

American National Standard

ANSI Z400.1-2004

*for Hazardous Industrial Chemicals –
Material Safety Data Sheets –
Preparation*



ANSI®
Z400.1-2004
Revision of
ANSI Z400.1-1998

American National Standard
for Hazardous Industrial Chemicals –

Material Safety Data Sheets – Preparation

Secretariat

American Chemistry Council

Approved March 31, 2004

American National Standards Institute, Inc.

American National Standard

Approval of an American National Standard requires review by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgement of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made towards their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Published by

**American National Standards Institute, Inc.
25 West 43rd Street, New York, NY 10036**

Copyright © 2004 by American National Standards Institute, Inc.
All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without prior written permission of the publisher.

Printed in the United States of America

Contents

	Page
Foreword	iv
Chapter 1 Scope and Purpose	1
1 Introduction	1
2 Scope, purpose and application	1
2.1 Scope	1
2.2 Purpose	2
2.3 Application	2
Chapter 2 Preparing an MSDS.....	3
1 General.....	5
2 MSDS organization.....	5
3 Appearance/communication principles	8
3.1 Appearance	8
3.2 Reading level and comprehension	9
4 General contents	10
4.1 Internal consistency	10
4.2 Review/preparation date.....	10
4.3 Units of measure	10
4.4 No blank data fields	11
4.5 Key/legend.....	11
4.6 Page and section numbers.....	11
4.7 Revision indicators	11
4.8 MSDS identifier.....	11
4.9 Disclaimer	12
4.10 Headers/footers	12
5 Hazard assessment.....	12
5.1 Collecting the information	12
5.2 Determining hazards	13
Chapter 3 Sections of an MSDS	15
1 Section 1: PRODUCT AND COMPANY IDENTIFICATION	17
2 Section 2: HAZARDS IDENTIFICATION.....	18
2.1 Emergency overview	18
2.2 OSHA regulatory status.....	19
2.3 Potential health effects	20
2.4 Potential environmental effects	21

	Page
3 Section 3: COMPOSITION/INFORMATION ON INGREDIENTS.....	23
4 Section 4: FIRST AID MEASURES	24
4.1 First aid procedures.....	24
4.2 Note to physicians	25
5 Section 5: FIRE FIGHTING MEASURES	26
5.1 Flammable properties.....	26
5.2 Extinguishing media	26
5.2.1 Suitable extinguishing media.....	26
5.2.2 Unsuitable extinguishing media.....	27
5.3 Protection of firefighters	27
5.3.1 Specific hazards arising from the chemical	27
5.3.2 Protective equipment and precautions for firefighters	28
6 Section 6: ACCIDENTAL RELEASE MEASURES	29
6.1 Personal precautions.....	29
6.2 Environmental precautions	29
6.3 Methods for containment.....	29
6.4 Methods for clean-up.....	29
6.5 Other information.....	30
7 Section 7: HANDLING AND STORAGE.....	31
7.1 Handling	31
7.2 Storage	32
8 Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION	33
8.1 Exposure guidelines	33
8.2 Engineering controls.....	34
8.3 Personal protective equipment (PPE)	34
8.3.1 Eye/face protection.....	35
8.3.2 Skin protection.....	35
8.3.3 Respiratory protection	35
8.3.4 General hygiene considerations.....	36
9 Section 9: PHYSICAL AND CHEMICAL PROPERTIES	37
10 Section 10: STABILITY AND REACTIVITY	39
10.1 Chemical stability	39
10.2 Conditions to avoid	39
10.3 Incompatible materials	39
10.4 Hazardous decomposition products	39

	Page
10.5 Possibility of hazardous reactions	40
11 Section 11: TOXICOLOGICAL INFORMATION	41
12 Section 12: ECOLOGICAL INFORMATION	45
13 Section 13: DISPOSAL CONSIDERATIONS	48
14 Section 14: TRANSPORT INFORMATION	50
14.1 Basic shipping information	50
14.2 Additional information	50
15 Section 15: REGULATORY INFORMATION	52
16 Section 16: OTHER INFORMATION	55
Chapter 4 Evaluating the completed MSDS	57
1 Format	59
2 Completeness	59
3 Internal consistency	59
4 Compliance	59
5 Appearance/communication principles	60
Chapter 5 References used to prepare this Standard	61
1 Regulatory/MSDS	63
2 General	63
Annexes	
A Summaries of regulatory data elements	65
A.1 Introduction	67
A.2 Data elements required for HCS	67
A.3 Data elements required under GHS	67
A.4 Data elements required for Canada's WHMIS	67
A.5 Data elements required for disclosure in EEC Safety Data Sheets	68
A.6 Data elements required for Mexico's NOM-114-STPS-1994	70
A.7 Data elements required for Japan's Guidelines	71
A.8 Data elements required for Australia's Guidelines	72
B MSDS Example	87
C Glossary	95
D Preparation Resources Document	119

Foreword (This foreword is not part of American National Standard ANSI Z400.1-2004.)

ANSI Z400.1-2004, *American National Standard for Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation* was developed by a technical committee of the American Chemistry Council (ACC) and was submitted for approval under ACC's ANSI-approved canvass method operating procedures.

The first *American National Standard for Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation*, ANSI Z400.1-1993, was developed in recognition of the need for guidance to help preparers of material safety data sheets (MSDSs) develop consistent and understandable documents that provide useful information to a variety of audiences. At that time, the standard introduced several items that had not been part of MSDSs in the past, including: the headings and order of the sections; the emergency overview; and sections 11 through 16.

The 1998 revision included: the addition of the OSHA product status; elements to improve consistency with international standards, internal consistency; and revisions of the annexes.

The 2004 revision includes the following significant changes:

- Improving hazard communication and aligning the Standard with the recommendations for safety data sheets in the Globally Harmonized System for Hazard Classification, Communication and Labeling (GHS) adopted by the United Nations in 2002;
- Improving readability and consistency and minimizing redundancy;
- Reordering the MSDS sections so Hazards Identification appears before Composition Information;
- Eliminating the option to list exposure guidelines in the Composition Information;
- Including a requirement that flammable properties appear in the physical and chemical properties section with an option to repeat them in the fire fighting measures section;
- Including required physical and chemical properties;
- Increasing consistency between the sections for Toxicological Information and Ecological Information, and including more complete and accurate lists of data types;
- Adding transportation elements that may be needed for transporting a chemical by various modes, to meet international regulations and for improved emergency response.

This standard contains 4 annexes, all of which are informative and are not considered part of the standard.

The following organizations, recognized as having an interest in the standardization of material safety data sheets, were contacted prior to the approval of this standard. Inclusion in this list does not necessarily imply that an organization concurred with the version of the proposed standard submitted to ANSI.

Adhesive and Sealant Council, Inc.
Aerospace Industries Association
AFL-CIO
Air and Waste Management Association
Air Conditioning Contractors of America, Inc.
American Academy of Clinical Toxicology

American Association of Occupational Health Nurses
 American Association of Poison Control Centers
 American Chemical Society
 American Dental Association.
 American Electronics Association
 American Feed Industry Association.
 American Fiber Manufacturers Association
 American Forest & Paper Association
 American Industrial Hygiene Association
 American Institute of Chemical Engineers (AIChE)
 American Insurance Services Group
 American Petroleum Institute
 American Public Health Association
 American Society of Safety Engineers
 American Supply Association
 American Trucking Associations
 American Wood Preservers Institute
 Argonne National Laboratory
 Asphalt Roofing Manufacturers Association
 ASTM E34.40 Hazard Communication Committee
 Automotive Industry Action Group
 Can Manufacturers Institute
 Canadian Chemicals Producers Association
 Canadian Labour Congress
 Chemical Abstracts Service
 Chemical Safety & Hazard Investigation Board
 CIIT Centers for Health Research
 Color Pigments Manufacturers Association
 Compressed Gas Association
 Consumer Specialties Product Association
 Cosmetic, Toiletry & Fragrance Association
 CropLife America
 Data Interchange Standards Association
 Defense General Supply Center
 Edison Electric Institute
 Environmental Protection Agency
 ETAD North America
 Flavor and Fragrance Specialties
 FM Global
 Graphic Arts Technical Foundation
 Hazardous Materials Advisory Council
 Independent Lubricant Manufacturers Association
 Industry Canada
 International Association of Fire Chiefs
 International Association of Fire Fighters
 International Chemical Workers Union Council
 International Institute of Synthetic Rubber Producers
 International Mass Retail Association
 International Sanitary Supply Association
 MDL Information Systems, Inc.
 National Association of Chemical Distributors
 National Association of Emergency Medical Technicians
 National Association of Homebuilders
 National Association of Printing Ink Manufacturers
 National Association of Scientific Materials Managers
 National Automobile Dealers Association
 National Elevator Industry, Inc.
 National Institute of Environmental Health Sciences
 National Institute of Standards and Technology
 National Lumber & Building Material Dealers Association
 National Paint & Coatings Association
 National Petrochemical & Refiners Association
 National Safety Council
 National Toxicology Program
 National Wholesale Druggists' Association
 Naval Supply Systems Command
 North American Insulation Manufacturers Association
 Organizational Resource Counselors

Pharmaceutical Research and Manufacturers of America
Printing Industries of America
Roof Coatings Manufacturers Association
Rubber Manufacturers Association
Screenprinting & Graphic Imaging Association International
Semiconductor Safety Association
Soap and Detergent Association
Society of American Florists
Society of the Plastics Industry
Sulphur Institute
Society of Toxicology
Synthetic Organic Chemical Manufacturers Association
The Weinberg Group
U.S. Consumer Product Safety Commission
U.S. Coast Guard
U.S. Dept. of Transportation
U.S. General Services Administration
United Steelworkers of America
WHMIS Division, Health Canada

The Working Group that developed this revision of the standard had the following members

Jayne Clifton, Chair
(Chevron Phillips Chemical Company)

Ali Basaran
(Eli Lilly and Company)
Edwin C. Bisinger
(Akzo Nobel Chemicals)
Susan Blanco
(American Chemistry
Council)
John D. Bruhnke
(Milliken Chemical)
Carl Carlin
(ATOFINA Chemicals)
Susan Conti
(Attorney-Consultant
for ACC)

Catherine Croke
(RohMax USA)
Stacie A. Eakin
(Lyondell Chemical)
Roger E. Etherington
(Vulcan Chemicals)
Wayne W. Henderson
(Bayer Corporation)
Michael Hulse
(Shell Chemical)
Roger Johnson
(Cognis Corporation)
Chun Man Lau
(Eastman Chemical)

Susan Martins
(PPG Industries)
Marlin McKinley
(Lubrizol)
David W. Peters
(Monsanto)
Janelle Restum
(Johnson Polymer)
Francis P. Rudy
(Air Products
& Chemicals)
Robert Skoglund
(3M)
Anne Stieffenhofer
(Eastman Kodak)

Chapter 1

Scope and Purpose

American National Standard for Hazardous Industrial Chemicals –

Material Safety Data Sheets – Preparation

1 Introduction

The development of new chemicals, the re-evaluation of existing chemicals and the ever-widening use of chemicals and chemical processes in a variety of applications have accentuated a need to provide information to people who use, handle or store hazardous industrial chemicals. As per the United States Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (HCS), a Material Safety Data Sheet (MSDS) is one means of providing this information.

MSDSs are an important resource and provide a wide range of information. Details on material identity, manufacturer information, hazard identity, emergency information, instructions on what to do if a hazardous situation has occurred, information on the prevention of hazardous situations, as well as other technical information are contained in an MSDS. It is imperative that this information be provided in a manner that is accurate, clear and concise.

The HCS provides little information regarding the format of an MSDS. In 1993, the *American National Standard for Hazardous Industrial Chemicals – Material Safety Data Sheets – Preparation* was developed to address the need for an MSDS format that was comprehensive, understandable and consistent. A complete, logical and internally consistent MSDS is more likely to result from an orderly approach. This Standard is organized to present concepts and guidance to those involved in the preparation of MSDSs.

2 Scope, purpose and application

2.1 Scope

This Standard applies to the preparation of MSDSs for chemicals and materials¹ used under occupational conditions. It presents basic information on how to develop and write MSDSs that are complete, clear and consistent. It also identifies information that must be included to comply with the HCS. Additional information is provided to help comply with state and federal environmental and safety laws and regulations. With the addition of certain data elements, this Standard is also acceptable for international use. This Standard is not intended to address the distribution of MSDSs.

This Standard is not intended to provide a rote specification for complying with the HCS or any other government requirements. Requirements change. It is the responsibility of the MSDS preparer to be aware of current HCS requirements.

¹ OSHA requires that an MSDS be prepared for chemicals that are hazardous according to the criteria described in the HCS. This Standard recognizes that MSDSs may be prepared for nonhazardous chemicals as well as hazardous chemicals. This Standard uses the term, material, to denote this wider scope of coverage.

2.2 Purpose

The purpose of this Standard is to provide a consistent format for an MSDS that will allow inclusion of information to comply with applicable laws. It will provide the MSDS writer with a framework to communicate useful, understandable information for materials and hazardous chemicals. Information on hazard assessment and labeling may be found in the current *American National Standard for Hazardous Industrial Chemicals – Precautionary Labeling* (ANSI Z129.1- 2000).

2.3 Application

2.3.1 Audience

This Standard is designed as an aid for individuals responsible for developing and reviewing MSDSs.

2.3.2 Organization and content

The content of this document is based on professional judgment of expert MSDS preparers. The information is presented in the order that it is likely to be utilized. Within this Standard, the intended interpretation of the words “shall, must, should, may and can” range in degree from compliance with the OSHA HCS to a voluntary, permissible or possibly appropriate action by the MSDS writer.

- Chapter 2 includes general information used to prepare an MSDS including formatting issues, effective communication principles, general MSDS information (e.g., revision date, page numbering, units of measure), guidance on information collection and hazards determination.
- Chapter 3 discusses individual sections of an MSDS. Subsections are numbered for purposes of organization only.
- Chapter 4 contains a brief discussion on evaluating the completed MSDS.
- Chapter 5 lists references used to prepare this Standard.
- Annex A contains regulatory information including elements of the Globally Harmonized System for Hazard Classification, Communication and Labeling (GHS), Canada, the European Union, Mexico and Japan, as well as the United States.
- Annex B contains a sample MSDS.
- Annex C contains a glossary of terms.
- Annex D contains MSDS preparation resources.

Chapter 2

Preparing an MSDS

1 General

This chapter provides information to an MSDS preparer that will help structure and organize an MSDS. Collecting information and conducting a hazard determination for a material is also discussed, along with presenting the information to MSDS users.

This Standard considers two main uses of the MSDS:

- a training and reference tool for workers and health, safety and environmental professionals;
- a resource for emergency responders.

However, MSDSs are used by a wide range of people with various backgrounds, education levels and needs. Under the OSHA Hazard Communication Standard (HCS), manufacturers provide MSDSs to their customers and these customers make them available to their employees. Other statutes and practices make MSDSs available to a wider audience. The information should be presented in a consistent and understandable format to meet the needs of this diverse audience.

This Standard prescribes titles and a specific order for the sections of an MSDS. The effectiveness of MSDSs for these purposes will be improved by presenting the information available in the same order every time. A consistent format makes it easier for the reader to find information on the MSDS.

2 MSDS organization

Section 1: PRODUCT AND COMPANY IDENTIFICATION

Section 2: HAZARDS IDENTIFICATION

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

Section 4: FIRST AID MEASURES

Section 5: FIRE FIGHTING MEASURES

Section 6: ACCIDENTAL RELEASE MEASURES

Section 7: HANDLING AND STORAGE

Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Section 10: STABILITY AND REACTIVITY

Section 11: TOXICOLOGICAL INFORMATION

Section 12: ECOLOGICAL INFORMATION

Section 13: DISPOSAL CONSIDERATIONS

Section 14: TRANSPORT INFORMATION

Section 15: REGULATORY INFORMATION

Section 16: OTHER INFORMATION

The questions and answers below form the basis for the ordering of information on the MSDS. Key information for emergency responders should be located near the beginning of the MSDS because it is needed quickly. Information pertaining to the health and safety of people should be presented before information on the environment. Detailed descriptions of the purpose and scope of each section can be found in Chapter 3.

2.1 What is the material and what do I need to know immediately in an emergency?

Section 1: PRODUCT AND COMPANY IDENTIFICATION (page 17)

- links the MSDS to the material label;
- identifies the manufacturer of the material;
- identifies a source for more information.

Section 2: HAZARDS IDENTIFICATION (page 18)

- provides an Emergency Overview, including physical properties;
- provides information on significant physical hazards;
- provides information on the potential adverse human health effects and symptoms that might result from reasonably foreseeable use and misuse of the material;
- provides information on potential environmental hazards;
- provides OSHA regulatory status.

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS (page 23)

- lists the OSHA hazardous components;
- may also list significant non-hazardous components;
- may also include additional information about components.

2.2 What should I do if a hazardous situation occurs?

Section 4: FIRST AID MEASURES (page 24)

- provides instructions to be followed if accidental exposure requires immediate treatment;
- may also include instructions to healthcare professionals.

Section 5: FIRE FIGHTING MEASURES (page 26)

- provides basic fire fighting guidance, including suitable and unsuitable extinguishing media.

Section 6: ACCIDENTAL RELEASE MEASURES (page 29)

- describes actions to be taken to minimize the adverse effects of an accidental spill, leak or release of the material.

2.3 How can I prevent hazardous situations from occurring?

Section 7: HANDLING AND STORAGE (page 31)

- provides information on appropriate practices for safe handling and storage.

Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION (page 33)

- includes exposure guidelines;
- provides information on practices and/or equipment that are useful in minimizing worker exposure;
- provides guidance on personal protective equipment (PPE).

Section 9: PHYSICAL AND CHEMICAL PROPERTIES (page 37)

- provides data, including fire and explosive properties, that can be used to help characterize the material and design safe work practices.

Section 10: STABILITY AND REACTIVITY (page 39)

- describes the conditions or materials that affect the hazards and/or intrinsic stability of the material;
- describes decomposition products that result from storage or handling.

2.4 Is there other useful information about this material?

Section 11: TOXICOLOGICAL INFORMATION (page 41)

- provides toxicological information on the material and/or its components.

Section 12: ECOLOGICAL INFORMATION (page 45)

- provides ecotoxicological information on the material and/or its components;
- provides environmental fate information on the material and/or its components.

Section 13: DISPOSAL CONSIDERATIONS (page 48)

- provides information that is useful in determining appropriate disposal measures for the material and/or its containers.

Section 14: TRANSPORT INFORMATION (page 50)

- provides basic shipping classification information.

Section 15: REGULATORY INFORMATION (page 52)

- provides information on regulations affecting the material.

Section 16: OTHER INFORMATION (page 55)

- provides additional information.

This Standard prescribes that certain types of information be placed within certain sections. However, because information has more than one purpose, some flexibility in placement is recognized. For example, flammable properties of the material must be listed in Section 9: PHYSICAL AND CHEMICAL PROPERTIES but may also be repeated in Section 5: FIRE FIGHTING MEASURES.

3 Appearance/communication principles

Preparing an MSDS involves collecting and summarizing facts from a wide variety of subject areas. The result must be understandable and useful to a diverse audience without oversimplifying the information so that it is no longer useful to the intended audience. Writers must recognize that the MSDS may be read for the first time in an emergency (under adverse conditions such as stress, time constraints and/or poor visibility) and could be the only immediate source of information on the material.

3.1 Appearance

For uniformity and ease in filing, as well as for further electronic distributions, a vertical (portrait) format is recommended. A standard paper size (8-1/2 x 11 inch – North America; A4 – Europe) is recommended.

Use a simple layout with well-marked and identified sections.

Provide an ample margin so that copying and binding do not cut off information. There should be sufficient space available for the user to add a code or identification number should they so choose.

Use left justification of text since this makes it easier to control eye movement and to read.

Use consistent line spacing and avoid crowding text to fit more information in a section or on a page.

Use space to separate fields and sections so reading is simplified.

Use simple type fonts. Ornate fonts are more difficult to read. Also avoid using a variety of type fonts on the same MSDS.

Avoid long strings of text typed in all capital letters because they are more difficult to read.

Use Arabic numbers (e.g., 1, 2, 3) because they are more familiar than Roman numerals (e.g., I, II, III) to the average reader.

Generally 10- to 14-point type size is easily readable for an MSDS.

– This is 8-point type

– This is 10-point type

– This is 12-point type

– This is 14-point type

Printed type should be clearly legible.

Do not depend solely on color to highlight heading or text. Some users may be color-blind or the document may be photocopied, thus losing the color highlighting. Red print also should be avoided as it is difficult to see during an emergency when red lights are flashing.

The use of reversal effects (e.g., white letters on dark background) for large blocks of text can decrease readability.

Pictograms and symbols should only be used to supplement written information unless specified by international regulations.

When using images or symbols containing text, select light colors with black text or dark colors with white text. The ability to produce a readable grayscale (black/white) print or fax is more important than color matching.

Avoid using footnotes on the MSDS. Instead, put information in parentheses within the sentence. Remember that the MSDS may be electronically reproduced and/or transmitted (e.g., faxed, copied, scanned or e-mailed). Take care to reduce the risk that characters might be cut off or garbled in these communications or conversion processes.

3.2 Reading level and comprehension

One of the greatest challenges in preparing an MSDS is writing so that various audiences can read and understand the information. Reading levels of users vary widely. The target audiences range from an untrained person needing general information to a highly trained professional. The information being conveyed is often very technical. It must be complete enough for the specialist yet understandable for the inexperienced MSDS user.

An additional challenge is that the target audiences change from section to section. In each discussion of an MSDS section (Chapter 3), the intended audiences for the information are identified to help the MSDS preparer determine the appropriate language level. The audiences are identified throughout the Standard as:

- Emergency Responder (e.g., firefighters);
- Employee (e.g., users and handlers of chemicals and materials);
- Employer;
- Toxicologist;
- Environmental Professional;
- Healthcare Professional (e.g., physician, registered nurse, physician's assistant);
- Occupational Health and Safety Professional (e.g., industrial hygienist);
- Transportation Professional (e.g., transporters and drivers);
- Others, including state and local emergency planning groups, members of the community, etc.

Examples of some areas where technical language may be appropriate are: "Note to Physicians," "Toxicological Information" and "Engineering Controls." When technical language is necessary in sections targeted for non-technical audiences, it is advisable also to include a less technical explanation.

Word choice and sentence structure greatly affect reading level and comprehension. In addition, phrases must be worded carefully to avoid confusion, especially if they will be translated into other languages where the meaning could become obscured. The following guidelines may be helpful in improving the readability and comprehensibility of the MSDS:

- Keep sentences short and direct. Use no more than two subordinate clauses.
- Use the active voice as much as possible.

EXAMPLE:

- Acid causes skin burns. (active)
- Burns to the skin are caused by acid. (passive)

- Instructions are more likely to be followed when consequences are described.
- Use lists with bullets rather than sentences with long strings of items to improve readability.
- Choose commonly used words, but avoid colloquialisms and slang.
- Use only common abbreviations and acronyms, and then give their definition in a key/legend or as soon after their first use as possible. Occasionally, however, an abbreviation or acronym may be so familiar to intended audiences that it may be used without a definition. In fact, some may be more familiar than the full name (e.g., OSHA, EPA, SARA, °F, °C, TLV® and TWA).

4 General contents

The following items are common to MSDSs. These items are either mandatory according to the HCS or recommended to help the reader use the MSDS. The information in 4.1 – 4.10 will be helpful when designing the overall layout of an MSDS.

