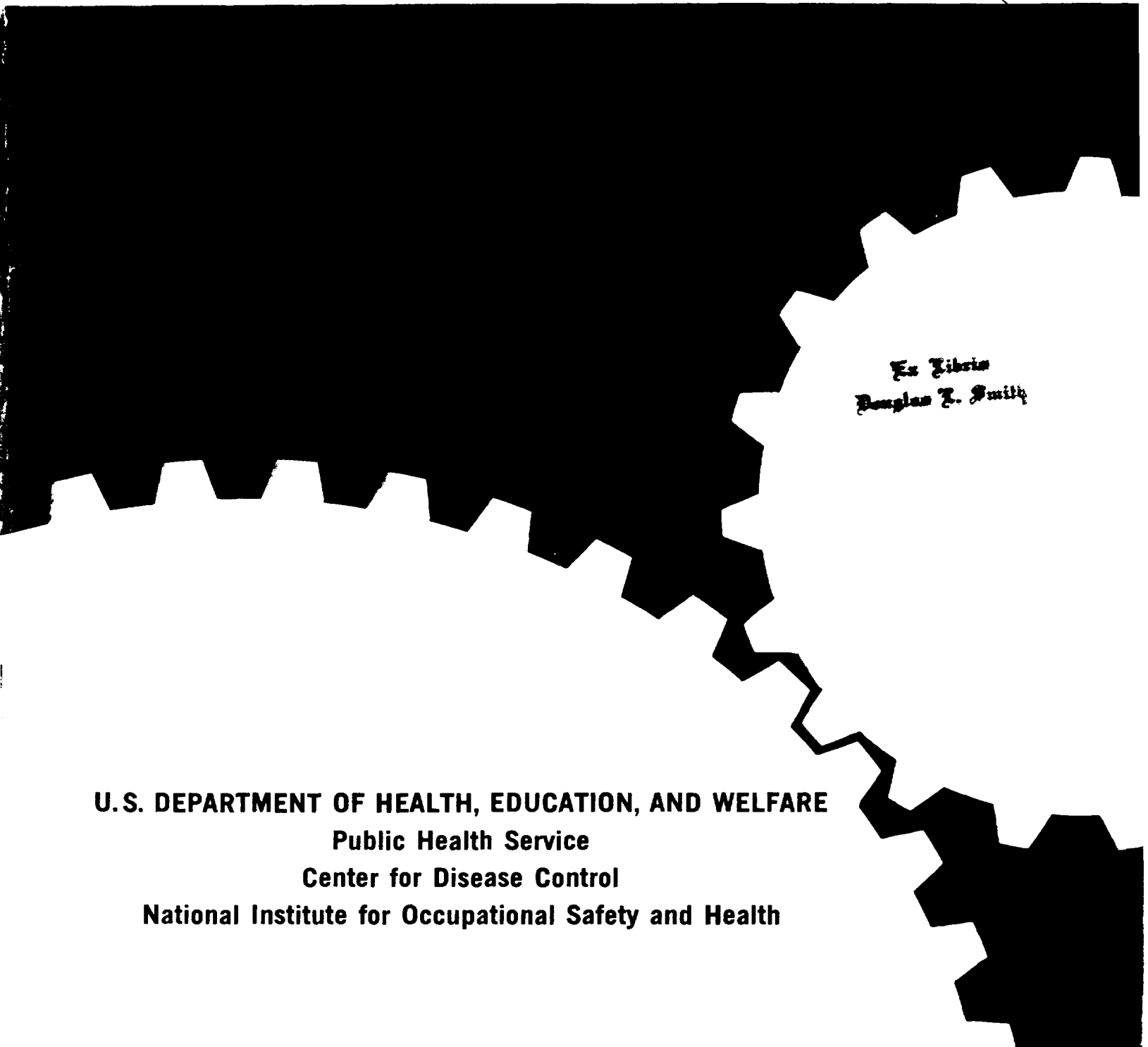


a recommended standard

AN IDENTIFICATION SYSTEM FOR OCCUPATIONALLY HAZARDOUS MATERIALS



*Ex Libris
Douglas L. Smith*

**U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health**

a recommended standard

**AN IDENTIFICATION SYSTEM FOR
OCCUPATIONALLY HAZARDOUS MATERIALS**



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

Center for Disease Control

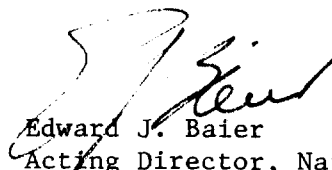
National Institute for Occupational Safety and Health

1974

PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for Standards to protect the health and safety of workers exposed to an ever-increasing number of potential hazards at their workplace. This document, which recommends an identification system for occupationally hazardous materials, is designed to allow the rapid determination of the relative danger that may result from exposure to materials found in the workplace.

