in the formation of a bleach solution; *Reactivity with Common Materials*: Contact with most foreign materials, organic matter, or easily chlorinated or oxidized materials may result in fire. Avoid contact with oils, greases, sawdust, floor sweepings, and other easily oxidized organic compounds; *Stability During Transport*: Stable if kept dry; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Potassium Dichromate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Flood the spill area with water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: May decompose, generating oxygen and hence supports the combustion of other materials; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Ignition may occur when the product is in contact with finely divided combustibles, such as sawdust; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Potassium Hydroxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: Dissolves with the liberation of much heat. Steam and violent agitation can be observed in the reaction; *Reactivity with Common Materials*: When wet, this material attacks metals such as aluminum, tin, lead, and zinc, producing flammable hydrogen gas; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and rinse with a dilute solution of acetic acid; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Potassium Iodide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Corrosive in all concentrations to most metals, except stainless steels, titanium, and tantalum; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Potassium Oxalate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Loses water at about 160 °C and decomposes to carbonate with no charring. The reaction is considered non hazardous; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Potassium Permanganate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Flood spill area with water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: May cause fire on contact with combustibles. Also containers may e; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Attacks rubber and most fibrous materials. May cause ignition of organic materials such as wood. Some acids, suchas sulfufic acid, may result in explosion; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Potassium Peroxide — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Flood with water from a protected area; *Fire Extinguishing Agents Not To Be Used:* A small amount of water may cause an explosion; *Special Hazards of Combustion Products:* No data; *Behavior in Fire:* Increases intensity of fire and can start fires when in contact with organic materials; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently with liberation of heat and oxygen and the formation of caustic solution; *Reactivity with Common Materials:* Forms explosive and self-igniting mixtures with wood and other combustible materials; *Stability During Transport:* Stable if kept dry; *Neutralizing Agents for Acids and Caustics:* Following the reaction with water, the caustic solution formed can be flushed away with water and area rinsed with dilute acetic acid; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Propane — Fire Hazards: *Flash Point (deg. F):* -156 CC; *Flammable Limits in Air (%):* 2.1 - 9.5; *Fire Extinguishing Agents:* Stop the flow of gas. For small fires, use dry chemicals. Cool adjacent areas with water spray; *Fire Extinguishing Agents Not To Be Used:* Water; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode. Vapor is heavier than air and can travel considerable distances to a source of ignition and flash back; *Ignition Temperature (deg. F):* 842; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 8.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common* Materials: No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

beta-Propiolactone — Fire Hazards: *Flash Point (deg. F):* 165 CC; *Flammable Limits in Air (%):* 2.9 (LEL); *Fire Extinguishing Agents:* Water, dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Vapors of unburned material are highly toxic; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* A slow, non-hazardous reaction occurs forming beta-hydroxypropionic acid; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Can polymerize and rupture containers especially at elevated temperatures. At 22 °C, approximately 0.04 % polymerizes per day; *Inhibitor of Polymerization:* None reported in the literature.

Propionaldehyde — Fire Hazards: *Flash Point (deg. F):* -22 OC; *Flammable Limits in Air (%):* 2.6 - 16.1; *Fire Extinguishing Agents:* On small fires use carbon dioxide or dry chemical. For large fires use alcohol type foam; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to source of ignition and flash back; *Ignition Temperature (deg. F):* 405; *Electrical Hazard:* Not pertinent; *Burning Rate:* 4.4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Polymerizes in the presence of acids and caustics; *Inhibitor of Polymerization:* Not pertinent.

Propionic Acid — Fire Hazards: *Flash Point (deg. F):* 134 OC, 130 CC; *Flammable Limits in Air (%):* 2.9 - 14.8; *Fire Extinguishing Agents:* Water, carbon dioxide, dry chemical, or alcohol foam; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:*

Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 1105; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Corrodes ordinary steel and many other metals. Reaction is non-violent and generally not hazardous; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Dilute with water then neutralize with lime solution or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Propionic Anhydride — Fire Hazards: *Flash Point (deg. F):* 136 OC, 145 CC; *Flammable Limits in Air (%):* 1.48 - 11.9; *Fire Extinguishing Agents:* Water, dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 545; *Electrical Hazard:* No data; *Burning Rate:* 3.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts slowly forming weak propionic acid. The reaction is non-violent and non-hazardous; *Reactivity with Common Materials:* Slowly forms a corrosive material if wet; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

n-Propyl Acetate — Fire Hazards: *Flash Point (deg. F):* 58 CC, 65 OC; *Flammable Limits in Air (%):* 2.0 - 8.0; *Fire Extinguishing Agents:* For small fires use carbon dioxide or dry chemical. For large fires, use alcohol foam; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 842; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

n-Propyl Alcohol — Fire Hazards: *Flash Point (deg. F):* 81 OC, 77 CC; *Flammable Limits in Air (%):* 2.1 - 13.5; *Fire Extinguishing Agents:* Carbon dioxide for small fires, and alcohol foam for large fires; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 700; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 2.9 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Propylene — Fire Hazards: *Flash Point (deg. F):* -162 CC; *Flammable Limits in Air (%):* 2.0 - 11; *Fire Extinguishing Agents:* Stop the flow of gas; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode. Vapors are heavier than air and can travel to a source of ignition and flash back; *Ignition Temperature (deg. F):* 927; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 8 mm/min as liquid. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Propylene Glycol — Fire Hazards: *Flash Point (deg. F):* 210 CC, 225 OC; *Flammable Limits in Air (%):* 2.6 - 12.5; *Fire Extinguishing Agents:* Water fog, alcohol foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 790; *Electrical Hazard:* Not pertinent; *Burning Rate:* 1.5 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Propylene Oxide — Fire Hazards: *Flash Point (deg. F):* -35 CC, -20 OC; *Flammable Limits in Air (%):* 2.1 - 38.5; *Fire Extinguishing Agents:* Carbon dioxide or dry chemical for small fires. Alcohol or polymer foam for large fires.; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may explode. Vapors are heavier than air and can travel to a source of ignition and flash back; *Ignition Temperature (deg. F):* 869; *Electrical Hazard:* Class I, Group B; *Burning Rate:* 3.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Polymerization can occur when this product is exposed to high temperatures or is contaminated with alkalies, aqueous acids, amines, and acidic alcohols; *Inhibitor of Polymerization:* Not pertinent.