4.1 Internal consistency

The MSDS needs to be reviewed to determine that information present in one section does not contradict information in another section. For example, a statement indicating the absence of a skin hazard in Section 2: HAZARDS IDENTIFICATION should not be followed by the presence of detailed first aid measures for skin contact in Section 4: FIRST AID MEASURES. Refer to Chapter 4 for a more detailed discussion.

4.2 Review/preparation date

The HCS requires every MSDS to have a preparation date or the date of the last revision. Display the date in the same format on each page of the MSDS so the reader knows that the entire document is the same version. If any other dates are used, they should be clearly labeled to avoid possible confusions. All dates should be formatted to avoid confusion between month/day/year versus day/month/year formats.

4.3 Units of measure

Show numerical data with the appropriate units of measure. These units of measure should be the most commonly used for the primary receiving country. For example, English units in the United States (US) and standard international units (SIUs) in Europe and Canada; alternative units may be put in parentheses. Indicate the temperature scale of items such as flash point and boiling point, by inserting °F or °C (Fahrenheit or Celsius). Pressure and other properties should also be shown in appropriate units. For example, pounds per square inch (psi) could be used for higher pressures and millimeters of mercury (mmHg) might be appropriate for below atmospheric pressure.

For some properties (e.g., vapor pressure, viscosity, solubility), that vary with temperature or other conditions indicate the conditions under which the value was measured or calculated.

EXAMPLE:

Boiling Point = 200 °F at 10 mmHg

Vapor Pressure = 4.1 psi at 70 °F (21 °C)

Some properties are dimensionless. Density has units of weight per volume, while specific gravity is a dimensionless number. However, the standard against which specific gravity is measured (most commonly water or air) should be indicated.

4.4 No blank data fields

The HCS requires an entry for every data field listed on an MSDS. If information is not available, not applicable or not noted for a listed field, the preparer should indicate it on the MSDS accordingly.

4.5 Key/legend

In general, try to avoid abbreviations. They are often confusing or unknown. If used, include a key/legend to define abbreviations or potentially ambiguous terms. For example, N/A has been used to denote "not available" and "not applicable." Without an explanation, the meaning is unclear.

4.6 Page and section numbers

Number the pages and sections using Arabic numerals rather than Roman numerals or letters of the alphabet. Indicate the total number of pages in the document and/or the last page in the document.

4.7 Revision indicators

Use revision indicators to help users determine what has been changed in an updated MSDS. Below are some methods used to indicate revisions in either the body or in Section 16: OTHER INFORMATION.

EXAMPLES:

- This MSDS has been revised in the following section(s):
 1. PRODUCT AND COMPANY IDENTIFICATION
 9. PHYSICAL AND CHEMICAL PROPERTIES
- The symbol (*) in the margin of this MSDS indicates that this line has been revised.
- The personal protection section of this MSDS was revised due to new recommendations.
- The pH was added to Section 9.

4.8 MSDS identifier

The preparer may assign an identifier (e.g., a number or code) to an MSDS to help track and identify it. It should appear on every page to make sure that all the pages are for the same product. It may also appear as part of Section 1: PRODUCT AND COMPANY IDENTIFICATION.

4.9 Disclaimer

The disclaimer is usually intended to provide limits on the liability of the MSDS preparer when the specific material is used, misused, handled or stored in a way that is not customary nor reasonably foreseeable. The use of a disclaimer is optional, is usually determined by a preparer's legal counsel and is typically found at the end of an MSDS.

4.10 Headers/footers

A header/footer may be used to indicate information intended to be listed on all pages, such as product name, preparation date, version, indication of continuation, etc. Ensure that enough space is allowed so that footers are not cut off when copying, faxing, etc.

5 Hazard assessment

The HCS requires that the MSDS present the known hazards of the material. The properties, characteristics and composition of the individual material are variables that can affect the hazard.

5.1 Collecting the information

As a first step, a preparer needs to collect information about the material. The types of information needed include:

- all components and known impurities, with Chemical Abstract Service (CAS) registry numbers where available and concentrations;
- physical, chemical and environmental characteristics;
- uses and reasonably foreseeable misuses;
- toxicity information obtained from:
 - internal company testing;
 - MSDSs or letters from suppliers;
 - published sources of information;
 - trade association testing or communication;
- Appendix C of the HCS, which provides a recommended base listing of outside sources for hazard information;
- Annex D of this Standard, which provides a list of useful resources for MSDS preparers.

The preparer should document the references and sources of information used in the hazard evaluation. This information will provide needed internal documentation. It will also help an MSDS preparer update the MSDS, answer inquiries and provide a historical reference.

5.2 Determining hazards

To perform a hazard determination, the collected data are assessed according to the appropriate regulatory criteria. The criteria for hazard determination in the Globally Harmonized System (GHS), Canada, the European Union and other legal jurisdictions, are different from the criteria used under the HCS. The assessment forms the basis for what is written on the MSDS. Professional judgment plays an important role in determining hazards.

When the physical, health and environmental hazards have been identified, their impact on all relevant sections of the MSDS shall be evaluated. Each of the other sections in the MSDS builds on or supports the hazards identified in this step.

5.2.1 Physical hazards

In assessing physical hazards of the material, primary sources of information are actual test data for the material or calculations from data on components. The HCS defines criteria for physical hazards, which are often numeric (e.g., flash point).

5.2.2 Health hazards

Health hazards are generally based on known human health effects or toxicity testing as described in Appendix A of the HCS. With health hazards, evaluations tend to rely more on interpretation and professional judgment on relevance of the data than in the case of physical hazards.

The MSDS preparer must refer to the complete mandatory Health Hazard Determination description found in Appendix B of the HCS. Key concepts taken from the HCS are as follows:

- One scientifically valid study with statistically significant results is sufficient evidence to note the effect on the MSDS;
- Chemicals are considered “hazardous” if they:
 - are regulated by OSHA (29 CFR 1910, Subpart Z);
 - have established occupational exposure limits (e.g., TLV, PEL, etc.);
 - are listed by NTP, IARC (see Glossary) or OSHA as carcinogens or potential carcinogens;
 - meet the criteria of Appendix B of the HCS.
- Evaluation of untested mixtures requires that the mixture be assumed to present the same health hazards as the components present above the OSHA threshold. The basic rule is that if there is no appropriate testing on the mixture, one shall address the health effects of all chemicals in the mixture present at concentrations of 1% or greater (threshold is 0.1% for carcinogens or potential carcinogens);
- If a hazardous component is present in a mixture below the 1% threshold (0.1% for carcinogens) and could be released in concentrations exceeding OSHA or ACGIH exposure guidelines the mixture is assumed to present the same hazard as the components;
- If a hazardous component is present in a mixture below the 1% threshold (0.1% for carcinogens) and could still present a hazard, the mixture is assumed to present the same hazard as the components;

- Where the manufacturer is aware of a use that results in the release of a new chemical to which there may be an exposure, the manufacturer should include the hazards of the released chemical. Examples include fumes from the use of welding rods, the use of diesel fuel resulting in exhaust, polymer process fumes, etc.

The *American National Standard for Hazardous Industrial Chemicals – Precautionary Labeling* (ANSI Z129.1-2000) also provides a discussion of the health hazard evaluation.

5.2.3 Environmental hazards

The HCS does not require an environmental determination, but criteria for making environmental hazard determinations can be found in The Globally Harmonized System of Classification and Labelling of Chemicals (GHS); and in the European Union (EU) and International Maritime Organization (IMO) regulations. It may be useful to refer to these criteria in deciding whether to include environmental hazard statements in your MSDS. See Chapter 5 for references.

Environmental hazards are generally based on ecotoxicological testing as well as environmental fate data. Like health hazards, environmental evaluations also tend to rely on interpretation and professional judgment on the relevance of these types of data. Conveying major potential environmental hazards in the MSDS is highly useful as it can influence the proper handling and disposal of a material.

Chapter 3

Sections of an MSDS

1 Section 1: PRODUCT AND COMPANY IDENTIFICATION

Purpose: This section names the material and links the MSDS to the label and shipping documents. It also identifies the manufacturer and provides a mailing address and contact phone number.

Audience: This information is intended for all MSDS users.

Scope: The identity of the material and the manufacturer shall be directly linked to the name found on the material label and/or shipping papers. This name should appear prominently on each page. The material may also be identified by alternative names, numbers, company product codes, Universal Product Code (UPC) or other unique identifiers. Synonyms may be used. A company may choose to use the same MSDS format for countries outside of the United States. Refer to appropriate regulations for specific modifications (e.g., a brief phrase describing product use is required for Canada and the EU).

If one generic MSDS is used to cover several grades or minor variants of a material, all grades or material names must be listed on the MSDS or the MSDS must clearly delineate the range of materials included.

EXAMPLES:

- The MSDS for Methyl Substituted Quinolites must contain the identifiers found on the label (e.g., Methoquin AB, Methoquin CD).
- The MSDS for Polypropylene 5000 Series (5000–5999) is the material name and the label states the specific name (e.g., Polypropylene 5005).

If an optional MSDS number or code is used to help identify the MSDS, it may appear within this section in addition to appearing on each page of the MSDS.

The name of the manufacturer, importer or other responsible party, along with a mailing address and phone number for obtaining additional information, must be included. An Internet website may also be included. In addition, a company may have a specific telephone number for quick response to emergencies or for DOT regulatory compliance purposes. This number should be readily identifiable on the MSDS. Many companies include references to emergency information services on their MSDS (e.g., CHEMTREC, CANUTEC [see Glossary]). Consult with the service provider before referencing the service on an MSDS, label, etc. Use of these emergency information services requires prior authorization and supply of current MSDSs.

Indicate if the telephone numbers have any restrictions, such as hours of operation (e.g., Monday – Friday, 8:00 a.m. – 6:00 p.m. EDT or 24 hours) or are limited to a specific type of information (e.g., general information, medical emergencies, transportation emergencies). If your data sheet is intended for foreign distribution, foreign emergency numbers should be included if available. If the US number is intended to respond to foreign emergencies, there should be an indication that the number is a United States phone number (e.g., (01) (201) 555-1212 [USA]).

2 Section 2: HAZARDS IDENTIFICATION

2.1 Emergency overview

Purpose: This overview describes the material's appearance and most significant immediate concerns.

Audience: Developed primarily for Emergency Responders, but useful for all MSDS users.

Scope: This subsection includes the physical state of the material and those health, physical and environmental hazards that require immediate attention in emergency situations. Labeling statements of hazard and other appropriate label statements will often be suitable to describe the hazards listed in this section. Generally, if a hazard is not included on the label, it would not be included in the Emergency Overview.

This overview should be the first part of Section 2: HAZARDS IDENTIFICATION. It can appear as a paragraph or as a list of statement of hazards, such as those derived using ANSI Z129.1-2000 or its subsequent revisions.

Items considered for the Emergency Overview include:

- What does the material look like? (e.g., color, physical form, shape)
- Does it have a distinctive odor? (e.g., sweet, acrid, sour)
- Can the vapors be seen? (e.g., color)

The Emergency Overview should also address hazards that, in an emergency situation, can cause severe immediate effects or that require immediate recognition to prevent subsequent serious effects. Following are some questions that may help determine severe immediate hazards:

- Does the material require a signal word such as those derived using ANSI Z129.1-2000 or its subsequent revisions or other applicable standards, etc.? (e.g., WARNING, DANGER)
- Is the material flammable, combustible or explosive?
- Does it present any significant or unusual fire or explosion hazard? (e.g., travels to source of ignition, forms explosive mixtures)
- Is the material an oxidizer, organic peroxide, pyrophoric, unstable (reactive) or water reactive?
- Are there significant reactivity hazards associated with emergency conditions? (e.g., uncontrolled reaction with water or organics, material will spontaneously decompose)
- Is the material shipped under pressure? (e.g., compressed gas, liquefied gas)
- Is the material highly toxic (OSHA) or poisonous (DOT)? If so, by what route of entry?
- Is the material dangerous when inhaled? (e.g., strong CNS depressant, corrosive, asphyxiation hazard, respiratory sensitizer)
- Does it cause burns to living tissue? (e.g., corrosive to skin, eyes, respiratory tract)
- Does it cause severe skin and/or eye irritation?

- Does it cause an allergic skin reaction?
- Does it require specialized medical treatment for any contact or exposure? (e.g., cyanide poisoning)
- Is it a confirmed, probable or possible human carcinogen? (NTP Report on Carcinogens, IARC Group 1, 2A or 2B, or OSHA listed carcinogen)
- Can a single exposure result in other serious adverse health effects? (e.g., delayed lung effects after short term exposure to oxides of nitrogen [NO_x])
- Is it highly toxic to aquatic organisms? (e.g., kills fish or algae at low concentrations)
- Will it be persistent in the environment? (e.g., PCBs, mercury)

EXAMPLE: Paragraph style

DANGER

A colorless liquid that can react violently with water, producing invisible clouds of toxic and corrosive vapor. Extremely corrosive to all body parts. May be fatal if swallowed or inhaled. Exposures require specialized first aid and medical follow-up. Not flammable, but reacts with most metals to form flammable hydrogen gas.

EXAMPLE: Label style

A milky white liquid with a strong, sweet odor.

WARNING

May cause eye irritation.

Will burn in a fire.

Extremely slippery when spilled.

Material is highly toxic to fish.

Hazard symbols, depicted as either black and white renditions or the symbol's name, may be included per international regulations.

If the material is not a significant, immediate concern for Emergency Responders, a statement indicating that it presents little or no hazard (if spilled) and/or no unusual hazard if involved in a fire may be included.

2.2 OSHA regulatory status

Purpose: The HCS status is very helpful in determining whether other HCS requirements such as formal training and worker access to the documents are needed.

Audience: This information is intended for all MSDS users.

Scope: To indicate the status of the material with respect to the HCS.

Indicate the status of the material with respect to the HCS. The HCS status (i.e., hazardous or non-hazardous) can be placed in the section's first page and be very helpful to determine whether formal training and other activities under the HCS are required. Three suggested phrases are:

- (1) This material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

(2) While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this MSDS contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available for employees and other users of this product.

(3) This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

A company may choose to use the same MSDS format for countries outside of the United States. Refer to appropriate regulations for specific modifications.

2.3 Potential health effects

Purpose: This subsection provides information on the potential adverse health effects and symptoms associated with exposure to the material and its components or known by-products, taking into consideration the customary and reasonably foreseeable use, misuse, handling and storage conditions. See Chapter 2 of this Standard for discussion of the hazard determination process.

The information should be presented in a manner that is easily understood by all audiences, ranging from the community and employees to health and medical professionals, since it is the primary source of health effect information for the material. It will aid in determining handling and other procedures.

Audience: This information is intended for all MSDS users.

Scope: This subsection includes information related to human health effects, if known, or presumed likely as a result of non-human studies. It reports only health effects relevant to humans and presents them in a way that can be quickly and easily understood. Signs and symptoms of exposure and medical conditions generally known to be aggravated by exposure to the material should be included. Supporting toxicology and epidemiology summaries or data where the relevance to human health is unclear should be included only in Section 11: TOXICOLOGICAL INFORMATION.

The MSDS should include the following elements, if applicable or known:

- relevant route(s) of exposure (e.g., eye, skin, inhalation, ingestion);
- frequency and duration of exposure (e.g., single, repeated, lifetime);
- severity of the effect (e.g., mild, moderate, severe);
- target organ(s) (e.g., liver, kidney, lung, skin);
- type of effect (e.g., irritation, allergic skin reaction, birth defects, cancer, blood effects);
- signs and symptoms of exposure;
- medical conditions or medication interactions generally known to be aggravated by exposure to the material;
- interactions with other chemicals known to enhance toxicity (e.g., methyl ethyl ketone increases n-hexane neurotoxicity).

For mixtures, the specific components that are the source of the hazard may be identified here or in another section, such as Section 11: TOXICOLOGICAL INFORMATION.

Carcinogens or potential carcinogens listed by OSHA, IARC or NTP shall be identified. Include them in this subsection during the discussion of health hazards or identify the hazard in this section and note the listing of the chemical in a separate section, such as Section 3: COMPOSITION/INFORMATION ON INGREDIENTS, Section 15: REGULATORY INFORMATION or Section 16: OTHER INFORMATION.

If there are data on a material that indicates that there are no significant health effects, this may be included on the MSDS. Although there is no OSHA regulatory requirement that "negative" test results (i.e., no adverse effects) be included on the MSDS, this fact may be important to the MSDS reader. It should be mentioned in Section 11: TOXICOLOGICAL INFORMATION and may also be included in Section 2.

EXAMPLE:

EYE

- May cause slight irritation.

SKIN

- Prolonged exposure may cause skin irritation.
- A single, prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts.

INGESTION

- Material is slightly toxic.
- Small amounts (a teaspoonful) are not likely to cause damage.

INHALATION

- Material is rapidly absorbed through the lungs.
- May cause damage to liver and kidneys.
- Overexposure may cause central nervous system depression, including drowsiness and unconsciousness.
- May cause irregular heartbeats, especially under conditions of stress.

CHRONIC EFFECTS

- Prolonged or repeated overexposure causes liver and kidney damage.
- May cause cancer based on animal studies.
- Listed as probable human carcinogen by IARC (Group 2A).
- The material has been tested in rats and found to cause no significant reproductive effects.

SIGNS AND SYMPTOMS

- Eye and skin irritation (redness or swelling); drowsiness or unconsciousness; and irregular heartbeats.
- Kidney damage may be seen by changes in urine output, urine appearance or edema (swelling from fluid retention).
- Liver damage may be seen by loss of appetite, jaundice (yellowish skin color) and occasional pain in the upper abdomen.

See Section 11: TOXICOLOGICAL INFORMATION.

2.4 Potential environmental effects

Purpose: This subsection may be used to provide information on the potential effects associated with release of the material and its components or known by-products into the environment.

Audience: This information is intended for all MSDS users.

Scope: This subsection includes information related to significant environmental hazards. It reports only relevant effects and presents them in a way that can be quickly and easily understood.

If the relevance to environmental fate and effect is unclear, the potential effects should be reported in Section 12: ECOLOGICAL INFORMATION, where appropriate discussion of the study can be made. This type of data presentation can be used to improve the readability of the document across audiences.

If there are no significant environmental effects, this may be included on the MSDS. Although there is no regulatory requirement that “negative” test results be included on the MSDS, this fact may be important to the MSDS reader. It should be mentioned in Section 12: ECOLOGICAL INFORMATION and may also be included in Section 2.

For mixtures, the specific components that are the source of the hazard may be identified here or in another section, such as Section 12: ECOLOGICAL INFORMATION.

EXAMPLES:

- Toxic to aquatic organisms.
- May cause long-term adverse effects in the aquatic environment.
- Not considered to be harmful to aquatic life.
- The material has been tested in algae and found to cause no significant toxic effects.

See Section 12: ECOLOGICAL INFORMATION.

3 Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

Purpose: This section identifies the components of a material.

Audience: This information is intended for all MSDS users.

Scope: All components, by-products and impurities that contribute to the hazards of the material or which otherwise meet the HCS criteria of a hazardous ingredient should be included in this section.

Manufacturers may choose to include other significant components including non-hazardous impurities and by-products, and chemicals covered under other federal, state or local regulations. Some manufacturers may choose to use this section for full ingredient disclosure. If a manufacturer chooses to list hazardous and non-hazardous components, it is useful to differentiate between the two.

When evaluating components for inclusion in this section, be aware of unique classes of materials. These materials may be hazardous reaction products formed during normal use (intended or unintended chemical generation), complex streams from a refining process or other "complex mixtures" where the identity of individual components may be unknown or may vary. Complex chemical mixtures that are recognized as single substances may be listed as a single component. If cited hazards are attributed to a component of the complex mixture, then it is advisable to indicate its presence; however, often it is not possible to distinguish the exact component responsible for the hazards of the "complex mixture" (e.g., gasoline, creosote).

- Exposure limits (e.g., PELs, TLVs, STELs) should not be included in this section. They should be located in Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION only.
- The regulatory status of components that appear on specific lists (e.g., SARA Title III; CERCLA) should not be included in this section. They should be located in Section 15: REGULATORY INFORMATION only.
- A company may choose to use the same MSDS format for countries outside of the United States. Refer to appropriate regulations for specific modifications.
- List components by chemical name, common name or synonym of component. The following three options may be used for listing components:
 - Option 1 – Hazardous components only (the minimum required under the HCS)
 - Option 2 – Hazardous components plus other significant components
 - Option 3 – Full disclosure of components

For any of these three options, the following approaches should be used:

- List corresponding CAS registry numbers, confidential chemical inventory number or trade secret registration numbers (i.e., New Jersey, Canada), where available.
- Provide percentages or ranges of percentages by weight or volume (state which) unless percentages are trade secrets.
- If one or more components are a trade secret, a company may indicate this by identifying the component(s) either by use of the words "proprietary" or "trade secret" or by describing the component(s) generically.

4 Section 4: FIRST AID MEASURES

4.1 First aid procedures

Purpose: This section is intended to provide appropriate emergency and first aid instruction. Provide instruction for each applicable route, in plain language, when the results of exposure require immediate treatment (first aid) and when simple measures may be taken before professional medical assistance is available. First aid procedures should be brief and easily understood by any untrained individual. As many common first aid terms may have different meaning or understandings in other languages or cultures, caution must be used to ensure that contents are easily understood. It may also be appropriate to include specific information (e.g., antidotes) for emergency responders and trained healthcare professionals.

Audience: This information is intended for all MSDS users.

Scope: Recommended first aid should be appropriate to the effects described in Section 2.3. When no effects are noted, first aid is not necessary. However, a statement about normal hygiene practices is appropriate. The following instructions should be observed when describing first aid measures in this section:

- Provide instructions by route of exposure. Use subheadings to indicate the procedure for each route (e.g., inhalation, skin, eye and ingestion). Arrange these subheadings in the same order as those in the Potential Health Effects heading, if appropriate;
- Instructions should be consistent with first aid statements included on precautionary labeling;
- Include simple remedial measures (e.g., wash contacted area, remove clothing, remove the exposed individual) if it will lessen exposure;
- If applicable, include information on first aid for exposures that result from a specific method of handling as opposed to the toxicity of the material (e.g., frostbite from cryogenic liquids or thermal burns from molten solids);
- Indicate whether immediate medical attention is required and if delayed effects can be expected after exposure. When there is no specific information, the following types of information should be cited, based on sound professional judgment:
 - removal of exposed individual from area (to fresh air);
 - removal of material from individual;
 - advice on removal and handling of contaminated clothing and shoes;
 - advice on whether to get immediate medical assistance.

A brief description of the most important symptoms and effects, especially when useful for diagnostic and further treatment, may be given here, but a detailed description of symptoms and effects should be given under Section 2: HAZARDS IDENTIFICATION.

- If appropriate, include any known antidotes that may be administered by persons trained in their use as part of the recommended first aid procedure.

- Use of “No Antidote Known” is not recommended, as this may create anxiety and misunderstanding concerning the toxic potential of the material.

4.2 Note to physicians

Purpose: This subsection conveys additional information on antidotes, specific treatments and diagnostic procedures outside of usual and customary practices administered by healthcare professionals.

Audience: This information is intended for healthcare professionals.

Scope: This subsection is recommended only where specific information is available. The information included here can relate to both immediate and delayed effects. The information can address both treatment/therapy and diagnostic procedures. Some considerations include the following:

- Clinical testing and medical monitoring for delayed effects should be discussed here.
- Recommend specific procedures for treatment. This would include details on emesis, lavage or antidotes.
- Treatment/therapy and diagnostic procedures which may be affected by preexisting medical conditions and involve a medical judgment, should be discussed here.
- Indicate when usual and customary procedures should not be performed due to contraindications.