Propylene Tetramer — Fire Hazards: *Flash Point (deg. F):* 120 CC, 134 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Water fog, foam, carbon dioxide or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 400; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Propyleneimine, Inhibited — Fire Hazards: *Flash Point (deg. F):* 25 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may be ineffective; *Special Hazards of Combustion Products:* Irritating nitrogen oxides are generated in fires; *Behavior in Fire:* Containers may explode when exposed to heat; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* 4.1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* A slow, non-hazardous reaction occurs, forming propanolamine; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* The product is stable if it is kept in contact with solid caustic soda (sodium hydroxide); *Neutralizing Agents for Acids and Caustics:* Dilute with water and rinse with vinegar solution; *Polymerization:* This material will polymerize explosively when in contact with any acid; *Inhibitor of Polymerization:* Solid sodium hydroxide (caustic soda).

n-Propyl Mercaptan — Fire Hazards: *Flash Point (deg. F):* 5 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic vapors of sulfur dioxide are generated; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* 5.1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability*

During Transport: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Pyridine — Fire Hazards: *Flash Point (deg. F):* 68 CC; *Flammable Limits in Air (%):* 1.8 - 12.4; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 900; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 4.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Pyrogallic Acid — Fire Hazards: *Flash Point (deg. F):* Not pertinent; this is a combustible solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reactions; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Q

Quinoline — Fire Hazards: *Flash Point (deg. F):* 225 CC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Water, dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen form in fires; *Behavior in Fire:* Exposure to heat can result in pressure build-up in closed containers, resulting in bulging or even explosion; *Ignition Temperature (deg. F):* 896; *Electrical Hazard:* No data; *Burning Rate:* 4.1 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Attacks some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

S

Salicylic Acid — Fire Hazards: *Flash Point (deg. F):* Not pertinent; this is a combustible solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Application of water or foam may cause frothing; *Special Hazards of Combustion Products:* Irritating vapors of unburned product and phenol form during fires; *Behavior in Fire:* This product sublimes and forms vapor or dust that can explode; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Selenium Dioxide — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* This product sublimes and forms toxic vapors when heated in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* In presence of water will corrode most metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Selenium Trioxide — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts vigorously with water forming selenic acid solution; *Reactivity with Common Materials:* Corrodes all metals in the presence of water; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and rinse with dilute solution of sodium bicarbonate or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Silicon Tetrachloride - Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Do not apply water or foam on adjacent fires; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Contact with water or foam applied to adjacent fires results in the formation of toxic and irritating fumes of hydrogen chloride; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts vigorously with water forming hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* In the presence of moisture, will corrode metals. The reaction is generally non-hazardous; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Silver Acetate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Silver Carbonate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Decomposes to silver oxide, silver, and carbon dioxide. The reaction is non violent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Silver Fluoride — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Silver Iodate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Silver Nitrate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Increases the flammability of combustible materials; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Silver Oxide — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Decomposes into metallic silver and oxygen. If large amounts of the product are involved in a fire, the oxygen liberated may increase the intensity of the fire; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Silver Sulfate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids*

and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium — Fire Hazards: *Flash Point (deg. F):* Not pertinent; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry soda ash, graphite, salt, or other approved dry powder such as dry limestone; *Fire Extinguishing Agents Not To Be Used:* Water, carbon dioxide, or halogenated extinguishing agents; *Special Hazards of Combustion Products:* The fumes of burning sodium are highly irritating to the eyes, skin, and mucous membranes.; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 250; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Sodium reacts violently with water, forming flammable hydrogen gas, and caustic soda solution. Fire often accompanies the reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* After the reaction with water, the caustic soda formed as a by-product can be diluted with water and then neutralized with acetic acid; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Alkylbenzenesulfonates — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Irritating vapors form in fires; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Alkyl Sulfates — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating vapors are generated in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Amide — Fire Hazards: *Flash Point (deg. F):* Flammable solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry soda ash, graphite, salt, or other recommended dry powder such as dry limestone; *Fire Extinguishing Agents Not To Be Used:* Water; *Special Hazards of Combustion Products:* Toxic and irritating ammonia gas may be formed in fires; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* No data; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently and often bursts into flames. Also forms caustic soda solution; *Reactivity with Common Materials:* No data; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* The caustic solution formed by the reaction with water can be diluted with water and then neutralized by acetic acid; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Arsenate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not*

To Be Used: Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* No information; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Arsenite — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic arsenic fumes may form. The use of self-contained breathing apparatus (SCBA) is recommended; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Azide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* May form toxic hydrazoic acid fumes in fires; *Behavior in Fire:* Containers may explode; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Dissolves to form an alkaline solution. The reaction is non-violent; *Reactivity with Common Materials:* Forms explosion-sensitive materials with some metals such as lead, silver, mercury, and copper; *Stability During Transport:* Stable but must not be in contact with acids; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Bisulfite — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Borate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* The compound melts into a glassy material that may flow in large quantities and ignite combustible materials it comes in contact with; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Borohydride — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Graphite, limestone, soda ash, sodium chloride powders; *Fire Extinguishing Agents Not To Be Used:* Water, carbon dioxide, or halogenated extinguishing agents; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Decomposes and produces highly flammable hydrogen gas; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts to form flammable hydrogen gas; *Reactivity with Common Materials:* Reacts with acids to form toxic, flammable diborane gas. Slowly attacks and destroys glass; *Stability During Transport:* Stable unless contaminated with acids or is overheated, thereby forming flammable hydrogen gas; *Neutralizing Agents for Acids and Caustics:* Caustic formed by the reaction with water can be diluted with water and then neutralized with acetic acid; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Cacodylate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Arsenic containing fumes are formed in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Corrodes many common metals but the reaction is non-hazardous; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Chlorate — Fire Hazards: *Flash Point (deg. F)*: Not flammable but the product will support combustion; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water; *Fire Extinguishing Agents Not To Be Used:* Fire blankets; *Special Hazards of Combustion Products:* In fire situations, oxygen is liberated which can increase the intensity of fires; *Behavior in Fire:* The product melts and then decomposes giving off oxygen gas that increases the intensity of fires. This product reacts explosively, either as a solid or liquid with all organic matter and some metals; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Chlorates are powerful oxidizing agents and can cause explosions when heated or rubbed with wood, organic matter, sulfur, and many metals. Even water solutions react in this manner if the solution is more than 30% concentrated, especially when warm; *Stability During Transport:* This product begins decomposing at 572 of with the evolution of oxygen gas. The decomposition may become self-sustaining. Oxygen liberation will increase the intensity of fires; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Chromate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic chromium oxide fumes may form in fires; *Behavior in Fire:* Can increase the intensity of fires when in contact with combustible materials; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Causes fire when in contact with combustible materials; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Cyanide — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* When sodium cyanide dissolves in water, a mild reaction occurs and some poisonous hydrogen cyanide gas is liberated. The gas is not generally a concern unless it is generated in an enclosed space. If the water is acidic, then large amounts of the toxic gas forms rapidly; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Dichromate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Flood with large amounts of water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Decomposes to produce oxygen upon heating. May ignite other combustibles upon contact; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* When in contact with finely divided combustibles, such as sawdust, ignition may occur; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Ferrocyanide — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Flood with large amounts of water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Decomposes to produce oxygen upon heating. May ignite other combustibles upon contact; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* When in contact with finely divided combustibles, such as sawdust, ignition may occur; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Hydride — Fire Hazards: *Flash Point (deg. F)*: Oil is flammable; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Powdered limestone and nitrogen-propelled dry powder; *Fire Extinguishing Agents Not To Be Used:* Water, soda ash, chemical foam, or carbon dioxide; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Accidental contact with water used to extinguish surrounding fires will result in the release of hydrogen gas and possible explosion; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts vigorously with water with the release of flammable hydrogen gas; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable at temperatures below 225 °C; *Neutralizing Agents for Acids and Caustics:* Neutralize only when accidental reaction with water is complete. Do not neutralize the flammable solid with aqueous solutions. Spent reaction solution may be neutralized with dilute solutions of acetic acid.; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Hydrosulfide Solution — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Corrodes most metals, but the reactions are generally non-hazardous; *Stability During Transport:* No reaction; *Neutralizing Agents for Acids and Caustics:* Flood with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Hydroxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* Dissolves with the liberation of considerable heat. The reaction violently produces steam and agitation; *Reactivity with Common Materials:* When wet, attacks metals such as aluminum , tin, lead, and zinc to produce flammable hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water, rinse with dilute acetic acid; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Hypochlorite — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* May decompose, generating irritating chlorine gas; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Destroy with sodium bisulfite or hypo and water, then neutralize with soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Methylate — Fire Hazards: *Flash Point (deg. F):* Not pertinent; this is a flammable solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry chemical, inert powders such as sand or limestone, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water, foam; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Contact with water or foam adjacent to fires will produce flammable mathanol; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Produces a caustic soda solution and a solution of methyl alcohol. The reaction is not violent; *Reactivity with Common Materials:* Attacks some polymers such as nylon and polyesters; *Stability During Transport:* Stable if kept dry; *Neutralizing Agents for Acids and Caustics:* Water followed by dilute acetic acid or vinegar; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Nitrite — Fire Hazards: *Flash Point (deg. F):* Not flammable, but may intensify fires; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Apply large amounts of water to adjacent fires. Cool exposed containers with water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen may form in fires; *Behavior in Fire:* May increase the intensity of fires if the chemical is in contact with combustible materials. This product may melt and flow at elevated temperatures; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Oxalate -Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Phosphate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* May melt with the loss of steam; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* All variations or grades of this chemical readily dissolve in water. ASPP and MSP form weakly acidic solutions. TSP forms a strong caustic solution, similar to soda lye: TSPP forms weekly alkali solution; *Reactivity with Common Materials:* When wet, MSP, ASPP, and TSP corrodes mild steel or brass. Others are not considered corrosive; *Stability During Transport:* All forms of sodium phosphate are stable. TSP tends to be hygroscopic and will form a hard cake; *Neutralizing Agents for Acids and Caustics:* For those grades of sodium hydroxide that form acidic or alkali solutions, dilution by water is recommended; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Silicate — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Silicofluoride — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Decomposes at red heat; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Sulfide — Fire Hazards: *Flash Point (deg. F)*: Moderately flammable solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating fumes of sulfur dioxide are generated in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Sulfite — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sodium Thiocyanate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating oxides of sulfur and nitrogen form in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sorbitol — Fire Hazards: *Flash Point (deg. F):* 542; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Water; *Fire Extinguishing Agents Not To Be Used:* Not data; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Stearic Acid — Fire Hazards: *Flash Point (deg. F):* 410 ~ 435 OC, 365 CC (as molten solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* No data; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* 743; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Styrene — Fire Hazards: *Flash Point (deg. F):* 93 OC, 88 CC; *Flammable Limits in Air (%):* 1.1 - 6.1; *Fire Extinguishing Agents:* Water fog, foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. At elevated temperatures as under fire conditions, polymerization may occur, resulting in containers exploding; *Ignition Temperature (deg. F):* 914; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 5.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction;

Reactivity with Common Materials: No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Polymerization can occur if the product's temperature is raised above 150 of. This can cause the rupture of containers. Avoid contact with metal salts, peroxides, and strong acids, which can cause polymerization to occur; *Inhibitor of Polymerization:* Tertiarybutylcatechol (10 ~ 15 ppm).

Sucrose — Fire Hazards: *Flash Point (deg. F):* Not pertinent; this is a combustible solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating fumes may form in fire situations; *Behavior in Fire:* The product melts and chars; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sulfolane — Fire Hazards: *Flash Point (deg. F):* 330 CC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Water, foam, dry chemicals, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating gases may form in fire situations; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sulfur Dioxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Containers may rupture, releasing toxic and irritating sulfur dioxide; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts non-violently with water to form corrosive acid; *Reactivity with Common Materials:* Corrodes aluminum; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* The mild acidity of water solution may be neutralized by dilute caustic soda; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sulfuric Acid — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Water used on adjacent fires should be carefully handled; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not flammable; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* None; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently with the evolution of heat (exothermic reaction). Significant agitation and spattering occurs when water is added to the chemical; *Reactivity with Common Materials:* Sulfuric acid is extremely hazardous in contact with many materials, particularly metals and combustibles. Dilute acid reacts with most metals, releasing hydrogen which can form explosive mixtures with air in confined spaces; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Dilute with large amounts of water, then neutralize with lime, limestone, or soda ash; *Polymerization:* Not flammable; *Inhibitor of Polymerization:* Not flammable.