EXAMPLE:

This product is not an inhibitor of cholinesterase. Treatment with atropine and oximes is not indicated.

EXAMPLE:

Treat any burns as thermal burns, after decontamination.

5 Section 5: FIRE FIGHTING MEASURES

Purpose: The information should describe the specific hazards arising from the fire and explosive properties of the material, the appropriate extinguishing media for the fire and special protective equipment and precautions for fire fighting.

This section is not intended to deal with non-emergency situations, such as proper handling and storage of flammables nor thermal stability of materials. Such information belongs in Section 7: HANDLING AND STORAGE and Section 10: STABILITY AND REACTIVITY.

Under certain stated conditions it may not be safe or advisable to extinguish a fire. In these instances the limiting conditions should be clearly stated.

Audience: This section is intended for employers, employees, emergency responders, and occupational health and safety professionals.

5.1 Flammable properties

Scope:

Qualitative flammable properties and reactivity hazards that enhance the fire and explosion potential such as those listed below should be stated in this section:

EXAMPLES:

- Powdered material may form explosive dust-air mixture.
- Contact with combustible materials may cause fire.
- Forms peroxides of unknown stability.

Flammable properties, such as flash point and flammable (explosive) limits that describe the potential fire hazard of a material, are considered as basic physical properties and belong in Section 9: Physical and Chemical Properties. This section may direct the reader to Section 9 for flammable properties. The flammable properties may be repeated in this section if they are considered useful in fire fighting of certain kinds of materials or in certain industries.

Specific flammability classifications such as that of National Fire Protection Association (NFPA) may be introduced in this section if they are particularly useful for certain materials or in certain industries.

5.2 Extinguishing media

Scope:

Note the appropriate (suitable) extinguishing media that should be utilized in the event or threat of a fire as well as those extinguishing media that should be avoided (unsuitable). If applicable, additional guidance should also be provided regarding the appropriate application of suitable media, the reasons that specified media are unsuitable and further insight on the characteristics or use of specified media.

5.2.1 Suitable extinguishing media

Specify suitable extinguishing media for a fire. Provide additional details on nature and use of media if warranted. A distinction should be made between the use of media to extinguish a fire versus as a precautionary measure to the threat or impact of a fire.

EXAMPLES:

- Use foam, carbon dioxide (CO₂) or dry chemical to extinguish fire. Caution: CO₂ will displace air in confined spaces and may cause an oxygen deficient atmosphere.
- Limit use of water spray to cool fire-exposed containers and to protect personnel.

5.2.2 Unsuitable extinguishing media

Identify unsuitable extinguishing media for a fire. The reason(s) why it is inappropriate should also be noted.

EXAMPLES:

- Water may not be effective to extinguish fire.
- Spattering of flammable liquid may result from spraying water.

5.3 Protection of firefightersScope:

In a fire situation, awareness of physical, chemical and thermal hazards is necessary so that protection of human health can be ensured. Proper instructions to firefighters can also help minimize impacts to the environment and property loss.

Guidance to firefighters should reflect the specific properties of the material because of difficulties in anticipating the size of the fire, the amount of material(s) involved, the immediate surroundings and other factors. All properties of the material that are likely to be hazardous must be considered, whether the material is burning or in proximity to other burning material.

5.3.1 Specific hazards arising from the chemical (e.g., nature of any hazardous combustion products)**— Physical hazards**

Some physical hazards to consider are explosive decomposition and violent rupture of containers caused by thermal expansion of compressed gases and liquids or by hazardous polymerization.

— Chemical hazards

Chemical hazards result most often from toxicity or corrosivity of either the material itself, its thermal decomposition products or from the contact of the material with surrounding substances including metals, air and water. Provide warnings concerning the expected route of exposure. In addition, highlight any conditions that are exacerbated or created by the conditions of a fire. For example, a material with high toxicity by inhalation but a low vapor pressure at ambient temperatures will be much more hazardous in a fire than under normal conditions.

The potential release of toxic products of combustion, such as carbon monoxide, should be mentioned. Since a variety of combustion products are possible from a given material, depending on fire conditions, a brief statement may be all that is appropriate. The MSDS should identify likely toxic components if the "smoke" (products of combustion) could be an unusually greater hazard than might occur in a typical structural fire.

EXAMPLES:

- acrid fumes including compound X
- possible cyanide-containing fumes
- highly toxic fumes of hydrogen fluoride

— Thermal hazards

Thermal hazards occur when burning materials give off intense heat, causing an increased likelihood that the fire will spread.

EXAMPLES:

- Containers can rupture and release highly toxic vapors or decomposition products if exposed to heat.
- Hazardous polymerization may take place during a fire due to heat. Closed containers could violently rupture.

5.3.2 Protective equipment and precautions for firefighters

Instructions for firefighters should be written to allow them to rapidly determine a strategy for controlling and containing a fire while protecting themselves.

— Standard protective equipment and precautions

Standard protection for all firefighters stated in this subsection of the MSDS text should include self-contained breathing apparatus (SCBA) and full fire fighting turn-out gear (Bunker gear).

— Specific protective equipment and precautions

For specific materials where this is not adequate protection, make further recommendations based upon the description of the specific hazards of the material in 5.3.1 above.

Additional examples of topics to address here are: warnings against flashback of flammable vapors; spattering and frothing from spraying water; using foam on high flash point liquids; using water spray to cool containers; establishing access points upwind of the hot zone; or creating a containment plan and measures for limiting environmental impact.

EXAMPLES:

- Stop flow of gas before attempting to extinguish fire.
- Evacuate area and fight fire from a safe distance.
- Keep upwind of fire. Wear full fire fighting turn-out gear (full Bunker gear) and respiratory protection (SCBA). Cool container with water spray.

6 Section 6: ACCIDENTAL RELEASE MEASURES

Purpose: This section contains information for responding to spills, leaks or releases in order to prevent or minimize the adverse effects on persons, property and the environment.

Audience: This information is intended for employees, employers, emergency responders, occupational health and safety professionals, and transportation professionals.

6.1 Personal precautions

Scope: Include information on personal protective equipment and precautions relating to spills and releases of the material. Examples could include removal of ignition sources for flammable materials, evacuation procedures, warnings to stay upwind, and securing the area. It may be useful to indicate when no special instructions are necessary or reference other sections that could be helpful. Include a statement that refers readers to personal protective equipment specified in the Section 8: EXPOSURE CONTROL/PERSONAL PROTECTION.

EXAMPLE:

Use personal protection recommended in Section 8. Isolate the hazard area and deny entry to unnecessary and unprotected personnel.

6.2 Environmental precautions

Scope: Include information on equipment and environmental precautions relating to spills and releases of the material.

EXAMPLE:

This material is a water pollutant. Keep out of drains, sewers, ditches and waterways. Minimize use of water to prevent environmental contamination.

6.3 Methods for containment

Scope: Include information on techniques and equipment to contain (e.g., diking or capping) or prevent further spread of spilled material or leaking containers. Where appropriate, distinguish between responses for large and small spills. It may be useful to indicate when no special instructions are necessary.

EXAMPLE:

Contain spilled liquid with sand or earth. DO NOT use combustible materials, such as sawdust.

6.4 Methods for clean-up

Scope: Include information on techniques (e.g., neutralization, decontamination, absorption, sweeping, vacuuming) and equipment (e.g., non-sparking tools) to clean-up spilled or leaked material and decontamination of the site. Where appropriate, distinguish between responses for large and small quantities of material. It may be useful to indicate when no special instructions are necessary.

EXAMPLE:

Eliminate all ignition sources. Use explosion-proof equipment. Dust can be a fire or explosion hazard. Vacuum or sweep material and place in a disposal container.

6.5 Other information

Scope: There may be specific reporting requirements associated with spills, leaks or releases. It may be useful to reference such reporting requirements in this section or in Section 15: REGULATORY INFORMATION.

EXAMPLE:

US regulations require reporting spills of this material that could reach any surface waters. The toll-free phone number for the US Coast Guard National Response Center is 1-800-424-8802.

7 Section 7: HANDLING AND STORAGE

7.1 Handling

Purpose: This subsection provides guidance on safe handling practices.

Audience: This information is intended for employees, occupational health and safety professionals and employers.

Scope: Emphasize precautions that are proper for the unique properties of the material rather than reviewing general good industrial practices.

Note or reference specific regulatory requirements that may exist for the safe handling of the material.

List handling practices that:

- minimize contact between the worker and the material;
- minimize risks from fire for flammables and combustibles or dangerous reactions with incompatible materials;
- minimize release of the material to the environment.

Include general warnings on what practices to avoid or restrict.

Standard precautionary label statements are suitable text for this section. (Refer to *American National Standard for Hazardous Industrial Chemicals – Precautionary Labeling*; ANSI Z129.1-2000.)

EXAMPLES: General warning to prevent exposure:

- Do not breathe (dust, vapor, mist, gas).
- Avoid contact with skin, eyes or clothing.

EXAMPLES: General hygiene recommendations to prevent continued exposure:

- Wash thoroughly after handling.
- Destroy contaminated shoes in proper manner.

Include handling practices, such as how to prevent vapor release, the need for a totally enclosed system, and other useful practices.

EXAMPLES:

- To avoid sudden release of pressure, loosen closure cautiously before opening.
- Minimize dust generation and accumulation.

Include statements about use of nonsparking tools, explosion-proof equipment and grounding when handling flammables.

EXAMPLES:

- To reduce potential for static discharge, bond and ground containers when transferring material.
- Use spark-proof tools and explosion-proof equipment.

List which practices should be followed to avoid dangerous reactions, such as inert gas blanketing, not using oil in equipment used for strong oxidizers, or not opening drums that could be under pressure.

EXAMPLES:

- Keep under nitrogen blanket.
- Use only clean, dry utensils in handling.

Include precautions about handling molten or hot materials, and cryogenics.

EXAMPLE:

Heat resistant gloves are recommended when handling molten materials.

7.2 Storage

Purpose: Provide information about appropriate storage practices.

Audience: This information is intended for employees and employers, including those involved in storage or transport of the material.

Scope: Emphasis should be placed on avoiding unusual or unique conditions that could injure individuals working with the stored materials as well as damage physical structures. Consider: explosive atmospheres, corrosive conditions and flammability hazards.

Consider conditions that could damage or destroy the product and its container, incompatible materials, evaporative conditions and ambient conditions (e.g., pressure, temperature, humidity, vibration). Include information on conditions necessary to maintain the integrity of the material. Note the need for any special construction materials necessary for packaging. Such information is required on MSDSs intended for jurisdictions such as the European Union. Note or reference specific regulatory requirements that may exist for the safe storage of the material.

EXAMPLE: Molten material

Solidifies at about ____ °F (____ °C) and may break container. Store in moderately warm place.

8 Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Exposure guidelines

Purpose: This subsection identifies established exposure guidelines for the material and/or its components.

Audience: This information is intended for occupational health and safety professionals, employers and employees.

Scope: OSHA PELs, ACGIH TLVs and BEIs, and established company exposure guidelines shall be listed in the MSDS for a pure material and for the components of a mixture which are required to be disclosed by regulation. Include other exposure guidelines at your discretion. These may include limits that are appropriate for other countries where the material may be used, and/or state-mandated PELs.

Exposure guidelines should indicate the identity of the material or the component, list the exposure limit including units of measure, specific notations (e.g., skin, ceiling or STEL) and exposure limits based on non-standard timeframes. The chemical names should match the names of the components listed in Section 3. If a TLV or PEL has a different name than the name of that component in Section 3, it should be explained to avoid confusion.

EXAMPLE: Exposure guidelines presented as text

Exposure guidelines:

methylchemical – TWA 100 ppm, STEL 150 ppm (OSHA AND ACGIH)
– TWA 50 ppm, STEL 100 ppm (XYZ Company)

ethylchemical – TWA 50 ppm, STEL N.E.

propylchemical – TWA 200 ppm, STEL 250 ppm (skin)

butylchemical – TWA 250 ppm (ACGIH)

(N.E. – Not Established)

EXAMPLE: Exposure guidelines presented as table

Exposure guidelines:

Component	OSHA		ACGIH		XYZ Company		Unit
	TWA	STEL	TWA	STEL	TWA	STEL	
methylchemical	100	150	100	150	50	100	ppm
ethylchemical	50	N.E.	50	N.E.	N.E.	N.E.	ppm
propylchemical	200(s)	250(s)	200(s)	250(s)	N.E.	N.E.	ppm
butylchemical	N.E.	N.E.	250	N.E.	N.E.	N.E.	ppm

(s) – Skin

(N.E. – Not Established)

8.2 Engineering controls

Purpose: This subsection discusses the engineering controls that may be appropriate to help minimize chemical or physical hazards.

Audience: This information is intended for employers, employees and occupational health and safety professionals.

Scope: This subsection includes any generally applicable engineering control measures, including ventilation needs and special process conditions needed to control exposures or hazards of the material during its normal anticipated use.

Include a statement such as “no specific controls are needed” for relatively innocuous materials or “handle only in fully enclosed systems and equipment” for materials that pose a high degree of hazard. Recommendations should adhere to good engineering practices. State the goals and limitations of ventilation systems and other engineering controls. These may include reducing exposures below established limits or controlling levels to minimize the potential of a physical hazard.

EXAMPLE:

Use exhaust ventilation to keep airborne concentrations below exposure limits.

Design criteria usually cannot be specified in an MSDS because of its complexity. This information is more appropriate in a technical design bulletin.

8.3 Personal protective equipment (PPE)

Purpose: This subsection provides guidance for selection of personal protective equipment (PPE) needed to minimize the potential for illness or injury due to exposure from the material.

Audience: This subsection is intended for employees, occupational health and safety professionals, and emergency responders.

Scope: Recommend PPE for each route of exposure that presents a potential hazard – inhalation, skin and eye/face. Note specific regulatory requirements for PPE (e.g., Toxic Substances Control Act (TSCA) 5(e) consent orders or significant new-use rules; OSHA chemical-specific standards).

List the preferred PPE material of construction (including eye protection, gloves, boots, etc.) as well as the recommended type of respirator, including the cartridge type. If known, also list the materials of construction and type of respirator that are NOT suitable for the product.

Emphasize the importance of minimizing or preventing contact or exposure to the product.

EXAMPLE:

Always wear a NIOSH-approved, positive-pressure, air-supplied respirator when handling this material.

Base the recommendations on the specific properties and hazards of the product. The text should cover PPE appropriate for:

— normal use and handling where the exposure potential has been determined;

- reasonably foreseeable use or misuse (e.g., emergency situations) where the potential for exposure is not well defined.

Fire fighting universally requires full respiratory protection (SCBA) and full fire fighting turnout gear (Bunker gear) to protect the wearer from a variety of hazards. If the material has some toxic hazard that could render the turnout gear inadequate under certain conditions, state this in Section 5: FIRE FIGHTING MEASURES and refer the reader to this section for further guidance.

Section 6: ACCIDENTAL RELEASE MEASURES should warn of a general need for PPE and refer the reader to Section 8 for instructions. By having all the PPE information together in this section, the reader can most effectively decide what PPE should be worn. Subsections 8.3.1 – 8.3.4 provide additional information for recommending the proper PPE.

8.3.1 Eye/face protection

Specify type of eye protection (safety glasses, goggles) and whether a face shield is necessary based on the hazard of the material and potential for contact. Include a general note on the circumstances requiring the PPE.

EXAMPLE:

Wear chemical splash goggles and face shield when eye and face contact is possible due to splashing or spraying of material.

8.3.2 Skin protection

Specify protective equipment to be worn (e.g., gloves, boots, bodysuit). Allow the reader to make decisions based on both MSDS data and an assessment of the local exposure potential.

To the extent possible, identify recommended materials of construction for protective equipment. Conversely, identify materials known to be unacceptable. Base the recommendations on laboratory permeation data, or appropriate field experience.

When specifying protective equipment for radioactive materials or those that represent a thermal hazard (e.g., molten materials, cryogenics), special consideration should be given to materials of construction and equipment design.

EXAMPLE:

Wear chemical resistant clothing such as gloves, apron, boots or whole bodysuits made from neoprene, as appropriate.

8.3.3 Respiratory protection

Identify appropriate types of respiratory protection for different conditions and the limitations on their use.

When air-purifying respirators are recommended, specify the proper purifying element (cartridge or canister).

EXAMPLE:

A NIOSH-approved air-purifying respirator with an organic vapor cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air-purifying respirators is limited. Use a positive-pressure, air-supplied respirator if there is any potential for uncontrolled release, exposure levels are not known or any other circumstances where air-purifying respirators may not provide adequate protection.

8.3.4 General hygiene considerations

This subsection can be inserted into an MSDS to provide general hygiene considerations not otherwise specified in subsections 8.3.1 through 8.3.3. It recognizes that while some materials may present no obvious hazard to health or environment, there are some general hygiene considerations that are practiced by industry and are generally applicable to industrial situations. Such considerations may include:

- Avoid breathing vapor or mist.
- Avoid contact with eyes and skin.
- Wash thoroughly after handling and before eating or drinking.

These general hygiene considerations are not material specific. If used, they are placed here to avoid diminishing the importance of the material specific recommendations. Alternatively, general hygiene considerations can be put into proper context by using some qualifying language.

EXAMPLE:

There are no known hazards associated with this material when used as recommended. The following general hygiene considerations are recognized as common good industrial hygiene practices.

9 Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Purpose: This section identifies the physical and chemical properties that characterize the material. This information is useful in determining proper product handling procedures.

Audience: This information is intended for all MSDS users.

Scope: The following properties subheadings must appear in this section, where appropriate and relevant according to the countries or regions for which the MSDS is intended and into which the product is being supplied. Some regulations (e.g., GHS) require these subheadings even if there are no data. Identify appropriate methods, units of measure or reference conditions for properties if applicable (see discussion in Chapter 2 on units of measure). If included, clearly identify specific properties that do not apply or for which data are not available. Where data for a mixture are not available but data for a major component do exist, this information may be provided with a suitable identification that the data apply to one component. It may be useful to indicate the resulting properties of a chemical which has been dissolved in water. For example, the pH of a solid is not applicable, but you may want to include the pH of an aqueous solution of a product, especially if the solution is hazardous.

- appearance (color, physical form, shape);
- odor;
- odor threshold;
- physical state;
- pH;
- melting/freezing point (specify which);
- initial boiling point and boiling range;
- flash point;
- evaporation rate;
- flammability (solid, gas);
- upper/lower flammability or explosive limits;
- vapor pressure;
- vapor density;
- specific gravity or relative density;
- solubility(ies) (specify solvent, e.g., water);

- partition coefficient: n-octanol/water;
- auto-ignition temperature;
- decomposition temperature.

While not inclusive, the following list contains additional properties that may apply only to certain materials. It is not necessary to list the following properties if data are not available or not applicable.

- heat value;
- particle size;
- volatile organic compounds (VOC) content;
- softening point;
- pour point;
- viscosity;
- bulk density;
- percent volatile;
- saturated vapor concentration (include reference temperatures);
- molecular weight;
- molecular formula.

10 Section 10: STABILITY AND REACTIVITY

Purpose: The HCS requires the disclosure of physical hazards that are associated with a material. This is accomplished by describing the status (stable or unstable) of the material along with the related conditions and consequences that are associated with a hazardous chemical reaction.

Audience: This section is intended for employers, employees, occupational health and safety professionals and emergency responders.

Scope: This section is intended to communicate the potential hazards associated with the stability and reactivity (see Glossary) of the material under specified conditions. The information that is presented in this section should be based, where available, on specific test data for the material. However, the information may also be based on general data for the class or family of chemical if it adequately represents the anticipated hazard of the material. Where test data for a mixture are not available, component data/information may be provided with a suitable identification that the data apply to a specified component. Emphasis should be placed on reactions with hazardous consequences. This section is not intended to prescribe appropriate proper handling and storage. Section 7: HANDLING AND STORAGE should be referenced for this type of information.

This section should address the following elements:

10.1 Chemical stability

Indicate if the material is stable or dangerously unstable under normal ambient temperature and pressure or anticipated storage and handling conditions. A reference should be provided to clarify the term "normal" to ensure that inappropriate assumptions are not made (e.g., 70 °F (21 °C) and 14.7 psig (760 mm Hg)).

10.2 Conditions to avoid

List conditions that may result in a hazardous situation (e.g., explosion, release of toxic or flammable materials, liberation of excessive heat, etc.) and should be avoided, such as heat, pressure, light, freezing, moisture, shock or other physical stresses. Undesirable conditions should also be specified with appropriate data if applicable (e.g., auto-decomposition temperature, sublimation point, etc.).

10.3 Incompatible materials

List specific materials or classes of chemicals (e.g., oxidizers, organics, acids) with which the product could react to produce a hazardous situation. When determining incompatibility, consider the materials, containers, contaminants and possible methods of conveyance that the product might be exposed to during transportation, storage and use.

10.4 Hazardous decomposition products

List known and reasonably anticipated hazardous materials produced as a result of decomposition, including oxidation (except burning), heating, chemical reaction with another material, electrolysis or decay. Hazardous decomposition products generally consist of flammable and toxic materials, pressure and heat.

10.5 Possibility of hazardous reactions

State if the material has the potential to undergo a chemical reaction that can result in an undesirable effect(s), such as pressure buildup, temperature increase or the formation of hazardous by-products. Hazardous reactions can include but are not limited to polymerization, decomposition, condensation and self-reactivity. A description of the reaction and the specific condition(s) that could cause or contribute to the hazardous reaction should be noted along with the associated effect(s). Additional information should be stated regarding the existence or need for stabilizers if applicable, including specific guidance on their application.

11 Section 11: TOXICOLOGICAL INFORMATION

Purpose: This section provides toxicological information (data and/or interpretation) on the material and/or its components. This section provides supporting information or additional detail for human health hazards presented in Section 2: HAZARDS IDENTIFICATION.

Audience: The information is intended for healthcare professionals, health and safety professionals, and toxicologists.

Scope: Information should be provided that can be used to assess the human health hazards or potential health effects of a material and/or its components. This information may include:

- human data (e.g., epidemiology studies, case reports, human patch tests)
- animal data (e.g., acute studies, repeat dose studies)
- in vitro data (e.g., Corrositex®; Ames tests)
- structure activity relationships (SAR): The prediction of biological and/or physiochemical activity using the results from tests on materials with similar key molecular structures, or using computer based assessments.

It may also include interpretation of data including its relevance to human health. The information should reflect a thorough evaluation of all relevant data and a scientifically defensible hazard assessment.

This section is not intended to present all known test data for the material and/or its components. Writers should use or seek professional judgment to present representative data that they feel will be most useful to intended audiences. The information should be presented in a manner that will facilitate classification by the user. Accordingly, the data must clearly indicate species, route of exposure, units of measure, and where applicable, test duration and test conditions. Studies of questionable human relevance may be included if the discussion will assist in the health hazard evaluation of the material and/or its components.

In some cases, there may be a wealth of test data available on the material and/or its components. If so, it may be desirable to summarize results by route of exposure, to discuss only selected studies, which are representative of the human health hazards reported in Section 2, or to simply provide a contact where the reader may obtain full details of the available data.

The following types of toxicity endpoints may be addressed. See Glossary, Annex C, for formal definitions of these terms. Studies which demonstrate no effect may also be included. Determination of target organ effects and species differences should be noted where appropriate. Effect and no-effect levels may be included.