Sulfuric Acid, Spent — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction, unless strength is above 80 ~ 90 %, in which case an exothermic reaction will occur. See sulfuric acid; *Reactivity with Common Materials:* Attacks many metals, releasing flammable hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Neutralize with limestone, lime, or soda ash after further dilution with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sulfur (Liquid) — Fire Hazards: *Flash Point (deg. F):* 405 CC; for recovered sulfur, see hydrogen sulfide; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Produces toxic sulfur dioxide gas; *Behavior in Fire:* Burns with a pale blue flame that is often difficult to see in daylight; *Ignition Temperature (deg. F):* 450 (for recovered sulfur, refer to hydrogen sulfide); *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No hazardous reactions noted; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sulfur Monochloride — Fire Hazards: *Flash Point (deg. F):* 245 CC, 266 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide, or water spray; *Fire Extinguishing Agents Not To Be Used:* Water reacts violently with this chemical; *Special Hazards of Combustion Products:* Toxic and corrosive fumes evolve upon heating; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 453; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently with water generating considerable heat and hydrogen chloride fumes. The resulting solution is a strong acid; *Reactivity with Common Materials:* As a liquid, it dissolves rubbers and plastics. After the reaction with water, the strong acid will attack metals, generating flammable hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* After reaction with water, the acid formed can be neutralized with lime or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Sulfuryl Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Water applied to adjacent fires should be handled carefully; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Toxic and irritating gases will form in fire situations; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* Reacts vigorously with water, releasing hydrogen chloride fumes and forming corrosive sulfuric acid; *Reactivity with Common Materials:* Acids formed by the reaction with moisture corrode metals and liberate flammable hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Acid formed by the reaction with water can be neutralized by limestone, lime, or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

T

Tallow — Fire Hazards: *Flash Point (deg. F)*: 509; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Foam, water, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water or foam can cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tallow Fatty Alcohol — Fire Hazards: *Flash Point (deg. F)*: > 270 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tannic Acid — Fire Hazards: *Flash Point (deg. F)*: Not pertinent; this is a combustible solid; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* This product decomposes at about 210 of to carbon dioxide and pyrogallol, which can form highly irritating vapors; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* 980; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2,4,5-T (Esters) — Fire Hazards: *Flash Point (deg. F)*: 265 ~ 420 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Hydrogen chloride gas as well as other irritating fumes may form in fire situations; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Incompatible with some plastics and elastomers; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Terabutyl Titanate — Fire Hazards: *Flash Point (deg. F)*: 170 CC; *Flammable Limits in Air (%):* 2 - 12; *Fire Extinguishing Agents:* Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* May give off a dense white smoke. Containers may explode; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* 3.4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts to form butanol and titanium dioxide. The reaction is non-violent; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids

and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tetrachloroethane — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating hydrogen chloride vapor can form in fire situations; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Attacks some forms of plastics and elastomers; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tetrachloroethylene — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating vapors may form in fire situations; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tetradecanol — Fire Hazards: *Flash Point (deg. F):* 285 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1-Tetradecene — Fire Hazards: *Flash Point (deg. F):* 230 CC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 455; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tetradecylbenzene — Fire Hazards: *Flash Point (deg. F):* No data; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* No data; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* 4.4 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tetraethyl Dithiopyrophosphate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Water, dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic phosphorous and sulfur oxides are formed in fire situations; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* A slow reaction occurs forming non-hazardous by-products; *Reactivity with Common Materials:* Corrosive to most metals in the presence of moisture; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tetraethylene Glycol — Fire Hazards: *Flash Point (deg. F):* 360 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* No data; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics and elastomers; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tetraethylenepentamine — Fire Hazards: *Flash Point (deg. F):* 340 OC; *Flammable Limits in Air (%):* 0.8 - 4.6; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Ammonia and toxic oxides of nitrogen may form in fires; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* 572; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics and elastomers; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tetraethyl Lead — Fire Hazards: *Flash Point (deg. F):* 200 CC, 185 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic gases are generated in fire situations; *Behavior in Fire:* Product may explode in fires; *Ignition Temperature (deg. F):* Decomposes at temperatures above 230 of; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Contact with rust and some metals can cause decomposition of the product; *Stability During Transport:* The product is stable at temperatures below 230 of. At higher temperatures, the product may detonate or explode when confined; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tetraethyl Pyrophosphate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Highly toxic gases and vapors of unburned material and phosphoric acid are formed in fire situations; *Behavior in Fire:* Water streams applied to adjacent fires will spread the contamination of this pesticide over a wide area; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts slowly to form phosphoric acid;

Reactivity with Common Materials: Corrosive to aluminum; slowly corrosive to copper, brass, zinc, and tin; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and then rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tetrafluoroethylene, Inhibited — Fire Hazards: *Flash Point (deg. F):* Not pertinent (gas); *Flammable Limits in Air (%):* 10 - 50; *Fire Extinguishing Agents:* Allow fire to burn itself out; stop the flow of gas if practicable; cool containers with water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* When burned in air, the gas forms toxic carbonyl fluoride and hydrogen fluoride; *Behavior in Fire:* Vapor is heavier than air and can travel distances to a source of ignition and flash back. Containers may explode; *Ignition Temperature (deg. F):* 370; *Electrical Hazard:* C_2F_4-air mixtures produce explosions which propagate through the smallest clearances. Product does not meet any group classification; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Can polymerize in the absence of inhibitor, especially when heated or in the presence of air; *Inhibitor of Polymerization:* d-limonene; pinene; tetrahydronaphthalene; 1-octene; methyl methacrylate.

Tetrahydrofuran — Fire Hazards: *Flash Point (deg. F):* 6 CC, -4 OC; *Flammable Limits in Air (%):* 1.8 - 11.8; *Fire Extinguishing Agents:* Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Irritating vapors are generated upon heating; *Behavior in Fire:* Product may explode. Vapor is heavier than air and can travel distances to a source of ignition and flash back; *Ignition Temperature (deg. F):* 610; *Electrical Hazard:* Not pertinent; *Burning Rate:* 4.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable unless about 0.1% of peroxides has accumulated because of prolonged storage in the presence of air. When concentrated by evaporation of solution, the product can explode; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* 0.025 % butylated hydroxytoluene (BHT) present to prevent peroxide formation.

Tetrahydronaphthalene — Fire Hazards: *Flash Point (deg. F):* 176 CC, 190 OC; *Flammable Limits in Air (%):* 0.8 - 5.0; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Avoid contact with water; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 725; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tetramethyl Lead — Fire Hazards: *Flash Point (deg. F):* 100 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic gases are generated in fires; *Behavior in Fire:* May explode; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* The product starts to decompose at around 212 of. If the decomposition occurs in a confined space, an explosion hazard can exist; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Thiophosgene — Fire Hazards: *Flash Point (deg. F):* No data; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water, foam; *Special Hazards of Combustion Products:* Toxic phosgene, hydrogen chloride, and sulfur dioxide may form in fire situations; *Behavior in Fire:* Product decomposes at temperatures above 200 °C to carbon bisulfide, which is extremely flammable, and carbon tetrachloride; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* In cold water, a slow reaction occurs forming hydrogen chloride, carbon disulfide, and carbon dioxide. In hot water, the reaction is accelerated; *Reactivity with Common Materials:* Corrodes metals in the presence of moisture; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization* Not pertinent.

Thiram — Fire Hazards: *Flash Point (deg. F):* Not pertinent (solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating oxides of sulfur are formed. Carbon disulfide may be formed from unburned material; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Thorium Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable, but may cause fire on contact with ordinary combustibles; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Releases toxic gaseous oxides of nitrogen in fire situations; *Behavior in Fire:* When large amounts of this product are involved in a fire situation, nitrate may fuse or melt, in which condition the application of water may result in extensive scattering of the molten material. The result is also an increase in the intensity of the fire; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* A non-violent reaction occurs, forming a weak solution of nitric acid; *Reactivity with Common Materials:* In the presence of easily oxidizable materials, may react rapidly causing possible ignition, violent combustion, or an explosion. Solutions in water are acidic and can corrode metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Titanium Tetrachloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Dry powder or carbon dioxide on adjacent fires; *Fire Extinguishing Agents Not To Be Used:* Do not use water if it can directly contact this chemical; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* If containers leak, a very dense white fume can form and obscure operations; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not flammable. **Chemical Reactivity:** *Reactivity with Water:* Reacts with moisture in air forming a dense white fume. Reaction with liquid water gives off heat and forms hydrochloric acid; *Reactivity with Common Materials:* The acid formed by reaction with moisture attacks metals, forming flammable hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Acid formed by the reaction with water can be neutralized by limestone, lime, or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Toluene — Fire Hazards: *Flash Point (deg. F):* 40 CC, 55 OC; *Flammable Limits in Air (%):* 1.27 - 7.0; *Fire Extinguishing Agents:* Carbon dioxide or dry chemical for small fire; ordinary foam for large fires; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapors are heavier than air and may travel considerable distances to a source of ignition and flash back; *Ignition Temperature (deg. F):* 997; *Electrical Hazard:* Class I, Group D; *Burning Rate:* 5.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Toluene 2,4-Diisocyanate — Fire Hazards: *Flash Point (deg. F):* 270 OC; *Flammable Limits in Air (%):* 0.9 - 9.5; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Irritating vapors are generated upon heating; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* > 300; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* A non violent reaction occurs forming carbon dioxide gas and an organic base; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Slow polymerization occurs at temperatures above 113 of. The reaction is not hazardous; *Inhibitor of Polymerization:* Not pertinent.

p-Toluenesulfonic Acid — Fire Hazards: *Flash Point (deg. F):* Not pertinent; this is a solid with low flammability; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Irritating oxides of sulfur may be formed; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* This is a strong acid that can react with common materials; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

o-Toluidine — Fire Hazards: *Flash Point (deg. F):* 167 OC, 85 CC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic oxides of nitrogen and flammable vapors may form; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* 900; *Electrical Hazard:* No data; *Burning Rate:* 3.6 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Toxaphene — Fire Hazards: *Flash Point (deg. F)*: 84 CC (solution); *Flammable Limits in Air (%):* 1.1 - 6.4; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Toxic vapors are generated when heated; *Behavior in Fire:* Solution in xylene may produce corrosive products when heated; *Ignition Temperature (deg. F):* 986 (solution); *Electrical Hazard:* Not pertinent; *Burning Rate:* 5.8 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Trichloroethane — Fire Hazards: *Flash Point (deg. F)*: No data; *Flammable Limits in Air (%):* 7 - 16; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating gases are formed in fire situations; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 932; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.9 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts slowly to form corrosive hydrochloric acid; *Reactivity with Common Materials:* Corrodes aluminum. The reaction is non-hazardous; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Trichloroethylene — Fire Hazards: *Flash Point (deg. F)*: 90 CC; practically nonflammable; *Flammable Limits in Air (%):* 8.0 - 10.5; *Fire Extinguishing Agents:* Water fog; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and irritating vapors are produced in fire situations; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 770; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reaction; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Trichlorofluoromethane — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Produces toxic and irritating vapors when heated to its decomposition temperature; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not flammable; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Trichlorophenol — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:*; *Special Hazards of Combustion Products:*; *Behavior in Fire:*; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

2,4,5-Trichlorophenoxy Acetic Acid — Fire Hazards: *Flash Point (deg. F)*: Not pertinent (solid); *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic hydrogen chloride and phosgene gases; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* Can be corrosive to common metals; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Trichlorosilane — Fire Hazards: *Flash Point (deg. F)*: -18 OC, > -58 CC; *Flammable Limits in Air (%):* 1.2 - 90.5; *Fire Extinguishing Agents:* Dry chemical, carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water, foam; *Special Hazards of Combustion Products:* Toxic hydrogen chloride and phosgene gases may form; *Behavior in Fire:* Difficult to extinguish; reignition may occur. Also, vapor is heavier than air and can travel to a source of ignition and flash back; *Ignition Temperature (deg. F):* 220; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently to form hydrogen chloride fumes (hydrochloric acid); *Reactivity with Common Materials:* Reacts with surface moisture to form hydrochloric acid which corrodes metals and generates flammable hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Trichloro-s-Triazinetrione — Fire Hazards: *Flash Point (deg. F)*: Not flammable but may cause fire on contact with ordinary combustible materials; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water in large amounts; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic chlorine or nitrogen trichloride may be formed in fires; *Behavior in Fire:* Containers may explode when heated; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* A non-hazardous reaction occurs forming a bleach solution; *Reactivity with Common Materials:* Contact with most foreign material, organic matter, or easily chlorinated or oxidized materials may result in fires. Avoid contacting this product with oil, sawdust, floor sweepings, other easily oxidized organic compounds; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tricresyl Phosphate — Fire Hazards: *Flash Point (deg. F)*: 410 CC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tridecanol — Fire Hazards: *Flash Point (deg. F)*:250 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Alcohol, dry chemical, water fog; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent;