- Acute dose effects: Effects that occur rapidly as a result of a single exposure or as a result of short-term exposures. (e.g., LD50, LC50).
- Repeated dose effects: Effects occurring as a result of the repeated daily exposure of experimental animals to the material and/or its components. (e.g., NOAEL, LOAEL)
- Irritation: Inflammatory effects on living tissue at the site of contact.
- Corrosivity: Visible irreversible destruction to tissue at the site of contact.

- Sensitization (skin and respiratory): The development of an allergic reaction in a substantial proportion of exposed people or animals after repeated exposure to the material and/or its components.
- Carcinogenicity: Animal studies and/or human data that demonstrate a material and/or its components causes cancer.
- Neurological effects: Effects on the structure or function of the nervous system. Effects on the nervous system and/or the production of emotional or behavioral abnormalities.
- Genetic effects: The alteration of genetic material (e.g., mutagenicity).
- Reproductive effects: Adversely affecting the ability of an organism to reproduce.
- Developmental effects: Birth defects or other effects on the developing embryo or fetus.
- Target organ effects: Effects on organ(s) or organ systems by direct or systemic exposure to the material and/or its components.

Toxicological data may be formatted in a variety of ways (e.g., by route of exposure, type of animal, or toxicological end point). The format may include data summaries on the material and/or its components, data summaries with interpretation, or narrative interpretation only (based on professional judgment) in cases where no specific judgment exists. The following are examples of how information may be presented for this section.

EXAMPLE: Data summaries on product or similar product

EYE EFFECTS: Slightly irritating to the rabbit eye. Draize Score: 18 out of 110.

SKIN EFFECTS: Slightly irritating to rabbit skin. Draize Score: 0.8 out of 8.0.
The potential for absorption through the skin in acutely toxic amounts is low; dermal LD₅₀ in rabbits: 20,000 mg/kg.

ACUTE ORAL EFFECTS: Single dose oral toxicity is practically nontoxic; the LD₅₀ in rats given the material as a 10% corn oil solution is 1,870 mg/kg for males and 3,730 mg/kg for females. Liver necrosis was observed in survivors.

ACUTE INHALATION EFFECTS: The 4-hr LC₅₀ in rats is 2,500 mg/kg (357 ppm). CNS depression would be expected. May be a cardiac sensitizer based on structural analogy.

SUBCHRONIC EFFECTS: Repeated inhalation exposure of rats for four or seven hours per day for eight days at 1,000 ppm resulted in ataxia, decreased body weight, increased SGPT, and caused increased relative liver and kidney weights with accompanying histologic changes of an adaptive nature. A two-week oral gavage study in rats given 300 mg/kg/day showed hepatic hypertrophy in females but not in males.

CHRONIC EFFECTS/CARCINOGENICITY: A bioassay was conducted by gavage in rats given 60 or 150 mg/kg/day and mice at 230 or 550 mg/kg/day. Both rats and mice showed evidence of increases in hepatocellular carcinoma and adenoma. The doses did not exceed the MTD and the material is listed as a potential carcinogen by IARC.

MUTAGENICITY: The material was negative in the Ames test. It bound covalently in vivo to DNA, RNA and tissue proteins from rats and mice when injected i.p.

EXAMPLE: Data summaries available only on components

REPORTED HUMAN EFFECTS:PRODUCT/SIMILAR PRODUCT – No human data are available for this product.

REPORTED ANIMAL EFFECTS: PRODUCT/SIMILAR PRODUCT – No animal data are available for this product.

Methylchemical: Oral LD₅₀ (rat) 110 mg/kg. Oral LD₅₀ (mouse) 100 mg/kg. Inhalation LC₅₀ (4 hrs, rat) 125 ppm, (2/6 deaths); 250 ppm (6/6 deaths). Dermal LD₅₀ (rabbits) 800 mg/kg. Skin irritation (rabbit) mild; eye irritation (rabbit) severe. Liver and kidney damage was observed in acute oral and inhalation studies.

EXAMPLE: Data summary with interpretation

Single exposure (acute) studies indicate:

Oral - slightly toxic to rats (LD₅₀ 1,900 mg/kg)

Skin Irritation - slightly irritating to rabbits

Eye Irritation - moderately irritating to rabbits

Birth defects including skeletal malformations were noted in the offspring of dogs given this product during pregnancy, but only at dosages which produced significant adverse effects in the mother. No birth defects were noted in the offspring of rats or rabbits exposed to this product during pregnancy. No effects were noted on the ability of male or female rats to reproduce when given this product in the diet for 3 generations. This product produced no genetic changes in standard tests using bacterial cells.

EXAMPLE: Data summaries in narrative form

Repeated exposure of humans to this product in controlled skin contact produced no skin irritation or skin allergy.

No skin allergy was observed in guinea pigs following repeated skin exposure. In rats and dogs, this product has a strong diuretic effect.

Following repeated exposure to this product in the feed, bladder effects were observed in rats and mice and kidney effects in female rats. Bladder stones, bladder hyperplasia and chronic inflammation were observed in long-term oral exposure studies of this product in rats or mice; kidney stones were also observed in female rats. The incidence of bladder tumors was increased in male rats and was associated with the chronic irritation from the stones.

The International Agency for Research on Cancer (IARC) has reviewed this product and determined that it is "not classifiable as to its carcinogenicity to humans (3)" (IARC Monographs, Supplement 7). This product has produced no genetic changes in standard tests using bacterial and animal cells and whole animals.

No birth defects were noted in the offspring of rats exposed to this product during pregnancy.

EXAMPLE: Interpretation only, using structure activity relationship

Neurotoxic effects, such as hind-limb paralysis, are expected for this chemical based on its structural activity relationship (SAR) to 1,3-diethylxyz.

EXAMPLE: Extensive data, call for information

There are extensive toxicological data available on the various components of this product. An adequate representation of all these data is beyond the scope of this document. If you need more information, please contact XYZ Chemical at the telephone number found in Section 1.

12 Section 12: ECOLOGICAL INFORMATION

Purpose: This section provides information to assist in the evaluation of the environmental impact of the material and/or its components if released to the environment. This section may be used to present information that supports statements of environmental hazards presented in Section 2: HAZARDS IDENTIFICATION.

Audience: This information is intended for environmental professionals and others who may be involved in evaluating use, disposal, spill control or waste treatment practices.

Scope: Information should be provided that can be used to assess the environmental hazards or potential environmental interactions of a material and/or its components. This includes environmental fate and toxicity to aquatic and terrestrial organisms. This information may include data from environmental studies and information extrapolated from similar or structurally related materials. It may also include interpretation of data including its relevance to the environment. The information should reflect a thorough evaluation of all relevant data and a scientifically defensible hazard assessment.

This section is not intended to present all known test data for the material or its components. Writers should use or seek professional judgment to present representative data that they feel will be most useful to intended audiences. The information should be presented in a manner that will facilitate classification by the user. Accordingly, the data must clearly indicate species, media, units of measure, test duration and test conditions. Studies of questionable ecological relevance may be included if its discussion will assist in the environmental hazard evaluation of the material and/or its components.

In some cases, there may be a wealth of test data available on the material and/or its components. If so, it may be desirable to summarize results by medium, to discuss only selected studies, which are representative of the environmental hazards reported in Section 2, or to simply provide a contact where the reader may obtain full details of the available data.

The following types of data may be addressed. Determination of effect and no-effect levels and species differences may be noted where appropriate.

- Ecotoxicity: Briefly discuss the acute and chronic effects of the product and/or its components
 - Toxicity to terrestrial and aquatic plants and animals (e.g., algae, invertebrates, fish and birds)
 - Toxicity to beneficial microorganisms (e.g., soil and sewage treatment microorganisms)
- Persistence/Degradability: Discuss the material's potential to degrade or be removed by biological and/or chemical processes and its potential to persist in the environment
 - Potential to undergo photolysis and/or hydrolysis
 - Potential for and rate of microbial degradation in soil, water or sediment
 - Products of degradation and their potential ecotoxicity
- Bioaccumulation/Accumulation: Discuss the potential of the material and/or its degradation products to accumulate/bioconcentrate in plants, invertebrates, fish and other aquatic organisms
 - Bioconcentration factor (BCF)
 - Octanol/water partition coefficient
- Mobility in Environmental Media: A discussion of the mobility of the material (and/or its degradation products)
 - The media/compartments (air, soil/sediment, water) into which the material partitions
 - The rate of movement through soil/sediment and/or groundwater

- Adsorption and desorption in soil
- The potential to reach groundwater and its expected effects
- Other Adverse Effects: A discussion of the material's environmental impact may not be limited to the above information. The following are examples of environmental information that may be listed and/or discussed in this section and referenced in other sections (water solubility, vapor pressure, etc.):
 - Physical/chemical properties affecting environmental fate and effects
 - Material's role in ozone depletion
 - Smog formation
 - Volatile organic compounds (VOCs) content
 - Heavy metals content
 - Hazardous air pollutants (HAPs) content

The following examples are provided to illustrate different approaches to presenting and summarizing ecological information. For all options, one can provide a phone number that may be called to obtain ecological information.

EXAMPLE: Interpretation with data on actual product

Ecotoxicological Information:

Aquatic Toxicity (Acute):

This product is highly toxic to fish and harmful to invertebrates and algae upon immediate exposure.

96-hour LC₅₀ *Salmo gairdneri* = 0.6 mg/L (nominal value).

48-hour EC₅₀ *Daphnia magna* = 30 mg/L (nominal value).

96-hour EC₅₀ *Selenastrum capricornutum* = 33 mg/L (cell numbers).

The aquatic toxicity tests were carried out using a static test system.

Terrestrial Toxicity:

No adverse effects were seen on plant germination at 10 mg/L in the following plants:

Rye grass, radish and lettuce

Chemical Fate Information:

28-day biodegradation = 40 %. The material is not readily biodegradable.

No inhibition of microbial activity was seen at 3 mg/L in a biodegradation test.

The bioaccumulation potential is low (log P_{ow} = 2.7).

EXAMPLE: Interpretation only (based on data on product)

Ecotoxicological Information:

This product is highly toxic to fish and algae upon immediate exposure.

Chemical Fate Information:

This product hydrolyzes within 5 hours. The half-life in soil is 3 days (both sandy and loam soils). There is little potential for this material to accumulate in plant or animal systems.

EXAMPLE: Data and interpretation based on major components and/or a product with a similar composition or chemistry

Ecotoxicological Information:

Aquatic Toxicity (Acute):

This product is highly toxic to fish and algae upon immediate exposure. This conclusion is based on data for Component A.

96-hour LC_{50} *Salmo gairdneri* = 9.6 mg/L (nominal value).

48-hour EC_{50} *Daphnia magna* = 30 mg/L (nominal value).

96-hour EC_{50} *Selenastrum capricornatum* = 33 mg/L (cell numbers).

The aquatic toxicity tests were carried out using a static test system.

A similar product caused no inhibition of microbial activity at 3 mg/L in a biodegradation test.

EXAMPLE: Extensive data, call for information

There are extensive ecological data available on the various components of this product. An adequate representation of all these data is beyond the scope of this document. If you need more information, please contact XYZ Chemical at the telephone number found in Section 1.

13 Section 13: DISPOSAL CONSIDERATIONS

Purpose: This section provides information that may be useful in the proper disposal, recycling or reclamation of the material and/or its container.

Audience: This section is primarily intended for environmental professionals and other technical persons or those individuals responsible for waste management activities.

Scope: This section may include information that is relevant to and will assist in determining the safe and environmentally preferred waste management options: disposal, recycling, reclamation, as well as parameters that will enhance or limit the options.

The following information may be useful:

- hazardous waste characteristic(s) or listing under applicable regulations [e.g., Resource Conservation and Recovery Act (RCRA) regulations as found in 40 CFR 261];
- discussion of physical/chemical properties that may affect disposal options (e.g., heat value) or reference to Section 9: PHYSICAL AND CHEMICAL PROPERTIES;
- advice that state or local regulations or restrictions may differ from federal regulations;
- advice that the information applies to the material as manufactured; processing, use or contamination may make the information inappropriate, inaccurate or incomplete;
- a reminder that the generator of the waste has the responsibility for proper waste identification based on characteristic(s) or listing, transportation and disposal.
- statements referring to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.

EXAMPLE: Generic language

Recover or recycle if possible.

Disposal should be in accordance with applicable regional, national and local laws and regulations. Local regulations may be more stringent than regional or national requirements.

This information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations.

If the material as supplied becomes a waste the following hazardous waste characteristic(s) or hazardous waste listing applies: insert regional, national or local hazard waste characteristic or hazardous waste listing information.

EXAMPLE: RCRA Hazardous waste if discarded

ID #P007. Recycle or incinerate at any EPA-approved facility or dispose in compliance with federal, state and local regulations.

Empty containers must be triple-rinsed prior to disposal.

EXAMPLES: Excess materials which are NOT classified as RCRA Hazardous

- If this product as supplied becomes a waste, it does not meet the criteria of a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261.
- The recommended disposal technology is solidification with stabilizing agents (such as fly ash or cement) so that no free liquid remains before disposal to a licensed industrial waste facility.

14 Section 14: TRANSPORT INFORMATION

Purpose: This section provides basic classification information and special precautionary information to help a knowledgeable user prepare a material for shipment.

Audience: This information is intended for transportation professionals (i.e., transporters and drivers), employers (including customers and distributors) and emergency responders.

Scope: This section contains information on codes and classifications for transport and any special precautionary information required by a user for transport or conveyance within or outside of their premises, differentiated by the mode of transport (i.e., land, inland waterways, sea and air). This section is not intended to contain every regulatory detail involving the transportation of a material.

14.1 Basic shipping description

Include the basic shipping description, consisting of:

- proper shipping name, which includes technical name(s) (for N.O.S. descriptions);
- hazard class; subsidiary hazard classes;
- identification number;
- packing group.

Consider indicating if a product is not regulated for shipping or if the classification changes based on quantity, packaging or method of shipment.

Additional elements that should be included, where applicable:

- hazardous substances;
- marine pollutants (Y/N), including name of marine pollutant and quantity.

14.2 Additional information

Additional information that may be included:

- other DOT requirements such as reportable quantities, modal restrictions, placarding, packaging, labeling or exemptions;
- Classification/descriptions under the U.S. Coast Guard regulations;
- classification/descriptions under international transportation regulations, including:
 - shipment by water [International Maritime Organization regulations (IMO)];
 - shipment by air [International Civil Aviation Organization (ICAO) and International Air Transport Association (IATA) regulations];
 - shipment in Canada [Transportation of Dangerous Goods (TDG) regulations];

- surface shipments in Europe [European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) and European Agreements Concerning the Carriage of Dangerous Goods by Rail (RID)]; and
- shipment in Australia [Australian Dangerous Goods (ADG) regulations].
- reference to the DOT “Emergency Response Guide”, the Federal Emergency Management Administration’s “Hazardous Materials Guide for First Responders,” the ICAO “Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods” and/or the IMO “Emergency Procedures for Ships Carrying Dangerous Goods,” as appropriate.
- reference to the Transport Canada “Emergency Response Assistance Plan,” if applicable.

Special Precautions:

- special handling procedures (i.e., refrigeration during transport);
- other special precautions.

15 Section 15: REGULATORY INFORMATION

Purpose: This section provides information on the regulatory status of a material and/or its components and its regulated uses. The information will be useful for compliance with health, safety and environmental laws and regulations.

Audience: This information is intended for employers, occupational health and safety, environmental and other regulatory compliance personnel.

Scope: The content and organization of this section depends on where the material is manufactured, its intended use or where it is marketed. This section is not intended to be a comprehensive list of the regulations that may apply to the material.

US Federal

The US Federal regulations, statutes and agencies to consider include the following: OSHA, TSCA, FIFRA, CERCLA, SARA Title III, CAA, CWA, SDWA, FHSA, DEA and FDA/USDA. (Acronyms are defined in the Glossary.)

- OSHA – indicate chemical-specific standards that may apply to this material or its ingredients;
- TSCA – indicate the material's inventory status or whether it is exempt from TSCA. Identify other sections of TSCA that may apply;
- CERCLA – indicate the reportable quantity (RQ) of the material.
- SARA Title III – indicate information on the material that may include the following:
 - Section 302 Extremely Hazardous Substances (EHS): Provide the chemical identity of the listed substance, its threshold planning quantity (TPQ) and its RQ;
 - Section 311/312: List the hazard class(es) of the material;
 - Section 313 Toxic Chemicals: Provide the chemical identity of the listed substances, its CAS Registry number or other designation reference, and its percent (%) by weight. This data element can be used for EPCRA supplier notification (40 CFR 372.45 (c) (5)).

International regulations to consider include the following:

- Canada
 - Workplace Hazardous Materials Information System (WHMIS) status and classification;
 - Canadian Environmental Protection Act (CEPA);
 - Export Notification requirements;
 - Canadian Domestic Substances List (DSL).
- European Union
 - European Inventory of Existing Commercial Chemical Substances (EINECS)
 - European classification including Symbols, Risk and Safety phrases.

- Other Chemical Inventories
 - e.g., Japan, Korea, China, Australia, Philippines.
- Product Registrations
 - e.g., China, Korea, Finland, Norway, Sweden, Switzerland, New Zealand.

US State regulations

Some states require inclusion of state-listed substances on an MSDS for materials used within that state. For example:

- The following states require listing substances at or below the HCS de minimis levels:
 - Massachusetts;
 - Pennsylvania;
 - Rhode Island

NOTE: This can also be accomplished by listing the substance in Section 3: COMPOSITION/INFORMATION ON INGREDIENTS.

- Some states may require disclosure of ingredients not considered to be hazardous by OSHA.

Companies may choose to provide the status of the components with respect to the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Although not required to be listed on the MSDS, it is one way of conveying whether or not a chemical or component is considered by the state of California to be a carcinogen or to have potential to cause reproductive harm.

EXAMPLE:**Inventory Status:**

Inventory	Status
United States (TSCA)	All ingredients are on the inventory or exempt from listing.
Canada (DSL)	All ingredients are on the inventory or exempt from listing.
European Union (EINECS)	One or more ingredients fall under the polymer exemption or are on the no longer polymer list.
Japan (METI)	All other ingredients are on the inventory or exempt from listing.
Philippines	All other ingredients are on the inventory or exempt from listing.
South Korea (KECL)	All ingredients are on the Inventory or exempt from listing.
Australia (AICS)	All ingredients are on the Inventory or exempt from listing.
China	All ingredients are on the Inventory or exempt from listing.

Federal Regulations:

SARA Title III Rules

Sections 311/312 Hazard Classes

Fire Hazard	Yes
Reactive Hazard	No
Release of Pressure	No
Acute Health Hazard	Yes
Chronic Health Hazard	Yes

Section 313 Toxic Chemicals

Benzene (CASRN 71-43-2) 0.5% by weight

Section 302 Extremely Hazardous Substances (EHS)/CERCLA Hazardous Substances

Ingredient	CERCLA/SARA RQ	SARA EHS TPQ
Benzene	10 lbs	Not Applicable

Other Federal Regulations:

Drug Precursor Regulations

This product and its salts are listed as Precursor Chemicals by the Chemical Diversion and Trafficking Act of 1988.

This product is listed as an Essential Chemical by the Chemical Diversion and Trafficking Act of 1988.

Weapons Precursor Regulations

This product is classified as an Unscheduled Discrete Organic Chemical (UDOC) or PSF chemical (phosphorus, sulfur or fluorine chemical).

State Regulations:

California Proposition 65: This product contains chemical(s) known to the State of California to cause cancer and/or to cause birth defects or other reproductive harm.

International Regulations:

Canada

WHMIS Classification: D-2B (TOXIC MATERIAL)

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

16 Section 16: OTHER INFORMATION

Purpose: This section provides a location for any additional information concerning the material that may be useful.

Audience: This information is intended for all MSDS users.

Scope: This section may include:

- Label text: Companies may wish to display their label statements as a service to customers or to help ensure that the label text will be consistent with the MSDS text.
- Companies may choose to indicate whether the MSDS complies with other country requirements.
- Hazard rating and rating systems: This information is intended solely for the use of individuals trained in the particular system. It may be advisable to state this in a disclaimer. Several different hazard rating systems have been developed and differences exist among the systems. Typically, these systems include acute health hazards, flammability and reactivity, and may also include other hazards. Different systems can frequently result in different ratings, causing potential confusion to readers not familiar with a system. If an MSDS contains a hazard rating code or symbol, you should clearly identify which system was used to generate the rating. Internal company codes should not be used on MSDSs in general distribution.
- Preparation and revision information (revision indicator): Many companies take information from the MSDS and enter it into a database. To avoid needing to compare all the information on the old and revised MSDS, identify all the changes in a Preparation and Revision Information (Revision Indicator) field. (See 4.5 of Chapter 3.)
- Key/legend: Gives explanation of abbreviations used in the MSDS.
- Other related literature.

Chapter 4

Evaluating the completed MSDS

Once the text for each section of the MSDS has been drafted, the entire document should be evaluated for format, completeness, internal consistency, compliance and appearance/language.

1 Format

The MSDS should be reviewed to ensure that it follows the 16-section format of this Standard and that required data elements are included in the appropriate places. This examination should include both specific data for each MSDS section as well as general requirements (e.g., page numbers, dates, MSDS identifiers).

2 Completeness

Does the MSDS content accurately reflect the information gathered on the hazards and handling of the subject material when evaluated using the professional judgment of the MSDS writer and other consulted professionals?

Is the information on the MSDS consistent with the data/information found in other company literature such as container labels, MSDSs for similar products, technical bulletins, bills of lading, etc.?

Is there text present for all headings to ensure that there are no blank data fields?

3 Internal consistency

The MSDS must be internally consistent so that information in one section does not state or imply a different level of hazard than another section.

Reviewers should be certain that:

- First aid and protective equipment recommendations are consistent with the hazards presented by the material;
- Statements indicating a flammability hazard are supported by appropriate fire fighting, handling and storage instructions;
- Toxicological information presented in Section 11: TOXICOLOGICAL INFORMATION that is significant to human health is reflected in Section 2: HAZARDS IDENTIFICATION.

An example of an inconsistency is:

- A statement that there is no skin contact hazard contradicted by detailed first aid information for skin contact or recommendations for excessive protective clothing.

4 Compliance

Is the document compliant with the HCS? Does the MSDS reflect significant new hazards information obtained within the past 90 days?

Does the MSDS contain all necessary data elements for the markets in which it will be distributed (e.g., exposure limits for European countries if intended for use in the EU)?

5 Appearance/communication principles

All of the appearance and language recommendations found in Chapter 2 should be followed.

Some of these include:

- Is the layout uniform?
- Is the type size large enough to be legible after transmission by fax or scanning?
- Is there sufficient spacing to allow easy reading and location of information?
- Are the margins adequate to ensure that the headers and/or footers are not cut off when the document is copied or faxed?
- Is the level of language appropriate to the audiences for each MSDS section? If technical terms are used in sections intended for all audiences, are they defined or explained?

Chapter 5

References used to prepare this Standard

1 Regulatory/MSDS

29 CFR 1910.1200 *et seq.* Occupational Health and Safety's Administration's Hazard Communication Standard (HCS).

Workplace Hazardous Materials Information System (WHMIS), Federal Bill C-70 (Chapter 30[1987] of the Statute of Canada), amending the Hazardous Products Act (HPA), Canada Labor Code (Part IV), other federal legislation and introducing the Hazardous Materials Information Review Act (HMIRA).

Commission Directive 2001/59/EC of 6 August 2001 adapting to technical progress for the 28th time Council Directive 67/548/EEC on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances.

Commission Directive 2001/58/EC of 27 July 2001 amending for the second time Directive 91/155/EEC defining and laying down the detailed arrangements for the system of specific information relating to dangerous preparations in implementation of Article 14 of European Parliament and Council Directive 1999/45/EC and relating to dangerous substances in implementation of Article 27 of Council Directive 67/548/EEC (safety data sheets).

The Globally Harmonized System of Classification and Labelling of Chemicals.
<http://www.unece.org/trans/danger/publi/ghs/officialtext.html>

International Maritime Dangerous Goods Code (IMDG) London, England: International Maritime Organization.

2 General

American National Standard for Hazardous Industrial Chemicals – Precautionary Labeling (ANSI Z129.1-2000), 2000.

National Fire Protection Association. Fire Protection Guide to Hazardous Materials (contains complete text of NFPA 49, 325M, 491M and 704). 11th Edition.

American Conference of Governmental Industrial Hygienists (ACGIH). Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 2003.

Worker's Compensation Board of British Columbia, *WHMIS Core Material: A Resource Manual for the Application and Implementation of WHMIS*, 1991.

Silk, J.C. and M.B. Kent, *Hazard Communication Compliance Manual: A Guide to OSHA's Hazard Communication Standard*, BNA Books, 1995.

Molinelli, R.P., M.J. Reale, and R.I. Freudenthal, *Material Safety Data Sheets: The Writer's Desk Reference*, Hill & Garnett Pub, 1992.

Annex A

(informative)

Summaries of regulatory data elements

Annex A

(informative)

Summaries of regulatory data elements

A.1 Introduction

The following Annex provides a summary table of the data elements of the HCS, the GHS, Canada's WHMIS, the EU Directive, Mexico's NOM-114-STPS-1994, Australia's NOHSC: 2011(1994), and the Japanese Ministry's guideline pertaining to MSDSs. The table does not include exact duplications of those regulations or exact wording from them. These summaries are provided to serve as an aid to the MSDS preparer, and are not intended for use without the American National Standard and the regulations. Specifically, in the case of the EU Directive, each country is responsible for implementing individual requirements and should be consulted.

No warranty, expressed or implied, is offered as to the accuracy of this table, although it is believed to be current at the time of printing of this Standard. For official positions on questions concerning compliance, the reader is referred to the government organization issuing the requirements.

A.2 Data elements required for HCS

The HCS does not include format requirements. The data elements in the table below are organized in accordance with the recommendations of this Standard.

A.3 Data elements required under GHS

The Globally Harmonized System for Classification and Labelling of Chemicals (GHS) is the result of a 10-year international effort to globally harmonize the classification and labeling of chemicals. It was adopted by the United Nations in 2002.

A.4 Data elements required for Canada's WHMIS

The Hazardous Products Act and Controlled Products Regulations (CPR) specify requirements for the content of MSDS for controlled products (hazardous materials) as part of the Workplace Hazardous Materials Information System (WHMIS). Disclosure of trade secret chemical identities is regulated by the Hazardous Materials Information Review Act and Regulations. Persons preparing MSDSs should be familiar with the requirements of these acts and regulations, including the Ingredient Disclosure List.

The current CPR specify that MSDS information be provided under nine headings. However, regulatory authorities will accept the 16-heading format used in the American National Standard (and as adopted by ILO in 1990), provided that all the required information items specified in Schedule 1, Column 3 of the CPR are addressed. These information items, as described in the CPR, are contained as subheadings under the 16 headings in the example arrangement in this clause.

If no information is available or applicable for any of the 16 section headings, then the section heading shall be marked either "Not Available" or "Not Applicable". Other statements are not acceptable.

The information items from Schedule 1, Column 3 described as subheadings below, shall be provided by the supplier, if information is available to the supplier and applicable to the product. If no relevant information is available or the item is not applicable to the product, the subheadings need not be disclosed on the MSDS. Other subheadings names with the same meaning may be used.

The MSDS can be supplied in English or in French, and the language can be specified by the purchaser or, when not specified, can be provided in the language used in the course of product sale to the purchaser.

The location of specific subheadings under the 16 section headings is an example only. Any subheading (with the exception of those indicated by *) may be relocated under another of the 16 section headings.

A.5 Data elements required for disclosure in EEC Safety Data Sheets

Commission Directive 91/155/EEC, defines detailed arrangements for system specific information relating to dangerous preparations in implementation of Article 14 of the European Parliament, and Council Directive 1999/45/EC relating to dangerous substances in implementation of Article 27 of Council Directive 67/548/EEC (safety data sheets). Commission Directive 2001/58/EC amended for the second time Directive 91/155/EEC July 27, 2001.

The current Annex to Commission Directive 91/155/EEC is designed to ensure content consistency and accuracy for each of the mandatory headings listed in Article 3, so that the resulting safety data sheets enables professional users to take necessary measures relating to the protection of health and safety in the workplace and protection of the environment.

The information provided by the safety data sheets should meet the requirements in Council Directive 98/24/EC on the protection of the health and safety of workers. In particular, the safety data sheet should enable the employer to determine whether any hazardous chemical agents are present in the workplace, and to assess any risk to the health and safety of workers arising from their use.

The information provided by the safety data sheets should be presented in the European Union approved 16-Section format with the following mandatory headings:

- Section 1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING
- Section 2. COMPOSITION/INFORMATION ON INGREDIENTS
- Section 3. HAZARDS IDENTIFICATION
- Section 4. FIRST AID MEASURES
- Section 5. FIRE-FIGHTING MEASURES
- Section 6. ACCIDENTAL RELEASE MEASURES
- Section 7. HANDLING AND STORAGE

Section 8. EXPOSURE CONTROL/PERSONAL PROTECTION

8.2. Exposure controls

For the purposes of this document exposure control means the full range of specific protection and prevention measures to be taken during use in order to minimize worker and environmental exposure.

8.2.2 Environmental exposure control

Specify the information required by the employer to fulfill his commitments under Community environmental protection legislation.

Section 9. PHYSICAL AND CHEMICAL PROPERTIES

pH:

Boiling point/boiling range:

Flash point:

Flammability (solid; gas):

Explosive properties:

Oxidizing properties:

Vapor pressure:

Relative density:

Solubility:

 water solubility:

 fat solubility (solvent – oil to be specified):

Partition coefficient: n-octanol/water:

Viscosity:

Vapor density:

Evaporation rate:

Section 10. STABILITY AND REACTIVITY

Section 11. TOXICOLOGICAL INFORMATION

Section 12. ECOLOGICAL INFORMATION

Section 13. DISPOSAL CONSIDERATIONS

Section 14. TRANSPORT INFORMATION

Section 15. REGULATORY INFORMATION

Section 16. OTHER INFORMATION

A.6 Data elements required for Mexico's NOM-114-STPS-1994

The Mexican Secretariat of Labor and Social Benefits Official NORM, NOM-114-STPS-1994 specifies the required elements for the content of MSDSs. The current NOM specifies that MSDS information be provided in Spanish, under twelve headings. However, regulatory authorities will accept the 16-heading format used in the American National Standard (and as adopted by ILO in 1990), provided that all the required information items specified in the NOM are addressed. If no information is available or applicable for any of the 16 section headings, then the section heading shall be marked either "Not Available" (ND) or "Not Applicable" (NA) in Spanish.

The MSDS must be reviewed and/or updated in a time period not to exceed one year.

1. Date Created: 2. Date Reviewed:

Section 1 GENERAL INFORMATION ON THE PERSON RESPONSIBLE FOR THE CHEMICAL SUBSTANCE

Section 2 GENERAL INFORMATION ON THE CHEMICAL

Section 3 IDENTIFICATION OF COMPONENTS

Section 4 PHYSICAL - CHEMICAL PROPERTIES

Section 5 FIRE OR EXPLOSION HAZARDS

Section 6 REACTIVITY INFORMATION

Section 7 HEALTH HAZARDS

PART 1 HEALTH EFFECTS

PART 2 EMERGENCY FIRST AID

Section 8 INFORMATION IN CASE OF SPILLS OR LEAKS

Section 9 SPECIAL PROTECTIONS

Section 10 TRANSPORTATION INFORMATION

Section 11 ECOLOGICAL INFORMATION

Section 12 SPECIAL PRECAUTIONS

A.7. Data elements required for Japan's Guidelines

The Japanese Ministry of Health and Welfare (MHW) and the Ministry of International Trade and Industry (MITI) issued Official Notice No. 1 "Guidelines for providing information pertaining to the safety of chemical substances" which specifies the required elements for the content of MSDSs. The current guideline specifies that MSDS information be provided in Japanese, under fifteen headings. However, the regulatory authorities will accept the 16-heading format as outlined in the Japanese Chemical Industry Association (JCIA) "Guideline for MSDS Preparation" and used in the American National Standard (and as adopted by ILO in 1990), provided that all the required information items specified in the ministry's guideline are addressed.

Section 1. COMPANY IDENTIFICATION

Section 2. PRODUCT NAME

Section 3. DANGER AND TOXICITY CLASSIFICATION

Section 4. EMERGENCY FIRST AID

Section 5. FIRE FIGHTING MEASURES

Section 6. ACCIDENTAL RELEASE MEASURES

Section 7. HANDLING AND STORAGE PRECAUTIONS

Section 8. EXPOSURE PREVENTION MEASURES

Section 9. PHYSICAL AND CHEMICAL PROPERTIES

Section 10. STABILITY AND REACTIVITY

Section 11. TOXICITY INFORMATION

- Corrosiveness towards skin
- Irritancy towards skin and eyes
- Sensitization
- Acute & subacute toxicity tests with LD₅₀ data
- Chronic toxicity tests
- Carcinogenicity
- Mutagenicity
- Teratogenicity
- Reproductive toxicity

Section 12. ECOLOGICAL INFORMATION

Section 13. DISPOSAL PRECAUTIONS

Section 14. TRANSPORTATION PRECAUTIONS

Section 15. APPLICABLE REGULATIONS

A.8. Data elements required for Australia's Guidelines

The National Model Regulations for the Control of Workplace Hazardous Substances issued by the National Occupational Health and Safety Commission [NOHSC: 1005 (1994)] provides guidance on the requirements for MSDSs, and [NOHSC: 2011 (1994)] provides guidance on meeting the requirements for MSDSs and advises on the acceptable formats for MSDSs. An Australian format MSDS is recommended which is comprised of four primary sections and four secondary sections. However, the European Union and ILO formats are accepted (16 section MSDS formats). The health effects criteria are the same as those used by the European Union. The criteria are revised periodically to maintain consistency with European Union Council Directives.

Regulatory Data Elements Organized as Shown in ANSI Z400.1-2004

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Section 1. PRODUCT AND COMPANY IDENTIFICATION	X	X				
*	Product identity the same as on label	X	X	X	X	X (Sec. 2)	X (Sec. 2)
*	Synonyms and other information		X			X (Sec. 2)	X (Sec. 2)
*	Chemical name or code					X (Sec. 2)	
*	Chemical family					X (Sec. 2)	

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Name, address, telephone number, emergency telephone number of the manufacturer, supplier, distributor, employer or other responsible party	X	X	X	X	X	X
	Product use		X	X	X		
	Date of preparation of the MSDS or date of last change	X	X	X	X	X	
*	Section 2. HAZARDS IDENTIFICATION	X	X				
*	Emergency Overview						
	Label Elements, including precautionary statements		X				
*	Potential Health Effects, including acute and chronic effects, listing target organs or systems	X	X	X	X	X	X
*	Signs and symptoms of exposure	X			X		X
*	Conditions generally recognized as aggravated by exposure	X					
*	Primary routes of exposure; including skin contact, skin absorption, eye contact, inhalation and ingestion	X		X	X	X	X
*	If listed as a carcinogen by OSHA, IARC, or NTP	X				X	

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Physical hazards	X	X	X	X	X	X
*	OSHA Regulatory Status						
*	Potential environmental effects (includes ecological effects)		X	X			X
*	Section 3. COMPOSITION/INFORMATION ON INGREDIENTS		X		X		X (Sec. 2)
*	Chemical and common name, and CAS registry number of the ingredients contributing to known hazards	X	X	X		X	
	Component identification with CAS No., UN No., "Ka-Shin-Ho" Registry No., and % composition						X
	The chemical identity and concentration or concentration ranges of all ingredients which are hazardous and are present above their cut-off levels.		X		X		
	Classification and R phrases in accordance with Directive 67/548/EEC				X		
	Generic chemical identity and Registry Number for trade secret ingredients registered with the Hazardous Materials Information Review Commission			X			

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
	Ingredient concentration in units of wt/wt, vol/vol, or wt/vol, expressed as • actual concentration • a range as specified in the CPR • a smaller range within the limits of a CPR-specified range			X			
*	For untested mixtures, the chemical and common name of ingredients at 1% or more (at 0.1 or greater, if listed carcinogens) that present a health hazard and those that present a physical hazard in the mixture	X					
	Hazardous ingredients (Controlled Products) present at 1.0% or more, or 0.1% or more, as appropriate, by weight • ingredients present which are on the WHMIS Ingredient Disclosure List, at or above, the minimum concentration specified on the List • ingredients with unknown toxicology properties • ingredients the supplier believes may be harmful			X			
	PIN (Transport Canada – Product Identification Number) ; UN number			X			
	LD50 (species route); LC50 (species) (see Section 11 as alternative location)			X		X	
	Component's degree of risk (according to NOM-114-STPS-1994 Section 6.2)					X	

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Section 4. FIRST AID MEASURES	X	X	X	X	X (Sec. 7)	X
*	Emergency and first aid procedures by route of exposure	X	X	X			X
	Indicate if doctor is needed		X		X		
*	Note to physicians		X			X	
*	Antidotes		X			X	
*	Section 5. FIRE FIGHTING MEASURES	X	X	X	X	X	X
*	Flammable properties information such as flash point and upper and lower flammable (explosive) limits, and method of determination	X	X	X	X	X (Sec. 4)	X (Sec. 10)
*	Generally applicable control measures, fire fighting procedures	X	X	X	X	X	X
*	Protective equipment and precautions for firefighters	X	X	X	X	X	X
*	Extinguishing media		X	X	X	X	X
*	Unsuitable extinguishing media		X				

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Hazardous combustion products		X	X	X	X	
*	Specific physical and chemical hazards arising from the chemical	X	X			X	
	Explosion data – sensitivity to static discharge			X	X		X (Sec. 10)
	Explosion data – sensitivity to mechanical impact			X	X		
	Self-ignition temperature					X (Sec. 4)	X (Sec. 10)
	Autoreactivity and Oxidizing Properties						X (Sec. 10)
*	Section 6. ACCIDENTAL RELEASE MEASURES	X	X	X	X		X
*	Methods for clean-up and containment	X	X	X	X	X (Sec. 8)	X
*	Personal precautions		X		X	X	
*	Environmental precautions		X		X		X
*	Other information						
	Prohibited materials				X		

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Section 7. HANDLING AND STORAGE	X	X	X	X	X (Sec. 12)	X
*	Generally applicable precautions for safe handling and use, including appropriate hygienic practices	X	X	X	X	X	X
*	Storage requirements and conditions		X	X	X	X	X
	Identification of incompatible materials or ignition sources		X		X		
	Special packaging materials				X		
*	Section 8. EXPOSURE CONTROLS/PERSONAL PROTECTION	X	X		X		
*	Exposure limits listed by OSHA include PELs, ACGIH or established company limits and for Japan include Japanese Industrial Health Organization limits	X	X	X	X	X	X
*	Personal protective equipment (PPE)	X	X	X	X	X	X
*	Eye/face protection	X	X	X	X	X	X
*	Skin protection	X	X	X	X	X	X
*	Respiratory protection	X	X	X	X	X	X

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	General hygiene considerations	X	X	X	X	X	X
	Component concentration that is Immediately Dangerous to Life and Health (IDLH)					X	
*	Section 9. PHYSICAL AND CHEMICAL PROPERTIES	X	X	X	X	X (Sec. 4)	X
*	Appearance , color		X	X	X	X	X
*	Odor		X	X	X	X	X
*	Physical state (i.e., gas, liquid, or solid)		X	X	X	X	X
*	pH		X	X	X	X	X
*	Vapour pressure; Mexico @ 20°C		X	X	X	X	X
*	Vapour density		X	X		X	
*	Boiling point		X	X	X	X	X
*	Freezing/melting point		X	X	X	X	X
*	Flash point		X				

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Flammability (solid, gas)		X				
*	Upper/Lower flammability or explosive limits		X				
*	Autoignition temperature		X				
*	Decomposition temperature		X				
*	Specific gravity			X			X
*	Evaporation rate		X	X		X	
	Coefficient of water/oil distribution			X			
*	Odor threshold		X	X			
*	Relative density		X		X	X	X
*	Solubility(ies)		X		X	X	X
*	Partition coefficient: n-octanol/water		X		X		
*	% volatility					X	

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Molecular weight					X	
*	Section 10. STABILITY AND REACTIVITY	X	X	X	X	X (Sec. 6)	X
*	Stability		X			X	
*	Physical hazards, including reactivity and hazardous (spontaneous) polymerization	X	X		X	X	
	Organic peroxide, pyrophoric, unstable (reactive), or water-reactive hazards	X					
*	Conditions to Avoid/ Conditions under which the product is chemically unstable		X	X	X	X	X
*	Incompatible materials		X	X	X	X	
*	Hazardous decomposition products		X	X	X	X	
*	Section 11. TOXICOLOGICAL INFORMATION (Information on Product or Ingredients)	X	X	X	X	X (Sec. 7)	X
*	Routes of exposure		X				
*	Symptoms		X				

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Immediate and delayed effects		X				
*	LD50 (species and route); LC50 (species)		X	X	X	X	X
*	Corrosiveness towards skin		X				X
*	Sensitization to product		X	X	X	X	X
*	Carcinogenicity		X		X	X	X
*	Irritancy of product		X	X	X	X	X
*	Reproductive toxicity		X	X	X	X	X
*	Teratogenicity		X	X	X	X	X
*	Mutagenicity		X	X	X	X	X
*	Chronic exposure		X	X	X	X	X
*	Name of toxicologically synergistic products		X	X	X		

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Section 12. ECOLOGICAL INFORMATION	X	X	X	X	X (Sec. 11)	X
*	Assessment of the possible effects and environmental fate		X	X			X
*	Describe most important characteristics like mobility, persistence and degradability, bioaccumulative potential and aquatic toxicity		X	X			X
	Ecotoxicity and chemical fate data established by the Secretariat of Urban Development and Ecology					X	
*	Section 13. DISPOSAL CONSIDERATIONS	X	X	X	X		X
*	Waste disposal		X	X	X		X
*	Waste disposal of packaging		X		X		
	If disposal presents a danger, describe residues and give safe handling information		X		X		X
*	Section 14. TRANSPORT INFORMATION	X	X	X	X	X (Sec. 10)	X
*	Basic shipping information	X	X	X	X	X	X

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Special shipping information, such as United Nation and national recommendations, and precautions to be taken during transport		X	X	X		X
*	Section 15. REGULATORY INFORMATION	X	X	X	X		X
*	National and local safety, health and environmental regulations specific for the product in question		X	X	X		X
	WHMIS classification for product. A statement: "This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR."			X			
	Information according to the Directives relating to the classification, packaging, and labeling of dangerous substances and preparations		X		X		
	Any restrictions on marketing and use, or limit values for exposure at the place of work				X		

ANSI	Organized as Shown in ANSI Z400.1-2004	HCS	GHS	WHMIS	EU (Australia)	Mexico	Japan
*	Section 16. OTHER INFORMATION	X	X		X		
*	Any other information that might be of importance for safety and health		X		X		X
	Give the date of issue of the data sheet, if not stated elsewhere				X		

Annex B
(informative)

MSDS Example

Section 1: PRODUCT AND COMPANY IDENTIFICATION

XYZ Company
123 Main St.
Hometown, USA 12345-1234

Company Phone Number: (800) 123-1234
Medical Emergency: (800) 234-2345
Chemical Emergency: (800) 345-6789

Product Name XYZ
Product Code: 67890

Issue Date: 01/02/2003
Supersedes Date: 01/02/2002

Section 2: HAZARDS IDENTIFICATION**EMERGENCY OVERVIEW**

Appearance/Odor: Colorless, free-flowing liquid with sweet odor.

WARNING**Flammable**

Causes severe eye and respiratory tract irritation and central nervous system depression (including unconsciousness).

Highly toxic to fish.

Potential Health Effects: See Section 11 for more information

Likely Routes of Exposure: Eye contact, skin contact, inhalation

Eye: Causes severe irritation (tears, blurred vision and redness). May result in permanent damage including blindness.

Skin: Prolonged exposure may cause moderate skin irritation. May cause drying/defatting of the skin.

Ingestion: Not likely to be toxic but may cause irritation of the mouth, throat and stomach.

Inhalation: A single brief (minutes) exposure may cause severe irritation (tightness in the chest, difficulty breathing and coughing). Prolonged overexposure may cause central nervous system depression with anesthetic effects (numbing) or narcotic effects (headache, dizziness, sleepiness, loss of coordination and unconsciousness).

Medical Conditions Aggravated By Exposure:

May cause more significant skin irritation in people with pre-existing skin conditions.

Target Organs: Liver Kidney

This product does not contain any carcinogens or potential carcinogens as listed by OSHA, IARC or NTP.

This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Potential Environmental Effects: See Section 12 for more information)

Highly toxic to fish

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS #	% by Wt.
Component A	123-45-6	60 – 90
Component B	Trade Secret	5 –15
Component C	None	Trade Secret
Component D	987-65-4	0.1

Section 4: FIRST AID MEASURES

Eye Contact	Immediately flush eyes with water for at least 15 minutes. Get medical attention.
Skin Contact	Remove contaminated clothing and wash before reuse. Wash skin with soap and water. Get medical attention if irritation develops.
Inhalation	Move to fresh air. Get medical attention if symptoms occur.
Ingestion	Do NOT induce vomiting. Do NOT administer anything by mouth to unconscious person. Offer water to drink. Get medical attention.

Note to Physicians:

This product is not an inhibitor of cholinesterase. Treatment with atropine and oximes is not indicated.

Section 5: FIRE FIGHTING MEASURES

Suitable Extinguishing Media: CO₂, water fog.

Unsuitable Extinguishing Media: Alcohol foam.

Products of Combustion: Oxides of carbon, nitrogen, sulfur.

Protection of Firefighters: Vapor can form explosive mixture and re-ignite. Cool and use caution when approaching fire-exposed containers. Vapors may be irritating to eyes, skin and the respiratory tract. Firefighters should wear self-contained breathing apparatus and full fire-fighting turnout gear.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions: Use personal protection recommended in Section 8.

Environmental Precautions: This material is a water pollutant. Do not let spilled or leaking material enter waterways.

Methods for Containment: Absorb spilled liquid in suitable material.

Methods for Clean-Up: Use spark-proof tools to sweep or scrape up and containerize.

Other Information: Spills of this material do not need to be reported to the National Response Center.

Section 7: HANDLING AND STORAGE**Handling**

Keep away from heat, sparks and flame. Use grounding and bonding connection when transferring this material to prevent static discharge, fire or explosion. Use spark-proof tools and explosion-proof equipment. Do not get in eyes. Do not breathe vapor. Avoid prolonged contact with skin. Use in well ventilated areas. Wash thoroughly after handling.