Behavior in Fire: Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1-Tridecene — Fire Hazards: *Flash Point (deg. F):* 175 (est.); *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Triethanolamine — Fire Hazards: *Flash Point (deg. F):* 355 CC, 375 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Dilute with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Triethylaluminum — Fire Hazards: *Flash Point (deg. F):* Spontaneously ignites in air at all temperatures; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Inert powders such as limestone or sand, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water, foam, halogenated extinguishing agents; *Special Hazards of Combustion Products:* Intense smoke may cause metal-fume fever; *Behavior in Fire:* Dense smoke of aluminum oxide is formed. Contact with water on adjacent fires causes violent reaction producing toxic and flammable gases; *Ignition Temperature (deg. F):* Not pertinent - product spontaneously ignites at ambient temperature; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently to form flammable ethane gas; *Reactivity with Common Materials:* No significant reactions reported; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Triethylamine — Fire Hazards: *Flash Point (deg. F):* 20 OC; *Flammable Limits in Air (%):* 1.2 - 8.0; *Fire Extinguishing Agents:* Carbon dioxide or dry chemicals for small fires; alcohol foam for large fires; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 842; *Electrical Hazard:* Not pertinent; *Burning Rate:* 6.2 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Dilute with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Triethylbenzene — Fire Hazards: *Flash Point (deg. F):* 181 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical, foam, or carbon dioxide; *Fire Extinguishing*

Agents Not To Be Used: Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Triethylene Glycol — Fire Hazards: *Flash Point (deg. F):* 350 CC, 330 OC; *Flammable Limits in Air (%):* 0.9 - 9.2; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 700; *Electrical Hazard:* Not pertinent; *Burning Rate:* 1.7 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Triethylenetetramine — Fire Hazards: *Flash Point (deg. F):* 275 CC, 290 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Dry chemical, alcohol foam, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Application of water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* 640; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* After dilution with water, can be stabilized with acetic acid; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Trifluorochloroethylene — Fire Hazards: *Flash Point (deg. F):* Not pertinent; this is a gas; *Flammable Limits in Air (%):* 16 - 34; *Fire Extinguishing Agents:* Let fire burn; stop the flow of gas; cool containers with water; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic hydrogen chloride and hydrogen fluoride gases are formed; *Behavior in Fire:* Vapor is heavier than air and can travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Polymerization can occur; *Inhibitor of Polymerization:* Terpenes or Tributylamine (1%).

Trifluralin — Fire Hazards: *Flash Point (deg. F):* >185 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Toxic and hazardous hydrogen fluoride gas may be formed in fires; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Triisobutylaluminum — Fire Hazards: *Flash Point (deg. F):* Not pertinent; this product ignites spontaneously; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents:* Inert powder such as sand or limestone, or dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water, foam, halogenated extinguishing agents; *Special Hazards of Combustion Products:* Dense smoke may cause metal-fume fever; *Behavior in Fire:* Dense smoke of aluminum oxide forms in fires; *Ignition Temperature (deg. F):* Ignites spontaneously under ambient conditions; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* Reacts violently to form flammable hydrocarbon gases; *Reactivity with Common Materials:* Not compatible with silicone rubber or urethane rubbers; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Trimethylamine — Fire Hazards: *Flash Point (deg. F):* Not pertinent; this is a gas; *Flammable Limits in Air (%):* 2.0 - 11.6; *Fire Extinguishing Agents:* Stop flow of gas. Use water, alcohol foam, dry chemical, or carbon dioxide on water solution fires; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F):* 374; *Electrical Hazard:* Not pertinent; *Burning Rate:* 8.0 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Although water solutions may be neutralized with acetic acid, simple evaporation will remove all the compound; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Trimethylchlorosilane — Fire Hazards: *Flash Point (deg. F):* 0 OC; *Flammable Limits in Air (%):* 1.8 (LEL); *Fire Extinguishing Agents:* Dry chemical; *Fire Extinguishing Agents Not To Be Used:* Water, foam; *Special Hazards of Combustion Products:* Toxic and irritating hydrogen chloride and phosgene may form in fires; *Behavior in Fire:* Difficult to extinguish; material easily re-ignites. Contact with water on adjacent fires should be avoided as irritating and toxic hydrogen chloride gas will form; *Ignition Temperature (deg. F):* 743; *Electrical Hazard:* No data; *Burning Rate:* 5.3 mm/min. **Chemical Reactivity:** *Reactivity with Water:* Reacts vigorously forming hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials:* Reacts with surface moisture evolving hydrogen chloride, which will corrode common metals and form flammable hydrogen gas; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tripropylene Glycol — Fire Hazards: *Flash Point (deg. F):* 285 OC; *Flammable Limits in Air (%):* 0.8 - 5.0; *Fire Extinguishing Agents:* Alcohol foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not To Be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Acrid fumes of acids and aldehydes may form in fires; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics and elastomers; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Tris(Aziridinyl)Phosphine Oxide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents:* Not pertinent; *Fire Extinguishing Agents Not To Be Used:* Not pertinent; *Special Hazards of Combustion Products:* Phosphoric acid mist may form in fires. Toxic oxide of nitrogen may form; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* Not pertinent; *Electrical Hazard:* Not pertinent; *Burning Rate:* Not pertinent. **Chemical Reactivity:** *Reactivity with Water:* No reaction unless in the presence of acids and caustics; *Reactivity with Common Materials:* Slow decomposition occurs, but generally the reactions are not hazardous; *Stability During Transport:* Stable if cool; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Violent, exothermic polymerization occurs at about 225 of. Acid fumes will also cause polymerization at ordinary temperatures; *Inhibitor of Polymerization:* None reported.

Turpentine— Fire Hazards: *Flash Point (deg. F):* 95 CC; *Flammable Limits in Air (%):* 0.8 (LEL); *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Forms heavy black smoke and soot; *Ignition Temperature (deg. F):* 488; *Electrical Hazard:* Not pertinent; *Burning Rate:* 2.4 mm/min. **Chemical Reactivity:** *Reactivity with Water* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

U

Undecanol — Fire Hazards: *Flash Point (deg. F):* 200 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:* Not pertinent; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

1-Undecene — Fire Hazards: *Flash Point (deg. F):* 160 OC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* Not pertinent; *Behavior in Fire:*:Not pertinent *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* Not pertinent; *Burning Rate:* 4.8 mm/min. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* No reactions; *Stability During Transport:* Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

n-Undecylbenzene — Fire Hazards: *Flash Point (deg. F):* 285 CC; *Flammable Limits in Air (%):* No data; *Fire Extinguishing Agents:* Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products:* No data; *Behavior in Fire:* No data; *Ignition Temperature (deg. F):* No data; *Electrical Hazard:* No data; *Burning Rate:* No data. **Chemical Reactivity:** *Reactivity with Water:* No reaction; *Reactivity with Common Materials:* May attack some forms of plastics; *Stability During Transport:* Stable;