Storage

Store in well ventilated area. Keep container closed when not in use. Product residue may remain in empty containers. Observe all label precautions until container is cleaned, reconditioned or destroyed. Residual vapors may explode on ignition. Do not cut, drill, grind or weld on or near this container.

Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION**Exposure Guidelines**

Component A	Not established.
Component B	TWA: 100 ppm (OSHA), TWA: 50 ppm (ACGIH)
Component C	TWA: 50 ppm (Manufacturer's suggested limit)
Component D	TWA: 200 ppm (ACGIH), STEL: 250 ppm (skin) (ACGIH)

Engineering Controls: Provide local exhaust ventilation.

Eye/face Protection: Wear chemical splash goggles and face shield.

Skin Protection: Wear chemical resistant clothing such as gloves, apron, boots or whole bodysuits made from neoprene, as appropriate.

Respiratory Protection: Use NIOSH-approved air-purifying respirator with organic vapor cartridge or canister.

General Hygiene Considerations: Wash thoroughly after handling. Have eye-wash facilities immediately available.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Color: Colorless.

Odor: Sweet.

Odor Threshold: Not available.

Physical State: Liquid.

pH: Not applicable.

Freezing Point: < -25 °F (< -32 °C)

Boiling Point: 165 °F (74 °C)

Flash Point: 60 °F (107 °C) (TCC)

Evaporation Rate: Not available.

Flammability (solid, gas): Not applicable.

Upper Flammability Limit: 12.0% @ 122 °F (50 °C)

Lower Flammability Limit: 6.5% @ 122 °F (50 °C)

Vapor Pressure: 85 mmHg @ 68 °F (20 °C)

Vapor Density: 4.8

Specific Gravity: 0.9 @ 60 °F (15 °C)

Solubility (water): Negligible.

Partition Coefficient (n-octanol/water): $\log K_{OW} = 2.49$

Auto-ignition Temperature: Not available.

Percent Volatile, wt. %: 100

Volatile Organic Compound (VOC) content, wt. %: 100

Section 10: STABILITY AND REACTIVITY

Stability: Stable.

Conditions to Avoid: Keep away from heat, sparks and flames.

Incompatible Materials: Strong acids and bases. Strong oxidizing and reducing agents.

Hazardous Decomposition Products: Ethylene oxide @ 100 °F (38 °C).

Possibility of Hazardous Reactions: Will not occur.

Section 11: TOXICOLOGY INFORMATION

ACUTE EFFECTS

Oral LD₅₀: > 5,000 mg/kg (rats)

Dermal LD50: > 2,000 mg/kg (rabbits)

Inhalation: In humans, irritation occurs at 200 ppm. CNS depression occurs at concentrations > 10,000 ppm; however, motor skills may be impaired at 1,000 ppm.

Eye Irritation: Primary Irritation Score 80/110. Severely irritating to the rabbit eye. Airborne concentrations >200 ppm cause irritation.

Skin irritation: Primary Irritation Score 4.0/8.0. Moderately irritating to rabbit skin.

Sensitization: Not expected to cause skin or respiratory sensitization based on similarities to other tested materials of similar composition.

CHRONIC EFFECTS

Carcinogenicity: No carcinogenic effects noted in rats exposed to 10 ppm in drinking water for 2 years. Liver and kidney tumors related to treatment were seen in mice exposed to 75 ppm in drinking water for 2 years.

Mutagenicity: Negative in Ames test with and without metabolic activation.

Reproductive Effects: No data.

Developmental Effects: No data.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity: Very toxic to fish. 96 hour LC50 = 0.5 mg/L (fathead minnow)
Persistence/ Degradability: Degradation is expected under aerobic and anaerobic conditions.
Bioaccumulation/ Accumulation: No appreciable bioconcentration is expected in the environment.
log Kow = 2.49.
Mobility in Environment: Appreciable volatilization is expected from water to air.

Section 13: DISPOSAL CONSIDERATIONS

Disposal: RCRA Hazardous Waste (ID# 0001). Dispose of in accordance with federal, state and local regulations.

Section 14: TRANSPORTATION INFORMATION

US DOT (ground)

Proper Shipping Description: Flammable liquids, n.o.s. (contains Component A, Component B), 3, UN 1993, II.

Canadian TDG (ground)

Proper Shipping Description: See US DOT

ICAO (air)

Proper Shipping Description: See US DOT

IMDG (water)

Proper Shipping Description: See US DOT

Section 15: REGULATORY INFORMATION

Global Inventories

TSCA: United States	Included
DSL: Canada	Included
ECL: Korea	Included
PICCS: Philippines	Included
ENCS: Japan	Included
AICS: Australia	Included
IECS: China	Included
EINECS: European Union	Included

SARA 313 Information

Component	CAS#	% by Wt.
Component D	987-65-4	0.1

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65)

This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins under California Proposition 65 at levels which would be subject to the proposition.

WHMIS: Canadian Workplace Hazardous Material Information System

B3, D2B

Section 16: OTHER INFORMATION

NFPA 704: National Fire Protection Association

Health - 2 Fire - 3 Reactivity - 0

0 = minimal hazard, 1 = slight hazard, 2 = moderate hazard, 3 = severe hazard, 4 = extreme hazard

Prepared by Company Name, Technical Expert

The information contained in this document applies to this specific material as supplied. It may not be valid for this material if it is used in combination with any other materials. It is the user's responsibility to satisfy oneself as to the suitability and completeness of this information for his own particular use.

Annex C

(informative)

Glossary

The glossary was developed to assist the MSDS writer. It defines the terms used in the Standard and those commonly used in MSDSs and source materials. It contains many regulatory definitions. Where multiple regulatory definitions exist, the OSHA definition is given first. Other regulatory definitions are given if relevant to information described in the guideline. These definitions are current as of the time of preparation of this Standard. Users of the glossary may wish to revise the terms as changes occur to keep it current.

The glossary definitions are meant to convey the concepts presented in the text of this Standard; they are not meant to be used outside the context of the Standard.

Where applicable, reference to the following sources is made by way of endnote on the glossary entries. The sources should be referred to when relying on this Annex.

Certain glossary definitions are from copyrighted sources. This material is used with permission as noted below:

By permission, from *Merriam-Webster's Collegiate® Dictionary, Eleventh Edition* ©2003 by Merriam-Webster, Incorporated (www.Merriam-Webster.com).

Reprinted with permission from NFPA 49-2001, *Hazardous Chemical Data*, 13th ed., as printed in the *Fire Protection Guide to Hazardous Materials*, copyright 2001, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the NFPA on the referenced subject, which is represented only by the standard in its entirety.

Verschueren, K., *Handbook of Environmental Data on Organic Chemicals*, 4th ed., 2001, John Wiley & Sons, Inc., Hoboken, NJ. Reprinted by permission of John Wiley & Sons, Inc.

Lewis, *Hawley's Condensed Chemicals Dictionary*, 14th ed., 2001, John Wiley & Sons, Inc., Hoboken, NJ. Reprinted by permission of John Wiley & Sons, Inc.

American National Standard for Hazardous Industrial Chemicals – Precautionary Labeling, ANSI Z129.1- 2000. © 2000 by the American National Standards Institute. Copies of this standard may be purchased from the American National Standards Institute, 25 West 43rd Street, New York, NY 10036 (www.ansi.org).

Reprinted from Taylor, *Dorland's Illustrated Medical Dictionary*, 29th ed., Taylor, copyright 1999, with permission from Elsevier.

Reprinted from *Dorland's Illustrated Medical Dictionary*, 26th ed., copyright 1995, with permission from Elsevier.

A

acclimation of microbes: The capability of microorganisms to adapt to the presence of a chemical.

ACGIH (American Conference of Governmental Industrial Hygienists): An organization of professional personnel in governmental agencies or educational institutions engaged in occupational safety and health programs. ACGIH establishes recommended occupational exposure limits for chemical substances and physical agents. (See TLV.) [1]

acid: Acids are materials that have a pH of less than 7. Acids with a pH in the 0 to 2 range are considered corrosive and will cause severe damage to skin and eyes.

activated sludge: A community of organisms present in a sewage treatment facility, acclimatized to the waste stream present in the facility, whose purpose is to biodegrade (react to) the waste stream.

acute health effect: Health effects that usually occur rapidly as a result of short-term exposures. Some examples are irritation, corrosivity (tissue destruction), narcosis and death. (Example lay language: immediate health effect.)

adequate ventilation: A condition falling within either or both of the following categories:

- (1) Ventilation to reduce levels of air contaminant below that which may cause personal injury or illness.
- (2) Ventilation sufficient to prevent accumulation to a concentration of contaminant vapor in air at a level in excess of 25 percent of the level set for the lower flammable limit as described in ANSI/NFPA 30 [2].

aerosol. A suspension of liquid or solid particles in a gas, the particles often being in the colloidal size range. Fog and smoke are common examples of natural aerosols; fine sprays (perfumes, insecticides, inhalants, antiperspirants, paints, etc.) are manufactured. [3].

AICS (Australian Inventory of Chemical Substances): A list of chemical substances that may be used commercially in Australia.

ALD: Approximate Lethal Dose (see LD₅₀).

alkali: Alkalies (or bases) are materials that have pH values greater than 7. Alkalies with pHs between 12 to 14 are considered to be corrosive and will cause severe damage to skin and eyes.

analgesia: Insensibility to pain without loss of consciousness [4].

anesthesia: Loss of sensation with or without loss of consciousness [4].

antagonism: The effect of one material or chemical that tends to counteract the effect of another material or chemical. Literally, antagonism means to work against.

antidote: A specific therapeutic measure that may or may not require the services of a physician [1].

apnea: A temporary stoppage of breathing.

article: OSHA defines an article as follows: A manufactured item other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of hazardous chemicals and does not pose a physical or health hazard to employees [5].

asphyxia: A lack of oxygen or excess of carbon dioxide in the body that results in unconsciousness and often death and is usually caused by interruption of breathing or inadequate oxygen supply. [4]. Can be induced by choking, drowning, electric shock, injury, or inhaling toxic gases. (Example lay language: Suffocation.)

asphyxiant: Material causing chemical suffocation.

aspiration hazard: A compound that presents the potential for aspiration (Inhaling liquids into the lungs) during or following ingestion. May lead to pneumonitis, an acute inflammation of the lungs. Compounds recognized as presenting an aspiration hazard include low-viscosity hydrocarbons or nonemulsion-type liquid chemical products that contain 10 percent or more hydrocarbons by weight and have a viscosity of less than 100 SUS at 100°F (16CFR1700).

ASTM (formerly known as the American Society for Testing and Materials): A source of voluntary consensus standards for material, products, systems and services. ASTM is a resource for sampling and testing methods, health and safety aspects of materials, safe performance guidelines and effects of physical and biological agents and chemicals [1].

ataxia: Loss of reflexes or muscular coordination. Signs can include twitching, stumbling or unsteady walk and shaking (Example lay language: Loss of muscle control (indicate muscles involved, e.g., staggering gait).)

atrophy: Decrease in the size of an organ or tissue from its normal size. (Example lay language: Shrinkage or wasting away of (organ or tissue).)

autoignition point: (autoignition temperature). The minimum temperature required to initiate or cause self-sustained combustion in any substance in the absence of a spark or flame. This varies with the test method. See flash point [3].

autoignition temperature: See autoignition point.

B

bioaccumulation (factor): A measure of the uptake and retention of a substance by an aquatic organism from its surrounding media and food.

bioavailability: A measure of the availability of a substance for biological uptake.

bioconcentration: The build-up of a chemical in plants and animals to levels above what is found in the surroundings.

biodegradation: A measure of the ability of a substance to decompose via biological processes.

biomagnification: The increase in chemical concentration levels in each higher level of the food chain.

BOD Test (Biochemical Oxygen Demand): An empirical bioassay procedure that measures the dissolved oxygen that microbial life consumes while assimilating and oxidizing the organic matter [6].

BOD: Commonly referred to as the results of the test described above.

boiling point: The temperature at which a liquid becomes a vapor. Mixtures will not normally have a distinct boiling point.

brachycardia: Slow heart rate. Also called bradycardia.

bronchitis: Inflammation of the mucous membrane of the bronchial tubes (larger air passages of the lungs). It may be caused by disease or physical or chemical irritants. Signs are generally that of a chest cold and may also include chest pain and coughing. (Example lay language: Inflammation of lungs.)

bulk density: Mass of solid material (e.g., powdered, granulated, pulverized, pelletized, etc.) per unit of volume.

burning rate: The time it takes a sample of solid material to burn a prescribed distance. The results are given in units of distance/time.

C

°C (degree Celsius): A unit of temperature, where water boils at 100°C and freezes at 0°C. To convert °C to °F, multiply the °C by 9/5 and add 32.

CAA (Clean Air Act): An air-quality statute administered by US Environmental Protection Agency.

CANUTEC (Canadian Transport Emergency Center): A national center established by Transport Canada to assist emergency response personnel in handling dangerous goods emergencies. CANUTEC has a 24-hour telephone number [613-996-6666 (collect calls accepted)] to help respond to chemical transportation emergencies for companies who have registered with them for this service. Their emergency response staff are bilingual (French and English).

carcinogen: A material that causes cancer. The HCS requires listing of carcinogens classified by OSHA, IARC and NTP. Other agencies and regulatory bodies also define and classify carcinogens, (e.g., ACGIH, EPA).

cardio-: A prefix that refers to the heart.

cardiovascular: A term indicating the heart and blood vessels.

CAS registry number: A number assigned by the Chemical Abstracts Service Chemical Registry System. A CAS Registry Number designates a single substance, so far as its structure has been elucidated in terms of atoms, valence bonds and stereochemistry. It can also designate a complex and variable substance that cannot be described in terms of a structure, but a unique chemical name.

caustic: See alkali.

CC (closed cup): A test procedure used in flash point measurements using a closed cup.

ceiling value: The maximum allowable human exposure limit for an airborne substance. Also see PEL and TLV [1].

central nervous system (CNS): The portion of the nervous system consisting of brain and spinal cord.

CEPA (Canadian Environmental Protection Act): Enacted on June 30, 1988, the major Canadian federal

environmental protection legislation, combining several pieces of legislation to create a comprehensive approach to the environmental protection of Canada. CEPA encompasses the life-cycle management approach to chemicals and requires the compilation of the Domestic and Nondomestic Substances Lists (DSL and NDSL respectively).

CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act): Also referred to as "Superfund". Was enacted in 1980 and is administered by US EPA. CERCLA was created to address the past disposal and clean up of inactive or abandoned hazardous waste sites.

CFCs (chlorofluorocarbons): A regulated class of chemicals that can cause ozone depletion.

CFR (United States Code of Federal Regulations): A publication of the regulations that have been promulgated under United States Law. The CFR is divided into titles. The following titles may be useful when using this Standard:

Title 29 – Contains HCS and other OSHA regulations;

Title 40 – Contains Environmental Protection Agency regulations, including TSCA;

Title 49 – Contains Department of Transportation (DOT) regulations.

NOTE – Changes to the regulations are published in the Federal Register.

chemical family: A group of substances that have a similar chemical structure. Example: acetone, methyl ethyl ketone (MEK) and methyl isobutyl ketone (MIBK) are members of the "Ketone" family; acrolein, furfural and acetaldehyde are members of the "aldehyde" family.

chemical: OSHA defines a chemical as any element, chemical compound or mixture of elements and/or compounds [5].

chemical manufacturer: An employer with a workplace where chemical(s) are produced for use or distribution [5].

chemical name: The scientific designation of a chemical in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry (IUPAC) or the Chemical Abstracts Service (CAS) rules of nomenclature, or a name that will clearly identify the chemical for the purpose of conducting a hazard evaluation [5].

CHEMTREC (Chemical Transportation Emergency Center): A national center administered by the American Chemistry Council (ACC) to relay pertinent emergency information concerning specific chemicals on requests from individuals. CHEMTREC has a 24-hour toll-free telephone number (800-424-9300) to help respond to chemical transportation emergencies for companies who have registered with them for this service.

chronic health effects: Adverse health effects resulting from long-term exposure or, persistent adverse health effects resulting from short-term exposures. (Example lay language: Delayed health effect; persistent health effect; health effect from prolonged exposure.)

closed system: System (equipment or apparatus) designed and used so that there is no release of the chemicals into the surroundings. Closed systems are indicated as a means to control conditions that would pose a physical hazard.

CNS: Central nervous system.

COD (chemical oxygen demand): The amount of oxygen required under specified test conditions for the oxidation of waterborne organic and inorganic matter [6].

combustible liquid:

(OSHA): Any liquid having a flash point at or above 100°F (37.8°C), but below 200°F (93.3°C), except any mixture having components with flash points of 200°F

(93.3°C) or higher, the total volume of which make up 99 percent or more of the total volume of the mixture [5].

(ANSI): Any liquid having a flash point above 141°F (60.5°C) and below 200°F (93.3°C). (Note, however, that a flammable liquid with flash point at or above 100°F (38°C) but not more than 141°F (60.5°C) may be considered a "combustible liquid" for purposes of this Standard if it has been or could be reclassified as a "combustible liquid" pursuant to 49 CFR 173.120(b)(2).) [2]

(DOT) Any liquid that does not meet the definition of any other hazard class specified and has a flash point above 141°F (60.5°C) and below 200°F (93°C). Flammable liquids with a flash point at or above 100°F (38°C), that does not meet the definition of any other hazard class may be reclassified as combustible liquids [8].

common name: Any designation or identification such as code name, code number, trade name, brand name, or generic name used to identify a chemical other than by its chemical name; e.g., the common name for dimethyl ketone is acetone [5].

compartment: See *media*.

component: ...A constituent part: ingredient [4].

compressed gas:

(OSHA)

- (i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70°F (21.1°C); or
- (ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70°F (21.1°C); or
- (iii) A liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by ASTM D323-72 [5].

(DOT)

compressed gas (nonflammable, nonpoisonous compressed gas-including compressed gas, liquefied gas, pressurized cryogenic gas in solution, asphyxiant gas and oxidizing gas): Any material (or mixture) which (1) exerts in the packaging an absolute pressure of 280 kPa (41 psia) at 68°F and (2) does not meet the definition of Division 2.1 or 2.3.[8].

compressed gas (liquefied): A gas which in a packaging under the charged pressure, is partially liquid at a temperature of 68°F (20°C) [8].

compressed gas (nonliquefied): A gas, other than in solution, which in a packaging under the charged pressure, is entirely gaseous at a temperature of 68°F (20°C) [8].

conjunctivitis: Inflammation of the mucous membrane lining the eyelid and covering the eyeball. (Example lay language: Eye irritation.)

consumer commodity: (DOT) A material that is packaged and distributed in a form intended or suitable for sale through retail sales agencies or instrumentalities for consumption by individuals for purposes of personal care or household use. This term also includes drugs and medicines [8].

container: (OSHA) Any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like that contains a hazardous chemical. Pipes or piping systems and engines, fuel tanks or other operating systems in a vehicle, are not considered to be containers [5].

cornea: Outer fibrous part of the eyeball which covers the iris and pupil [7].

corrosive material: (OSHA) A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. This term shall not refer to action on inanimate surfaces [5].

(DOT) Corrosive material means a liquid or solid that causes full thickness destruction in human skin at the site of contact within a

specified period of time, or a liquid that has a severe corrosion rate on steel or aluminum based on the criteria in 49 CFR 173.137(c)(2).

CPR: Canadian Controlled Products Regulations.

CPR: Cardio-pulmonary Resuscitation.

CPSA (Consumer Product Safety Act): The umbrella statute of the Consumer Product Safety Commission. It established the agency and defines its basic authority.

cryogenic liquid: (DOT) A refrigerated liquefied gas having a boiling point colder than -130°F (-90°C) at 101.3 kPa (14.7 psi) absolute [8].

cutaneous: See *dermal* [1]. (Example lay language: Of the skin.)

CWA (Clean Water Act): A water quality statute administered by the US EPA.

cyanosis: A bluish discoloration of skin and nails caused by a deficiency of oxygen in the blood.

D

dangerous when wet: (DOT) A material that, by contact with water, is liable to become spontaneously flammable or to give off flammable or toxic gas at a rate greater than 1 liter per kilogram of the material, per hour [8].

dangerously reactive chemical: A chemical that falls within any of the following categories: a chemical that undergoes a violent self-accelerating exothermic reaction with common materials or by itself, or under conditions of shock/impact, pressure or temperature; or a chemical that reacts with common materials (such as air, moisture) or reacts with itself, to release a gas or a type or in quantities that present an immediate hazard [2].

DEA (Drug Enforcement Administration, US Department of Justice): America's primary drug law enforcement agency.

decomposition: Breakdown of a material or substance (by heat, chemical reaction, electrolysis, decay or other processes) into parts or elements or simpler compounds [1].

delayed hazard: The potential to cause an adverse effect that manifests itself after a long period of time. Carcinogenicity, teratogenicity and certain target organ/system effects are examples of delayed hazards [2].

density: The mass (weight) per unit volume of a substance.

deposition: For environmental purposes, entrance of a substance into any environmental media.

dermal: Relating to the skin [1].

dermatitis: Inflammation of the skin [7].

developmental effects (developmental toxicity): (U.S. EPA) Effects of a substance on developing organisms following exposure to the pregnant females, including death, structural abnormalities or altered growth, and maternal effects.

DOT (Department of Transportation): An agency of the US Federal government that regulates the transport of hazardous materials.

DSL (Domestic Substance List): A list of chemical substances that may be used commercially in Canada.

dysplasia: Abnormal development or growth of an organ, tissues, or cells.

dyspnea: Difficulty in breathing; labored breathing or shortness of breath often associated with lung or heart disease.

E

EC₅₀ (effective concentration): A calculated value, derived experimentally, which represents a concentration that would affect 50% of the tested population.

ecotoxicity: The potential to be harmful to any organism in the environment.

ED₅₀ (effective dose): The calculated dose, derived experimentally, which would produce a specified effect in 50% of the test population.

edema: Presence of abnormally large amounts of fluid in intercellular spaces of body tissues [10]. Swelling of tissues or cells.

EDI: (Electronic Data Interchange): A standardized format for transmitting information electronically.

EEC: (European Economic Community): Former name of the European Union (EU).

EINECS (European Inventory of Existing Chemical Substances): A static list of chemical substances, identified by EINECS and CAS Registry Numbers, that were in the European Union market between January 1, 1971, and September 18, 1981.

ELINCS (European List of Notified Chemical Substances): A dynamic list of chemical substances, identified by EINECS Numbers, on which notifications have been made to the European Union since September 18, 1981.

ENCS (Existing and New Chemical Substances): A list of chemical substances that may be used commercially in Japan.

employer: (OSHA) A person engaged in a business where chemicals are either used, distributed, or are produced for use or distribution, including a contractor or subcontractor [5].

environmental fate: The expected result when a chemical is released to the air, water or soil.

environmental hazard: The adverse effects (measured as ecotoxicity) that may result from exposures (related to persistence and bioaccumulation potential) to a chemical or physical agent present in the environment.

EPA (Environmental Protection Agency): A US Federal agency with regulatory and enforcement authority on environmental matters. Administers FIFRA, CWA, CAA,

RCRA, TSCA, CERCLA and other environmentally related acts [1].

EPCRA: Emergency Planning and Community Right-to-Know Act; See *SARA Title III*.

epidemiology: Science concerned with the study of disease incidence and distribution in a general population.

epistaxis: Nosebleed, hemorrhage from the nose [7].

erythema: A name applied to redness of the skin produced by congestion of the capillaries which may result from a variety of causes, the etiology or a specific type of lesion often being indicated by a modifying term [7]. (Example lay language: Redness of the skin.)

EU (European Union): Formerly European Economic Community (EEC).

explosive:

(OSHA) A chemical that causes a sudden, almost instantaneous, release of pressure, gas and heat when subjected to sudden shock, pressure, or high temperature [5].

(DOT) There are six classes of explosives. The following classes cover explosives where the major hazard is:

- 1.1 mass explosion hazard;
- 1.2 projection hazard;
- 1.3 fire hazard and either a minor blast hazard or minor projection hazard or both but not a mass explosion hazard;
- 1.4 minor explosion hazard;
- 1.5 insensitive explosives;
- 1.6 an extremely insensitive detonating article [8].

explosive limits: See *flammable limits*.

exposure: (OSHA) exposure or exposed means that an employee is subjected in the course of employment to a hazardous chemical that is a physical or health hazard and includes potential (e.g., accidental or possible) exposure. "Subjected" in terms of health hazard includes any route of entry

(e.g., inhalation, ingestion, skin contact or absorption) [5].

extremely flammable liquid: Any liquid having a flash point less than 20°F (-6.7°C) or any liquid having a flash point of less than 141°F (60.5°C) and a boiling point of less than 95°F (35°C) [2].

extremely hazardous substance (EHS): A chemical identified by EPA under Section 302 of EPCRA (SARA Title III) and listed in 40 CFR 355 Appendix A and B.

eye hazard: (OSHA) Chemicals which affect the eye or visual capacity.

F

°F (degree Fahrenheit): A unit of temperature where water boils at 212°F and freezes at 32°F [1]. To convert °F to °C, subtract 32, then multiply by 5/9.

FDA (Food & Drug Administration): A US Federal agency which regulates food, medicine and medical devices.

first aid: Immediate measures that can be taken by the victim or other persons in case of contact or exposure to a chemical, including ending the exposure and using materials generally available to reduce or eliminate adverse health effects [2].

flammable aerosol: An aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening [5].

flammable gas:

(OSHA)

- (a) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of thirteen (13) percent by volume or less; or

- (b) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than twelve (12) percent by volume, regardless of the lower limit [5].

(DOT) A material which is a gas at 68°F (20°C) or less and 101.3 kPa (14.7 psi) of pressure. A material which has a boiling point of 68°F (20°C) or less at 101.3 kPa (14.7 psi) and:

- (a) is ignitable at 101.3 kPa (14.7 psi) when in a mixture of 13% or less by volume with air; or
- (b) has a flammable range at 101.3 kPa (14.7 psi) with air of at least 12% regardless of the lower limit [8].

flammable liquid:

(OSHA) Liquid, flammable means any liquid having a flashpoint below 100°F (37.8°C) except any mixture having components with flashpoints of 100°F (37.8°C) or higher, the total of which make up 99 percent or more of the total volume of the mixture [5].

(DOT) A flammable liquid (Class 3) means a liquid having a flash point of not more than 60.5°F (141°F) or any material in a liquid phase with a flash point at or above 37.8°C (100°F) that is intentionally heated and offered for transportation or transported at or above its flash point in a bulk packaging, with the following exceptions:

- (1) Any liquid meeting one of the definitions specified in 49 CFR 173.1115;
- (2) Any mixture having one or more components with a flash point of 60.5°C (141°F) or higher, that make up at least 99 percent of the total volume of the mixture, if the mixture is not offered for transportation or transported at or above its flash point;
- (3) Any liquid with a flash point greater than 35°C (95°F) which does not sustain combustion. A procedure for determining if a material sustains combustion when heated under test conditions and exposed to an external source of flame is provided in 29 CFR Appendix H of this 49 CFR 173.120;

- (4) Any liquid with a flash point greater than 35°C (95°F) and with a fire point greater than 100°C (212°F) according to ISO 2592;
- (5) Any liquid with a flash point greater than 35°C (95°F) which is in a water-miscible solution with a water content of more than 90 percent by mass [8].

flammable limits: The range of concentration of a flammable gas or vapor (percentage by volume in air) in which an explosion can occur upon ignition in a confined area [3]. The minimum and maximum concentrations of vapor in air below and above which propagation of flame does not occur, usually expressed in terms of percent by volume of the vapor or gas in air.

Lower Flammable Limit (LFL). The lowest concentration of a flammable vapor or gas/air mixture that will ignite and burn with a flame.

Upper Flammable Limit (UFL). The highest concentration of a flammable vapor or gas/air mixture that will ignite and burn with a flame. [11].

flammable solid: (OSHA) A solid, other than a blasting agent or explosive as defined in 29 CFR 1910.109(a), 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. A chemical shall be considered to be a flammable solid, if when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis [5].

(DOT) See 49 CFR 173.124(a).

flash point: The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested by one of the following:

- (1) Tag closed tester (in accordance with ANSI/ASTM D56) is for liquids with a viscosity of below 5.5 centistokes at 104°F (40°C), or below 9.5 centistokes

at 77°F (25°C) and a flash point below 200°F (93°C) that do not contain suspended solids and that do not have a tendency to form a surface film under test conditions.

- (2) Pensky-Martens closed tester (in accordance with ANSI/ASTM D593) is for liquids with a viscosity greater than 5.5 centistokes at 104°F (40°C) that contain suspended solids and that tend to form a surface film under test conditions. (3) Setaflash closed-cup apparatus (in accordance with ASTM D3278) is for liquids having flash points between 32°F (0°C) and 230°F (110°C) and a viscosity lower than 150 stokes at 77°F (25°C).

For mixtures, if the result of the test by any of these methods is above 100°F (37.8°C), evaporate a fresh sample to 90% of the original volume and retest. The lower of the two values shall be taken as the flash point [2].

foreseeable emergency: (OSHA) Any potential occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which could result in an uncontrolled release of a hazardous chemical into the workplace [5].

formula, chemical: A written representation using symbols of a chemical entity or relationship. There are several kinds of formulas:

- (1) *Empirical*. Expresses in simplest form the relative number and the kind of atoms in a molecule of one or more compounds; it indicates composition only, not structure.
- (2) *Molecular*. Shows the actual number and kind of atoms in a chemical entity (i.e., a molecule, group, or ion).
- (3) *Structural*. Indicates the location of the atoms, groups, or ions relative to one another in a molecule, as well as the number and location of the chemical bonds.
- (4) *Generic*. Expresses a generalized type of organic compound in which the variables stand for the number of atoms or for the kind of radical in a homologous series.

- (5) *Electronic*. A structural formula in which the bonds are replaced by dots indicating electron pairs, a single bond being equivalent to one pair of electrons shared by two atoms [3].

freezing point: Temperature at which a liquid substance becomes a solid. Also see melting point.

fume: Airborne particulate formed by the evaporation of a solid.

G

gastric lavage: Medical procedure involving irrigation or washing out of the stomach.

gavage: Forced feeding, especially through a tube passed into the stomach [7].

gestation: The length of time from conception to birth; pregnancy.

GHS: The Globally Harmonized System of Classification and Labelling of Chemicals. Contains harmonized classification criteria and hazard communication elements.

H

Hazard Communication Standard (HCS): The Hazard Communication Standard (HCS) is an OSHA regulation issued under 29 CFR Part 1910.1200. It details the requirements of MSDSs and labeling.

hazardous: The term hazardous is defined by many laws and regulations including OSHA (29 CFR), DOT (49 CFR), CERCLA (40 CFR) and RCRA (40 CFR).

hazardous chemical: Any chemical which presents a physical, health or environmental hazard.

hazardous polymerization: A polymerization reaction that can result in the uncontrolled generation of heat and pressure. Such reactions may be initiated by chemical catalysts or physical agents such as heat or radiation (including sunlight). Such reactions may occur in

reaction vessels or in other containers (including shipping containers).

health hazard: A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that an acute or chronic health effects may occur in exposed employees. The term, health hazard, includes chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic system and agents that damage the lungs, skin, eyes, or mucous membranes [5].

hematopoietic system: System responsible for the formation of blood cells.

Henry's Law Constant: The value (H) at a given temperature that is indicative of the volatility of the substance. Henry's law states that the mass of a soluble gas that dissolves in a finite mass of liquid at a given temperature is very nearly directly proportional to the partial pressure of that gas. This means that the Henry's law constant (H) can be related to solubility and vapor pressure at a given temperature.

hepato-: Prefix meaning the liver.

hepatotoxin: A substance that can cause liver damage [5].

highly toxic chemical: (OSHA) A chemical falling within any of the following categories:

- A chemical that has a median lethal dose (LD₅₀) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each;
- A chemical that has a median lethal dose (LD₅₀) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less, if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each; or,
- A chemical that has a median lethal concentration (LC₅₀) of gas or vapor in

air of 200 parts per million (ppm) or less by volume, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less, if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each. [5].

HMIS (Hazardous Material Information System): A system, developed by the National Paint and Coatings Association, designed to inform workers of the hazards of the chemicals they use and of means of protecting themselves from those hazards. It uses a numerical rating to indicate the level of hazard, with 4 being the highest and 0 the lowest. It addresses acute health, flammability and physical hazards.

HMIS (Department of Defense Hazardous Materials Information System): A data repository of MSDS information maintained by the Defense General Supply Center.

hydrolysis: Decomposition in the environment via reaction with water.

hypersensitivity: an exaggerated response by the body to an allergen; an allergic reaction.

I

IARC (International Agency for Research on Cancer): A scientific panel of the World Health Organization (WHO) which evaluates and classifies the carcinogenic potential of chemicals and processes.

IC₅₀ (inhibition concentration): A calculated statistical value whereby a concentration causes inhibition of an effect, behavior or biological action in 50% of the treated subjects or animals.

IDLH:

(NIOSH) Immediately Dangerous To Life or Health. A condition that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such environment.

(OSHA) An atmosphere that poses an immediate threat to life, would cause irreversible health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

identity: Any chemical or common name which is indicated on the material safety data sheet (MSDS) for the chemical. The identity used shall permit cross-references to be made among the required list of hazardous chemicals, the label and the MSDS [5].

immediate hazard: The potential to cause an adverse effect that manifests itself after a short period of time. See *acute health effects* [1].

importer: The first business with employees within the Customs Territory of the United States, which receives hazardous chemicals produced in other countries for the purpose of supplying them to distributors or employers within the United States [5].

incompatible: Materials that could cause dangerous reactions by direct contact with one another [1].

inflammable: A synonym of flammable.

ingestion: Taking in by the mouth [1]. (Example lay language: Swallowing.)

inhalation: Breathing in [1].

in silico: mathematical modeling based on chemical structure to predict biological, toxicological and physiochemical activity of a substance.

intubation: To insert a tube into a hollow organ or body passage, such as the larynx or trachea.

in vitro: Experiments with cells or tissues from organisms conducted outside of the organism.

in vivo: Experiments in living organisms.

I.P. (intraperitoneal): Injection into the peritoneal cavity. A route of administration.

iris: Circular pigmented membrane

between the cornea and lens, perforated by the pupil [7].

iritis: Inflammation of the iris, usually marked by pain, congestion of the ciliary region, photophobia, contraction of the pupil and discoloration of the iris [7].

irritant:

(OSHA) A non-corrosive chemical which causes a reversible inflammatory effect on living tissue at the site of contact (for example eyes, skin, or respiratory tract). This may include defatting agents, which by removal of natural skin oils, causes irritation following prolonged or repeated exposure. Materials with Draize skin tests scores below two are not generally considered skin irritants, while scores of five or above generally indicate severe skin irritants. The degree of irritation is determined by using recognized guidelines or other appropriate techniques. (See 16 CFR 1500.41, 16 CFR 1500.42 and the OECD Guidelines for Testing of Chemicals, Number 404 and 405.)

(OSHA) A chemical is an eye irritant if determined by using the procedures in 16 CFR 1500.42 or other appropriate techniques.

irritation: A condition of irritability, soreness, roughness, or inflammation of a bodily part [4].

ISO: International Standards Organization.

I.V. (intravenous): Injection into a vein. A route of administration.

J

jaundice: A sign of liver damage, characterized by yellow appearance of the skin and eyes.

JCIA: Japanese Chemical Industry Association.

L

lacrimation: Excessive discharge of tears.

lacrimator: A material that causes excessive tearing of the eyes either from direct contact or vapors. (Example lay language: chemical causing tearing.)

lay language: Language that can be understood by the public without any special training.

LC₅₀ (lethal concentration): The calculated concentration of a material in air that is expected to kill 50 percent of a group of test animals with a single exposure (usually 1 or 4 hours). The LC₅₀ is expressed as parts of material per million parts of air, by volume (ppm) for gases and vapors, or as milligrams of material per liter of air (mg/l) or milligrams of material per cubic meter of air (mg/m³) for dusts and mists as well as for gases and vapors [1].

LC_{LO} (lethal concentration low): The lowest concentration of a substance in air which has been reported to have caused death in humans or animals. The reported concentrations may be entered for periods of exposure that are less than 24 hours (acute) or greater than 24 hours (subacute and chronic).

LD₅₀ (lethal dose) A single calculated dose of a material expected to kill 50 percent of a group of test animals. The LD₅₀ dose is usually expressed as milligrams or grams of material per kilogram of animal body weight (mg/kg or g/kg). The material may be administered by mouth or applied to the skin [1].

LD_{LO} (lethal dose low): The lowest dose of a substance introduced by a route, other than inhalation, over any given period of time in one or more divided portions and reported to have caused death in humans or animals [12].

LEL or LFL (lower explosive limit, or lower flammable limit, of a vapor or gas): The lowest concentration (lowest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. Also see *UEL* [1].

lethargy: A lowered level of consciousness marked by listlessness, drowsiness and

apathy [7]. (Example lay language: fatigue or slowness, tiredness.)

liquefied compressed gas: See *compressed gas*.

LOAEL (lowest observed adverse effect level): Lowest observed level that produced adverse toxic effects.

LOEL (lowest observed effect level): Lowest observed level that produced effects.

M

malaise: A feeling of general discomfort, distress, or uneasiness, an out-of-sorts feeling [1].

material: All types of classifications of chemicals, such as products, raw materials, isolated manufacturing intermediates, as well as hazardous and non-hazardous chemicals. Also included are items that may normally be considered non-hazardous, but may give off hazardous chemicals during customary and reasonably foreseeable use and misuse, handling and storage; such items are not subject to the article exemption under the HCS (29 CFR 1910.1200).

medium (media): Segment(s) or "compartment(s)" of the environment; air, water, soil, or sediment.

melting point: The melting point or freezing point of a pure substance is the temperature at which its solid and liquid phases are in equilibrium at atmospheric pressure. The terms melting point and freezing point are often used interchangeably, depending on whether the substance is being heated or cooled.

METI: Japanese Ministry of Economy, Trade and Industry.

mineralization: In environmental terms, the final result of ultimate biodegradation; complete conversion of the substance to basic compounds such as carbon dioxide, water and inorganic compounds.

mist: Liquid droplets suspended in air generated by condensation from the gaseous to the liquid state or by breaking up a liquid into a dispersed state by splashing, foaming, atomizing, or the like [2].

molecular formula: See *formula, chemical*.

molecular weight: Weight (mass) of a molecule based on the sum of the atomic weights of the atoms that make up the molecule [1].

mutagen: A substance or agent capable of altering the genetic material in a living cell [1].

N

NAERG: North American Emergency Response Guide.

narcosis: A state of stupor, unconsciousness, or arrested activity produced by the influence of narcotics or other chemicals [1].

narcotic: A material that produces stupor, insensibility and sometimes unconsciousness.

nausea: Tendency to vomit, feeling of sickness at the stomach [1].

NCI (National Cancer Institute): Part of the National Institutes of Health that studies cancer causes and prevention as well as diagnosis, treatment and rehabilitation of cancer patients [1].

necrosis: Death of tissue. Corrosive chemicals may cause localized tissue damage at site of contact, which may lead to permanent damage and scarring. (Example lay language: tissue destruction.)

neoplasia: The uncoordinated growth of abnormal cells which is more rapid than of other tissues, forming benign or malignant tumors. (Hodgson, 1988)

nephrotoxin: A material that may cause effects and potential injury to the kidneys.

neural: Describing a nerve or the nervous system.

neuritis: Inflammation of a nerve, pain, and tenderness, anesthesia and paresthesia, paralysis, wasting and disappearance of the reflexes [7].

neurotoxin: A material that affects the nerve cells and may produce emotional or behavioral abnormalities [1].

neutralize: To eliminate potential hazards by inactivating strong acids, caustics and oxidizers. For example, acids can be neutralized by adding an appropriate amount of caustic substance to the spill [1].

NFPA (National Fire Protection Association): An international membership organization that promotes/improves fire protection and prevention and establishes safeguards against loss of life and property by fire.

NIOSH (National Institute for Occupational Safety and Health, US Public Health Service, US Department of Health and Human Services): Among other activities, tests and certifies respiratory protective devices and air-sampling detector tubes and recommends occupational exposure limits for various substances.

NOAEL (No observed adverse effect level): The highest dosage level of a substance that causes no observed adverse effects in a given test. (Hodgson 1988)

NOEC (No observable effect concentration): The highest concentration of a substance that causes no observed effects in a given test. (Hodgson 1988)

NOEL (No observed effect level): The highest dosage level of a substance that causes no observed effects in a given test. (Hodgson 1988)

Non-Domestic Substances List (NDSL): A list of chemical substances, maintained under Canadian regulations, identified by CAS Registry Numbers, that are in world commerce, but not in Canada.

NRC (National Response Center): A notification center operated by the US Coast Guard that must be called when significant oil or chemical spills, or other environment-related accidents occur. The toll-free telephone number is 1-800-424-8802 [1].

NTP (National Toxicology Program): A scientific agency under the US Department of Health and Human Services that tests chemicals and evaluates their carcinogenicity. The results are published in their Annual Report on Carcinogens.

O

octanol/water partition coefficient: A measure of environmental fate, specifically bioaccumulation and bioconcentration (expressed as log K_{ow} or log P_{ow}) that measures the ability of a chemical to be absorbed in fatty tissues.

odor threshold: The lowest concentration of a substance in air that can be detected by the sense of smell.

OECD (Organization for Economic Cooperation and Development): An international organization that, among other things, develops and publishes Guidelines for Testing of Chemicals.

oral: Used in or taken into the body through the mouth [1].

organic peroxide: Any organic compound containing oxygen (O) in the bivalent -O-O- structure and that may be considered to be a structural derivative of hydrogen peroxide where one or more of the hydrogen atoms has been replaced by an organic radical [5], [8].

OSHA (Occupational Safety and Health Administration, US Department of Labor): A US Federal agency which regulates workplace safety and health.

oxidizer:

(OSHA) "Oxidizer" means a chemical other than a blasting agent or explosive as defined in 29 CFR 1910.109 (a), that initiates or promotes combustion in other materials,

thereby causing fire either of itself or through the release of oxygen or other gases [5].

(DOT) A material that may, generally, by yielding oxygen, cause or enhance the combustion of other materials [8].

P

partitioning: The separation of a material into environmental media based on its physical properties.

PEL (Permissible Exposure Limit): An occupational exposure limit established under OSHA's regulatory authority. It may be a time-weighted average (TWA) concentration or a maximum concentration never to be exceeded either instantaneously (CEILING), during any 15-minute period (STEL), or during any other OSHA specified time period (PEAK).

Pensky-Martens Closed Cup (PMCC): A method for determining flash point [1].

peripheral neuropathy: Functional disturbances and/or pathological changes in the nerves of the extremities (hands, feet, arms and legs).

persistence: The length of time a compound may remain in the environment.

personal protection: The act of protecting the body against contact with known or anticipated chemical or physical hazards.

pH: A dimensionless number that represents the hydrogen ion (H^+) concentration of an aqueous solution. A pH of 7 is neutral. Numbers increasing from 7 to 14 indicate greater alkalinity. Numbers decreasing from 7 to 0 indicate greater acidity.

photolysis: Decomposition of a chemical via sunlight.

photophobia: Intolerance/aversion to light.

physical hazard: A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide,

an oxidizer, pyrophoric, unstable (reactive), or water-reactive [5].

physical state: Physical form and shape (liquid, crystal, powder, gas, etc.).

placenta: (Hodgson 1988) Structure through which the mammalian fetus receives nourishment from maternal blood, and through which it eliminates waste products.

pneum(o)-: Combining form denoting relationship to (a) respiration, (b) the lungs, (c) air, (d) pneumonia [7].

pneumoconiosis: A condition of the lung in which there is permanent deposition of particulate matter and the tissue reaction to its presence.

poison: See *poisonous material*.

poisonous material: (DOT) A material, other than a gas, which is known to be so toxic to humans as to afford a hazard to health during transportation, or which, in the absence of adequate data on human toxicity:

- (1) Is presumed to be toxic to humans because it falls into one of the following categories when tested on laboratory animals (whenever possible, animal test data that has been reported in the chemical literature should be used):
 - (a) *Oral toxicity.* A liquid with an LD₅₀ for acute oral toxicity of not more than 500 mg/kg or a solid with an LD₅₀ for acute oral toxicity of not more than 200 mg/kg.
 - (b) *Dermal toxicity.* A material with an LD₅₀ for acute dermal toxicity of not more than 1,000 mg/kg:
 - (c) *Inhalation toxicity.* (A) A dust or mist with an LC₅₀ for acute toxicity on inhalation of not more than 10 mg/l; or (B) A material with a saturated vapor concentration in air at 20°C (68°F) of more than one-fifth of the LC₅₀ for acute toxicity on inhalation of vapors and with an LC₅₀ for acute toxicity on inhalation of vapors of not more than 5000 ml/m³; or

- (2) Is an irritating material, with properties similar to tear gas, which causes extreme irritation, especially in confined spaces [8].

polymer: Chemical material composed of repeating molecular structural units.

polymerization: The process of joining two or more like molecules to form a more complex molecule whose molecular weight is a multiple of the original and whose physical properties are different.

POTW (Publicly Owned Treatment Works): Sewage treatment plant.

PPE (Personal Protection Equipment): Includes respirators, gloves, safety glasses, chemical-resistant clothing, etc.

pressure-generating chemical: A chemical that falls within any of the following categories:

- (a) a chemical that may present a pressure hazard typically over time by decomposition and/or spontaneous polymerization;
- (b) a chemical that is used to pressurize the contents of a self-pressurized container [2].

product name: The name under which a product is sold.

pulmonary edema: A build-up of fluid in the lungs.

pyrophoric: A chemical that will ignite spontaneously in air at a temperature of 130°F (54.4°C) or below [5]. Also see *spontaneously combustible*.

pyrophoric material: A liquid or solid that, even in small quantities and without an external ignition source, can ignite within 5 minutes after coming in contact with air when tested according to paragraph 3.a(1) or 3.a(2) as appropriate for Appendix E to 49 CFR 173.124 [8].

pyrolysis: Transformation of a compound into one or more other substances by heat alone, i.e., without oxidation. It is thus similar to destructive distillation. Though the

term implies decomposition into smaller fragments, pyrolytic change may also involve isomerization and formation of higher molecular weight compounds [3].

R

R and S phrases: Risk and Safety phrases mandated for hazardous chemicals by the European Union.