Neutralizing Agents for Acids and Caustics: Stable; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Uranyl Acetate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Dissolves and reacts producing a milky like solution. The reaction is non hazardous; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Uranyl Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable but may cause fire on contact with combustible materials; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Apply flooding amounts of water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen are formed in fires; *Behavior in Fire*: Intensifies fires. When large quantities are involved, nitrate may fuse or melt. The application of water may then cause extensive scattering of the molten material; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Dissolves in water forming a weak solution of nitric acid. The reaction is nonhazardous; *Reactivity with Common Materials*: When in contact with easily oxidizable materials, this chemical may react rapidly enough to cause ignition, violent combustion, or explosion. Water solutions are acidic and can corrode metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization*: Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Uranyl Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: No data; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No data; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Urea — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Melts and decomposes, generating ammonia; *Ignition Temperature (deg. F)*: Not flammable; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not flammable. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Occurs only above melting point (132 °C), yielding ammonia and other products. The decomposition is not explosive; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Urea Peroxide — Fire Hazards: *Flash Point (deg. F)*: Not pertinent. This is a combustible solid that may cause fire upon contact with ordinary combustible materials; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Inert powders such as sand and limestone, or water; *Fire*

Extinguishing Agents Not to be Used: Not pertinent; *Special Hazards of Combustion Products*: Irritating ammonia gas may be formed in fires; *Behavior in Fire*: Melts and decomposes, giving off oxygen and ammonia. Increases the severity of fires. Containers may explode; *Ignition Temperature (deg. F)*: > 680; *Electrical Hazard*: No data; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Forms solution of hydrogen peroxide. The reaction is nonhazardous; *Reactivity with Common Materials*: There are no significant reactions under ordinary conditions and temperatures. At 50 °C (122 of) the chemical reacts with dust and rubbish; *Stability During Transport*: Stable below 60 °C (140 of); *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

V

Valeraldehyde — Fire Hazards: *Flash Point (deg. F):* 54 OC; *Flammable Limits in Air (%)*: No data; *Fire Extinguishing Agents*: Foam, dry chemical or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: Not pertinent; *Burning Rate*: 1.9 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Vanadium Oxytrichloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Water, unless in flooding amounts should not be used on adjacent fires; *Special Hazards of Combustion Products*: Irritating fumes of hydrogen chloride form during fires;*Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts forming a solution of hydrochloric acid; *Reactivity with Common Materials*: In presence of moisture will corrode most metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water and sprinkle with powdered limestone or rinse with dilute solution of sodium bicarbonate or soda ash; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Vanadium Pentoxide — Fire Hazards: *Flash Point (deg. F)*: Not flammable; *Flammable Limits in Air (%)*: Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: May increase the intensity of fires; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Vanadyl Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: No data; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common*

Materials: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Vinyl Acetate — Fire Hazards: *Flash Point (deg. F):* 18 CC, 23 OC; *Flammable Limits in Air (%):* 2.6 - 13.4; *Fire Extinguishing Agents*: Carbon dioxide or dry chemical for small fires, and ordinary foam for large fires; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Vapor is heavier than air and may travel to a source of ignition and flash back, causing product to polymerize and burst or explode containers; *Ignition Temperature (deg. F)*: 800; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 3.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: *Stable*; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Polymerization can occur when the product is in contact with peroxides and strong acids, but only under extreme conditions; *Inhibitor of Polymerization*: Hydroquinone and or Diphenylamine.

Vinyl Chloride — Fire Hazards: *Flash Point (deg. F):* -110 OC; *Flammable Limits in Air (%):* 4 - 26; *Fire Extinguishing Agents*: For small fires use dry chemical or carbon dioxide. For large fires stop the flow of gas if feasible. Cool exposed containers with water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Forms highly toxic combustion products such as hydrogen chloride, phosgene, and carbon monoxide;*Behavior in Fire*: Container may explode in fire. Gas is heavier than air and may travel to a source of ignition and flash back; *Ignition Temperature (deg. F)*: 882; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 4.3 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Polymerizes when exposed to sunlight, air, or heat unless stabilized by inhibitors; *Inhibitor of Polymerization*: Not normally used except when high temperatures are expected. Normally phenol can be used (typically 40 to 100 ppm).

Vinyl Fluoride, Inhibited — Fire Hazards: *Flash Point (deg. F):* Not pertinent. This is a flammable, compressed liquified gas; *Flammable Limits in Air (%)*: 2.6 - 21.7; *Fire Extinguishing Agents*: Allow fire to burn out; stop the flow of gas if feasible. Cool adjacent containers with water; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Toxic hydrogen fluoride gas is generated in fires; *Behavior in Fire*: Vapor is heavier than air and can travel to a source of ignition and flash back. Containers may explode; *Ignition Temperature (deg. F)*: 725; *Electrical Hazard*: No data; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Polymerization can occur in the absence of inhibitor; *Inhibitor of Polymerization*: Terpene B (0.2%).

Vinylidene Chloride, Inhibited — Fire Hazards: *Flash Point (deg. F)*: 0 OC; *Flammable Limits in Air (%):* 7.3 - 16.0; *Fire Extinguishing Agents*: Foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Toxic hydrogen chloride and phosgene form in fires;*Behavior in Fire*: May explode in fires due to polymerization. Vapor is heavier than air and can travel to a source of ignition and flash back; *Ignition Temperature (deg. F)*: 955 - 1,031; *Electrical Hazard*: Not pertinent; *Burning Rate*: 2.7 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: Contact with copper or aluminum can cause polymerization; *Stability During Transport*:

Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization*: Can occur if the product is exposed to sunlight, air, copper, aluminum, or heat; *Inhibitor of Polymerization*: Methyl Ether of Hydroquinone (200 ppm) and or phenol (0.6 to 0.8 %).

Vinyl Methyl Ether, Inhibited — Fire Hazards: *Flash Point (deg. F):* -69 OC; *Flammable Limits in Air (%)*: 2.6 - 39; *Fire Extinguishing Agents*: Allow fire to burn and shut off the flow of gas if feasible. Extinguish small fires with dry chemical or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may explode. Vapor is heavier than air and can travel to a source of ignition and flash back; *Ignition Temperature (deg. F)*: No data; *Electrical Hazard*: No data; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Reacts slowly to form acetaldehyde. The reaction is generally not hazardous unless occurring in hot water or acids are present; *Reactivity with Common Materials*: Acids cause polymerization; *Stability During Transport*: Stable but must be segregated from acids;*Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Can polymerize in the presence of acids; *Inhibitor of Polymerization*: Dioctylamine; Triethanolamine; Solid Potassium Hydroxide.