RCRA (Resource Conservation and Recovery Act): A statute enacted in 1976 that is administered by US EPA, RCRA was created to regulate the treatment, storage and disposal of hazardous chemical waste.

reactive: See *unstable*.

reactivity: Chemical reaction with the release of energy. Undesirable effects (such as pressure buildup; temperature increase; formation of noxious, toxic, or corrosive byproduct) may occur because of the reactivity of a substance to heating, burning, direct contact with other materials, or other conditions in use or in storage [1].

reducing agent: In a reduction reaction (which always occurs simultaneously with an oxidation reaction), the chemical or substance that (1) combines with oxygen or (2) loses electrons to the reaction [1].

refrigerant gas or dispersant gas: (DOT) All nonpoisonous refrigerant gases, dispersant gases (fluorocarbons) and mixtures thereof, or any other compressed gas having a vapor pressure greater than or equal to 1792 kPa (260 psi) at 130°F (54°C) and restricted for use as a refrigerant, dispersant, or blowing agent [8].

registry number: See *CAS number*.

reproductive toxin: (OSHA) Chemical which affects the reproductive capabilities including chromosomal damage (mutagens) and effects on fetuses (teratogenesis).

residue: (DOT) Means the hazardous material remaining in packaging, including a tank car, after its contents have been unloaded to the maximum extent practicable and before the packaging is either refilled or

cleaned of hazardous material and purged to remove any hazardous vapors [8].

respiratory: Pertaining to respiration [7].

respiratory sensitizer: (GHS) A substance that will induce hypersensitivity of the airways following inhalation of the substance.

RQ (Reportable quantity):

(CERCLA) The quantity of a substance designated under CERCLA as hazardous, the release of which requires notification to the National Response Center, (800) 424-8802 [9].

(DOT) Reportable quantity means the quantity specified for a substance in the Appendix to the Hazardous Materials Table [8].

(SARA) Reportable quantity means the quantity specified in Title III, section 304, which requires specific reporting.

routes of exposure: The means by which material may gain access to the body, for example, breathing, swallowing, or through the skin or eyes.

RTECS (Registry of Toxic Effects of Chemical Substances): Published by NIOSH, RTECS is a compendium of the known toxic and biological effects of chemical substances [12]. See *NIOSH*.

S

SDWA (Safe Drinking Water Act): A U.S. federal statute enacted in 1974 to regulate the nation's public drinking water supply.

SAR (Structure Activity Relationship): Using chemical structure to predict biological and physiochemical activity.

SARA Title III: Title III of the Superfund Amendments and Reauthorization Act of 1986 also known as the Emergency Planning and Community Right-to-Know Act (EPCRA). It requires extensive submission of information about hazardous chemicals to EPA, States and local communities and

establishes a national program of emergency planning. Administered by EPA.

SDS: Safety Data Sheet.

S.Q.: See *Subcutaneous*.

self-heating material: A material that, when in contact with air and without an energy supply, is liable to self-heat. A material of this type which exhibits spontaneous ignition or if the temperature of the sample exceeds 200 °C during the 24-hour test period when tested in accordance with paragraph 3.b(1) of Appendix E to 49 CFR 173.124 [8].

sensitizer: 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.

silicosis: A disease of the lungs (fibrosis) caused by the inhalation of silica dust [1]. See *pneumoconiosis*.

slurry: A liquid containing insoluble material in suspension.

solubility : A numerical expression describing the degree to which one material will dissolve in another.

solution: Any homogeneous liquid mixture of two or more chemical compounds or elements that will not undergo any segregation under conditions normal to transportation [8].

specific gravity: The weight of a material compared to the weight of an equal volume of water at specified temperatures. Also the weight of a vapor or gas as compared to an equal volume of air at a specified temperature.

spontaneously combustible materials: (DOT) Spontaneously combustible materials are broken down into two categories: *pyrophoric material* and *self-heating material*.

stability: The ability of a material to remain unchanged under expected and reasonable conditions of storage or use.

STEL (Short Term Exposure Limit): See *PEL* and *TLV*.

subchronic (health effect): A health effect occurring as a result of the repeated daily exposure of experimental animals to a chemical for part (approximately 10 percent) of a life span.

subcutaneous: Beneath the skin [7].

synergism: The simultaneous action of separate materials that together, have an effect greater than the sum of the individual effects.

systemic toxicity: The toxicity observed when a substance has an adverse effect in a part of the body distant from the site of exposure/administration.

T

tachycardia: A very rapid heart rate.

target organ effect: The effect of a material on an organ or system that can be a result of direct contact with the organ or through systemic toxicity. OSHA provides examples of the types of target organ effects in 29 CFR 1910.1200, Appendix A.

TCC (Tag Closed Cup): A standard method of determining flash point. See flash point.

TOC (Tag Open Cup): A standard method of determining flash point. See flash point.

teratogen: A material that has the capability of causing physical defects in the developing embryo.

teratology: The study of embryonic developmental defects.

THoD (Theoretical Oxygen Demand): A measure of the total amount of oxygen required to oxidize a chemical completely; calculated from the molecular formula.

tinnitus: Ringing in the ears, or other noises like a buzzing.

TLV (Threshold Limit Value): Developed by ACGIH-recommended limitation for a material at or below which workers should have no health problems. TLVs are expressed as a time-weighted average (TWA) for an 8-hour day, as a short-term exposure limit (STEL) maximum 15-minute exposures (no more than 60 minutes/day), or as a ceiling value (C) that is not to be exceeded under any condition. TLVs with a "skin" notation indicate that the material may represent exposure by this route. The TLVs are presented in the ACGIH annual publication, Threshold Limit Values and Biological Exposure Indices.

toxic chemical: (OSHA) A chemical that falls within any of the following categories:

- A chemical that has a median lethal dose (LD_{50}) of more than 50 milligrams per kilogram (ppm), but no more than 500 milligrams per kilogram (ppm) of body weight, when administered orally to albino rats weighing between 200 and 300 grams each.
- A chemical that has a median lethal dose (LD_{50}) of more than 200 milligrams per kilogram, but no more than 1000 milligrams per kilogram of body weight, when administered by continuous contact for 24 hours (or less, if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.
- A chemical that has a median lethal concentration (LC_{50}) in air of more than 200 parts per million (ppm), but no more than 2000 parts per million (ppm) of gas or vapor by volume, or more than 2 milligrams per liter, but no more than 20 milligrams per liter, of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less, if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each [5].

(SARA) A chemical so designated under Section 313 of SARA Title III and listed in 40 CFR 372.65. Its release into the environment must be reported annually to the EPA and to designated State officials.

The presence of a toxic chemical in a mixture or trade name product must be notified to customers. A statement about this notification must be incorporated into or attached to the MSDS for that product.

toxicology: The scientific study of poisons, their actions, their detection and the treatment of the conditions produced by them [7].

TPQ (Threshold Planning Quantity): The designated quantity of a SARA Extremely Hazardous Substance as listed in 40 CFR 355 Appendix A and B that if equaled or exceeded at a facility triggers emergency planning provisions under SARA Title III.

trade secret: (OSHA) Trade secret means any confidential formula, pattern, process, device, information, or compilation of information that is used in an employer's business and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it. 29 CFR 1910.1200, Appendix D sets out the criteria to be used in evaluating trade secrets [5].

transformation: Also biotransformation. The oxidation or alteration of the chemical structure of a substance, resulting in the loss of physical and chemical properties, or primary biodegradation.

transport (ecological): Moving from one ecological medium or compartment to another.

TSCA (Toxic Substances Control Act): Enacted in 1976, TSCA gives US EPA the authority to require tests, to restrict or prohibit the manufacture, use, distribution, export and disposal of chemical substances and mixtures.

TSCA Inventory: A dynamic list of chemical substances, identified by CAS Registry Numbers or by EPA Accession Numbers, that are manufactured, imported, or processed for commercial purposes in the United States since January 1, 1975.

TWA (Time-weighted average): See *TLV* and *PEL*.

U

UEL or UFL (Upper explosive limit or upper flammable limit of a vapor or gas):

The highest concentration (highest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present [1]. See also *LEL*.

UN number: An identification number assigned by the United Nations to hazardous materials in transportation. They are used to readily identify hazardous materials in transportation emergencies. Those preceded by "NA" are associated with descriptions not recognized for international shipments, except to and from Canada.

unstable (reactive): 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 [5].

urticaria: An allergic reaction, characterized by raised bumps on the skin or mucous membranes and usually accompanied by intense itching, to an allergen such as food, plants, inhalants (pollen) or chemicals.

USDA (United States Department of Agriculture): A US Federal agency which supports the production of agriculture.

ultraviolet (UV): Radiation in the region of the electromagnetic spectrum including wavelengths from 100 to 3900 Å. UVA covers the region 315 to 400 Å. UVB covers the region 280 to 315 Å. Hazard: Dangerous to eyes, overexposure causes severe skin burns (sunburn). Use: Air sterilization in hospitals, microscopy [3].

UV: See *ultraviolet*.

V

vapor: The gaseous form of a substance that is liquid or solid in its normal state (i.e., at standard temperature and pressure) [2].

vapor density: The weight of a vapor or gas as compared to a standard, usually air.

vapor pressure: The pressure exerted by a saturated vapor above its own liquid in a closed container [1].

VOC (volatile organic compound): A precursor or forerunner to the creation of ozone; a class of pollutants regulated under the Clean Air Act.

volatility from water: A measure of how much of a gas will remain in water, versus how much will be in air, using Henry's Law Constant (amount of gas absorbed by a liquid at a given temperature).

W

water reactive chemical: (OSHA) A chemical that reacts with water to release a gas that is either flammable or presents a health hazard [5].

water reactive material: (DOT) See dangerous when wet [8].

WEEL (Workplace Environmental Exposure Level) Guides: Established by the AIHA (American Industrial Hygiene Association) WEEL Committee for certain substances that do not have exposure guidelines established by other organizations (see ACGIH TLVs). All WEELs are expressed as time-weighted average (TWA) concentrations; however, different time periods are specified, depending on the properties of the material.

WHMIS (Workplace Hazardous Materials Information System): A Canadian nationwide system to provide information to workers on hazardous materials used in the workplace through the use of labels, MSDSs and worker education. It is the Canadian counterpart of the HCS, but has different provisions and interpretations.

List of Sources

- [1] MSDS Glossary, *Hazard Communication – A Compliance Kit*, (OSHA 3104), US Government Printing Office (GPO) No. 929-022-00000-9.
- [2] American National Standard for Hazardous Industrial Chemicals – Precautionary Labeling (ANSI Z129.1-2000), 2000.
- [3] Lewis, *Hawley's Condensed Chemicals Dictionary*, 14th ed., 2001, John Wiley & Sons, Inc., Hoboken, NJ. Reprinted by permission of John Wiley & Sons, Inc.
- [4] By permission, from *Merriam-Webster's Collegiate® Dictionary, Eleventh Edition* ©2003 by Merriam-Webster, Incorporated (www.Merriam-Webster.com).
- [5] 29 CFR 1910.1200 et seq., Occupational Health and Safety's Administration's Hazard Communication Standard (HCS).
- [6] Verschueren, K., *Handbook of Environmental Data on Organic Chemicals*, 4th ed., 2001, John Wiley & Sons, Inc., Hoboken, NJ. Reprinted by permission of John Wiley & Sons, Inc.
- [7] Reprinted from Taylor, *Dorland's Illustrated Medical Dictionary*, 29th ed., Taylor, copyright 1999, with permission from Elsevier.
- [8] 49 CFR 171 Department of Transportation, Federal Hazardous Materials Regulations.
- [9] Data Interchange Standards Association, (DISA) X12.36, Material Safety Data Sheet Transaction Set (848), The Accredited Standards Committee (ASC) X12, 7600 Leesburg Pike, Suite 430, Falls Church, VA 22043.
- [10] Reprinted from *Dorland's Illustrated Medical Dictionary*, 26th ed., copyright 1995, with permission from Elsevier.
- [11] Reprinted with permission from NFPA 49-2001, *Hazardous Chemical Data*, 13th ed., as printed in the *Fire Protection Guide to Hazardous Materials*, copyright 2001, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the NFPA on the referenced subject, which is represented only by the standard in its entirety.
- [12] National Institute for Occupational Safety and Health (NIOSH), *Registry of Toxic Effects of Chemical Substances (RTECS)*, maintained on CD.

Annex D (informative)

Preparation Resources Document

Annex D

(informative)

Preparation Resources Document

RESOURCE	MSDS Section																Gen	Comment
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
29 CFR 1910.1000 OSHA Air Contaminants - Permissible Exposure Limits								X										
40 CFR 260-263 EPA - Solid Wastes Hazardous Waste Management System													X					
49 CFR 100-199,397 Hazardous Materials Transportation														X	X			
ACGIH Quick Selection Guide to Chemical Protective Clothing, 4 th Edition, Krister Forsbert, S.Z. Mansdorf, Cincinnati, OH: American Conference of Governmental Industrial Hygienists, Publication #9090								X										
Agency for Toxic Substances & Disease Registry (ATSDR) 404-639-0615		X									X							
ANSI Z129.1 for Hazardous Industrial Chemicals - Precautionary Labeling New York, NY: American National Standards Institute		X		X			X									X		
Z88.2 Recommended Practice for Respiratory Protection Fairfax, VA: American Industrial Hygiene Association								X										
AQUIRE (Aquatic Toxicity Information Retrieval) Database U.S. Environmental Protection Agency, http://www.epa.gov/med/databases/databases.htm#aquire												X						Aquatic data only; available from several data vendors
Canadian Centre for Occupational Health and Safety (CCOHS) http://www.ccohs.ca/		X									X							
Casarett and Doull's Toxicology: The Basic Science of Poisons New York, NY: McGraw Publishing Co.		X									X							
Catalog of Teratogenic Agents [Shepard's] Baltimore, MD: The Johns Hopkins University Press		X									X							
Center for Disease Control (CDC) http://www.cdc.gov , 404-639-3235		X									X							
Chemical Carcinogen Risk Information System (CCRIS®) Bethesda, MD: National Library of Medicine (NLM)											X							
Chemical Hazard Response Information System (CHRIS) U.S. Coast Guard					X	X		X	X			X						
Chemical Identification File (ChemID®) Bethesda, MD: National Library of Medicine (NLM)			X															
CHEMTREC (non-emergency) 1-800-262-8200														X			X	
Clinical Toxicology of Commercial Products: Acute Poisoning [Gosselin] Baltimore, MD: Williams and Wilkins		X		X							X							
Comprehensive Guide to Hazardous Properties of Chemical Substances, John Wiley & Sons, Inc.		X							X		X							
Consumer Product Safety Commission (CPSC) Hotline 800-638-2772																	X	

*The latest edition should be used.

RESOURCE	MSDS Section																Gen	Comment
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Dangerous Properties of Industrial Materials [Sax] New York, NY: Van Nostrand Reinhold										X								
Developmental and Reproductive Toxicology (DART® and ETICBACK®) Bethesda, MD: National Library of Medicine (NLM)											X							
Documentation of the Threshold Limit Values and Biological Exposure Indices Cincinnati, OH: American Conference of Governmental Industrial Hygienists		X						X			X							
DRUGDEX® Englewood, CO: MICROMEDEX, Inc.		X	X	X							X							
Emergency Planning & Community Right To Know Hotline 800-535-0202															X		X	
Environmental and Occupational Medicine Boston, MA: Little, Brown, and Co. McGraw-Hill/Appleton and Lange		X		X							X							
Environmental Fate Database Syracuse Research Corporation, http://esc.syrres.com/efdb.htm												X						
Environmental Protection Agency (EPA) http://www.epa.gov/															X			
Essential Practices for Managing Chemical Reactivity Hazards, Center for Chemical Process Safety (CCPS).					X	X	X			X								
FIFRA (Pesticide Information), U.S. Environmental Protection Agency 703-308-8010															X		X	
Fire Protection Guide to Hazardous Materials Quincy, MA: National Fire Protection Association					X					X								
Fundamentals of Industrial Hygiene Itasca, IL: National Safety Council								X										
Gene-Tox Program of the U.S. EPA, The (GENE-TOX®) Bethesda, MD: National Library of Medicine (NLM)											X							
Goldfrank's Toxicologic Emergencies Norwalk, CT: Appleton and Lange McGraw-Hill Professional		X		X							X							
Guidance Document for Preparing Material Safety Data Sheets (MSDS) Specifically Focusing on Hazard Determination for Plastics and Plastic-Related Materials; SPI Publication AE-152 Washington D.C.: The Society of the Plastics Industry, Inc. http://www.plasticsindustry.org/public/oheic/onepage.htm																X		
Guide to Occupational Exposure Values Cincinnati, OH: American Conference of Governmental Industrial Hygienists								X										
Haddad & Winchester's Clinical Management of Poisoning and Drug Overdose Philadelphia, PA: W.B. Saunders Co.		X		X							X							
Handbook of Chemistry and Physics Cleveland, OH: Chemical Rubber Company (CRC Press)									X									
Handbook of Environmental Data on Organic Chemicals [Verschuere] John Wiley & Sons, Inc.												X						
Handbook of Environmental Degradation Rates Chelsea, MI: Lewis Publishers												X						
Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Lewis Press												X						
Handbook of Pesticide Toxicology San Diego, CA: Academic Press-Harcourt Brace and Co											X							
Handbook of Toxic and Hazardous Chemicals and Carcinogens Park Ridge, NJ: Sittig, Noyes Data Corp		X									X							
Hawley's Condensed Chemical Dictionary John Wiley & Sons			X						X								X	

*The latest edition should be used.

RESOURCE	MSDS Section																Gen	Comment
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Hazardous Materials Toxicology Clinical Principles of Environmental Health Baltimore, MD: Williams & Wilkins		X									X							
Hazardous Substances Data Bank (HSDB®) Bethesda, MD: National Library of Medicine (NLM)		X		X			X		X		X	X						
HAZARTEXT® Englewood, CO: MICROMEDEX, Inc.		X	X	X	X	X	X	X	X	X	X	X	X		X			Fee required to access data
Industrial Hygiene and Toxicology [Patty's] New York, NY: Wiley-Interscience		X	X					X			X							
Hamilton & Hardy's Industrial Toxicology 5 th Edition [edited by] Raymond D. Harbison, St. Louis, MO: Mosby-Year Book Inc., c1998											X							
Improving Reactive Hazard Management U.S. Chemical Safety & Hazard Investigation Board										X								
Integrated Risk Information System (IRIS®) Bethesda, MD: National Library of Medicine (NLM)											X							
International Agency for Research on Cancer (IARC) Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man Geneva, Switzerland: World Health Organization. http://monographs.iarc.fr/		X									X							
International Air Transport Association (IATA) 2000 Peel Street Montreal, Quebec, Canada H3A 2R4														X	X			
International Maritime Dangerous Goods Code (IMDG) London, England: International Maritime Organization														X	X			
Material Safety Data Sheet, The: A Practical Guide to First Aid Material Safety Data Sheet, The: A Practical Guide to First Aid Callaghan and Cooper, Ontario, Canada: Canadian Centre Occupational Health and Safety http://www.ccohs.ca/products/publications/firstaid/		X		X														
Material Safety Data Sheets Collection Schenectady, NY: Genium Publishing Corporation http://www.hz.genium.com/searchmsds/																	X	
Material Safety Data Sheets, The Writer's Desk Reference Boca Raton, FL: Aribet Books HILL & GARNETT PUB.																	X	
Medical Literature On-line (Medline®) Bethesda, MD: National Library of Medicine (NLM)		X		X							X							
Medical Toxicology: Diagnosis and Treatment of Human Poisoning New York, NY: Williams and Wilkins		X		X							X							
Merck Index, The, An Encyclopedia of Chemicals, Drugs and Biologicals White House Station, NJ: Merck and Co.			X						X									
National Cancer Institute 800-4-CANCER											X							
National Fire Protection Association 617-770-3000					X		X		X									
National Institute of Health (NIH) http://www.nih.gov		X									X							
National Institute of Occupational Safety and Health (NIOSH) Educational Resource Centers 800-356-4674																	X	
National Institute of Occupational Safety and Health (NIOSH) 800-356-4674																	X	
National Pesticide Telecommunications Network 800-858-7378		X	X								X							
National Toxicology Program (NTP) http://ntp-server.niehs.nih.gov		X									X							

*The latest edition should be used.

RESOURCE	MSDS Section																Gen	Comment
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
NIOSH Pocket Guide to Chemical Hazards Washington, DC: U.S. Government Printing Office		X		X				X			X							
North American Emergency Response Guidebook Washington, DC: U.S. Department of Transportation		X		X	X	X								X				
NTP Annual Report on Carcinogens and Summary of the Annual Report on Carcinogens Rockville, MD: National Technical Information Service (NTIS)		X									X							
Occupational Safety and Health Administration (OSHA) - Computerized Information System (OCRS) http://www.osha-slc.gov/ , 800-321-6742																	X	
Occupational Safety and Health Administration (OSHA), http://www.osha.gov/ , 800-321-6742																	X	
Oil and Hazardous Materials, Technical Assistance Data System (OHM/TADS) U.S. Environmental Protection Agency					X	X						X	X					
Perry's Chemical Engineers' Handbook New York, NY: McGraw-Hill							X											
POISINDEX® Englewood, CO: MICROMEDEX, Inc.		X	X	X							X							Fee required to access data
Poisoning and Drug Overdose McGraw-Hill		X		X							X							
Proctor and Hughes' Chemical Hazards of the Workplace John Wiley & Sons		X						X			X							
Quick Selection Guide to Chemical Protective Clothing John Wiley & Sons								X										
Recognition and Management of Pesticide Poisonings, Dr. Routt Reigart and Dr. James Roberts, EPA's Office of Pesticide Programs, Washington, D.C., 5 th Edition, 1999 http://www.epa.gov/pesticides/safety/healthcare/handbook/handbook.htm		X		X							X							
Recognition of Health Hazards in Industry John Wiley and Sons		X									X							
Registry of Toxic Effects of Chemical Substances (RTECS®), National Institute of Occupational Safety & Health (NIOSH), Atlanta, GA											X							Fee required to access data
Reproductive Hazards of Industrial Chemicals New York, NY: Academic Press		X									X							
ReproRisk® System Englewood, CO: MICROMEDEX, Inc.											X							Fee required to access data
Society for Chemical Hazard Communication (SCHC) http://www.schc.org																X		
Superfund Hotline, U.S. Environmental Protection Agency 800-424-9346 or 202-260-1163													X					
Teratogen Information System (TERIS) 206-543-2465											X							
Threshold Limit Values and Biological Exposure Indices Cincinnati, OH American Conference of Governmental Industrial Hygienists		X						X			X							
TOMES® System Englewood, CO: MICROMEDEX, Inc.		X		X	X		X	X	X	X	X	X		X	X			Fee required to access data
Toxicology Information Response Center (Oak Ridge, TN) 423-576-1746											X							
Toxicology Literature On-line (Toxline®) Bethesda, MD: National Library of Medicine (NLM)		X									X							

*The latest edition should be used.

RESOURCE	MSDS Section																Gen	Comment
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Toxicology of the Eye Springfield, IL: Charles C. Thomas Publisher		X		X							X							
TSCA Assistance Office Hotline, U.S. Environmental Protection Agency 202-554-1404															X			
TSCA Test Submissions (TSCATS) U.S. Environmental Protection Agency		X									X							
U.S. Department of Agriculture/National Agriculture Library http://www.nalU.S.da.gov/		X		X							X							
U.S. Food and Drug Administration 301-827-0548															X		X	
WHMIS Core Material Richmond, British Columbia, Canada: Workers' Compensation Board															X	X		
Workplace Hazardous Materials Information System (WHMIS) Ottawa, Ontario, Canada: Department of Corporate and Consumer Affairs															X	X		