Vinyltoluene — Fire Hazards: *Flash Point (deg. F)*: 137 OC, 125 CC; *Flammable Limits in Air (%):* 0.8 - 11; *Fire Extinguishing Agents*: Water fog, foam, carbon dioxide, or dry chemical; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Containers may explode or rupture in fires due to polymerization; *Ignition Temperature (deg. F)*: 914; *Electrical Hazard*: Not pertinent; *Burning Rate*: 6.0 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reactions; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Slow at ordinary temperatures but when hot may rupture container. Also polymerized by metal salts such as those of iron or aluminum; *Inhibitor of Polymerization*: Tertiary Butylcatechol (typically 10 to 50 ppm).

Vinyltrichlorosilane — Fire Hazards: *Flash Point (deg. F)*: 60 OC, 52 CC; *Flammable Limits in Air (%)*: 3 (LEL); *Fire Extinguishing Agents*: Dry chemical or carbon dioxide; *Fire Extinguishing Agents Not to be Used*: Water, foam; *Special Hazards of Combustion Products*: Toxic chlorine and phosgene gases are formed; *Behavior in Fire*: Fire is difficult to extinguish because of ease in re-ignition. Contact with water applied to fight adjacent fires will result in the formation of irritating hydrogen chloride gas; *Ignition Temperature (deg. F)*: 505; *Electrical Hazard*: No data; *Burning Rate*: 2.9 mm/min. **Chemical Reactivity:** *Reactivity with Water*: Reacts vigorously, producing hydrogen chloride (hydrochloric acid); *Reactivity with Common Materials*: Reacts with surface moisture to evolve hydrogen chloride, which will corrode common metals and form flammable hydrogen gas; *Stability During Transport*: Stable if protected from moisture;*Neutralizing Agents for Acids and Caustics:* Flush with water and rinse with sodium bicarbonate or lime solution; *Polymerization:* May occur in absence of inhibitor; *Inhibitor of Polymerization*: Diphenylamine, Hydroquinone.

W

Waxes: Carnauba — Fire Hazards: *Flash Point (deg. F):* 540 CC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of*

Combustion Products: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Waxes: Paraffin — Fire Hazards: *Flash Point (deg. F):* 390 CC; 380 - 465 OC; *Flammable Limits in Air (%):* Not pertinent; *Fire Extinguishing Agents*: Water, foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water or foam may cause frothing; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 473; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

X

m-Xylene — Fire Hazards: *Flash Point (deg. F):* 84 CC; *Flammable Limits in Air (%):* 1.1 - 6.4; *Fire Extinguishing Agents*: Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*: 986; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 5.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

o-Xylene — Fire Hazards: *Flash Point (deg. F):* 63 CC; 75 OC; *Flammable Limits in Air (%):* 1.1 - 7.0; *Fire Extinguishing Agents*: Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*: 869; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 5.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

p-Xylene — Fire Hazards: *Flash Point (deg. F):* 81 CC; *Flammable Limits in Air (%):* 1.1 - 6.6; *Fire Extinguishing Agents*: Foam, dry chemical, or carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Water may be ineffective; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back; *Ignition Temperature (deg. F)*: 870; *Electrical Hazard*: Class I, Group D; *Burning Rate*: 5.8 mm/min. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Xylenol — Fire Hazards: *Flash Point (deg. F):* 186; *Flammable Limits in Air (%):* 1.4 (LEL); *Fire Extinguishing Agents*: Water, dry chemical, carbon dioxide, foam; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Toxic vapor of unburned material may form in fire; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: 1110; *Electrical Hazard*: Data not available; *Burning Rate*: Data not available. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; Neutralizing Agents for Acids and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Z

Zinc Acetate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Ammonium Chloride - Zinc Acetate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Acetate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Arsenate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Borate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Bromide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Chloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Chromate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Dialkyldithiophosphate — Fire Hazards: *Flash Point (deg. F):* 360 CC; *Flammable Limits in Air (%):* Data not available; *Fire Extinguishing Agents*: Water, dry chemical, foam, carbon dioxide; *Fire Extinguishing Agents Not to be Used:* Data not available; *Special Hazards of Combustion Products*: Irritating oxides of sulfur and phosphorus may form in fires; *Behavior in Fire*: Data not available; *Ignition Temperature (deg. F)*: Data not available; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction at ordinary temperatures; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; Neutralizing Agents for Acids and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Fluoroborate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fire; *Behavior in Fire*: May increase intensity of fire when in contact with combustible material; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Phenolsulfonate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Irritating oxides of sulfur may form in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Phosphide — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Use water, foam, or dry chemical on adjacent fires; *Fire Extinguishing Agents Not to be Used:* Any agent with an acid reaction (e.g. carbon dioxide or halogenated agents) will liberate phosphine, a toxic and spontaneously flammable gas; *Special Hazards of Combustion Products*: Irritating oxides of phosphorus may be formed in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: No data . **Chemical Reactivity:** *Reactivity with Water*: Reacts slowly with water, more rapidly with dilute acid, to form phosphine gas, which is toxic and spontaneously flammable; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable unless exposed to moisture; toxic phosphine gas may then be released and collect in closed spaces; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Silicofluoride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Toxic and irritating hydrogen fluoride and silicon tetrafluoride are formed in fires; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zinc Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zirconium Acetate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zirconium Nitrate — Fire Hazards: *Flash Point (deg. F):* Not flammable but may intensify fire; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Toxic oxides of nitrogen may form in fire; *Behavior in Fire*: May increase intensity of fire when in contact with combustible materials; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: Dissolves to give an acid solution; *Reactivity with Common Materials*: Will corrode most metals; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Flush with water; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zirconium Oxychloride — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for Acids and Caustics:* Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization*: Not pertinent.

Zirconium Sulfate — Fire Hazards: *Flash Point (deg. F):* Not flammable; *Flammable Limits in Air (%):* Not flammable; *Fire Extinguishing Agents*: Not pertinent; *Fire Extinguishing Agents Not to be Used:* Not pertinent; *Special Hazards of Combustion Products*: Not pertinent; *Behavior in Fire*: Not pertinent; *Ignition Temperature (deg. F)*: Not pertinent; *Electrical Hazard*: Not pertinent; *Burning Rate*: Not pertinent. **Chemical Reactivity:** *Reactivity with Water*: No reaction; *Reactivity with Common Materials*: No reaction; *Stability During Transport*: Stable; *Neutralizing Agents for*

Acids and Caustics: Not pertinent; *Polymerization:* Not pertinent; *Inhibitor of Polymerization:* Not pertinent.

Index