I am pleased to acknowledge the contributions to this report by the staff of NIOSH and the valuable constructive comments by the Review Consultants on identification systems, and by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine. The NIOSH recommendations are not necessarily a consensus of all of the consultants that reviewed this document. A list of the NIOSH Review Committee members and of the Review Consultants appears on pages vi and vii.



Edward J. Baier
Acting Director, National Institute
for Occupational Safety and Health

The Industrial Hygiene Services Branch, Division of Technical Services (DTS), National Institute for Occupational Safety and Health, had primary responsibility for the development of this document. The Office of Research and Standards Development (ORSD) provided coordination and review. Richard J. Lewis, Sr. of DTS had NIOSH program responsibility for the development of the document, and Frank W. Mackison of ORSD served as criteria manager.

NIOSH REVIEW CONSULTANTS ON
THE IDENTIFICATION SYSTEM

Robert H. Armbruster, M.D.
Palo Alto Medical Clinic
Palo Alto, California 94301

Vincent J. Castrop
Industrial Hygiene Department
General Motors Corporation
Warren, Michigan 48090

Irving H. Davis
Division of Occupational Health
Michigan Department of Health
Lansing, Michigan 48914

Hervey B. Elkins, Ph.D.
Belmont, Massachusetts 02179

Paul D. Halley
Medical Department
Standard Oil Company
Chicago, Illinois 60605

Robert L. Harris, Jr., Ph.D.
Raleigh, North Carolina 27609

Leonard A. Krause, Sc.D.
Olin Corporation
Branford, Connecticut 06405

Howard L. Kuznetz
Shell Oil Company
Houston, Texas 77002

James O. Pierce, Sc.D.
University of Missouri
Columbia, Missouri 65201

Carl Zenz, M.D.
Allis-Chalmers Manufacturing Company
Milwaukee, Wisconsin 53201

REVIEW COMMITTEE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

A. Walter Hoover, M.D.
Division of Occupational
Health Programs

Jane A. Lee, R.N.
Division of Technical Services

Denis J. McGrath, M.D.
Office of Research and
Standards Development

Frank L. Mitchell, D.O.
Office of Research and
Standards Development

Robert L. Peterson
Western Area Occupational
Health Laboratory

Ex Officio:

Herbert E. Christensen, D.Sc.
Office of Research and Standards
Development

A RECOMMENDED STANDARD FOR AN IDENTIFICATION SYSTEM FOR
OCCUPATIONALLY HAZARDOUS MATERIALS

Table of Contents

	<u>Page</u>
PREFACE	
REVIEW COMMITTEES	
I. RECOMMENDATIONS FOR A STANDARD: AN IDENTIFICATION SYSTEM FOR OCCUPATIONALLY HAZARDOUS MATERIALS	
Section 1 - Applicability	1
Section 2 - Assignment of Hazard Rating	2
Section 3 - Preparation of Warning Information	2
Section 4 - Implementation of the System	2
Section 5 - Availability of the Data Sheets	3
II. INTRODUCTION	4
III. SCOPE AND OBJECTIVE OF THE IDENTIFICATION SYSTEM FOR OCCUPATIONALLY HAZARDOUS MATERIALS	5
IV. BASIS FOR THE IDENTIFICATION SYSTEM	
a. Utility of the Identification System for Worker Protection	7
b. Evaluation of Other Systems	8
V. COMPONENTS OF THE IDENTIFICATION SYSTEM FOR OCCUPATIONALLY HAZARDOUS MATERIALS	
a. Definition of a Hazardous Material	13
b. Criteria for Determination of Degree of Hazard	15
(1) Determination of Degree of Health Hazard	15
(2) Determination of Degree of Fire Hazard	17
(3) Determination of Degree of Reactivity Hazard	20
c. Preparation of a Material Safety Data Sheet	22
d. Preparation of the Hazard Alert Symbol	39
e. Selection of Label Statements	41
VI. USE OF PLACARDS, LABELS, AND MSDS	43
VII. REFERENCES	47
IX. APPENDIX I - Glossary of Terms	50
IX. APPENDIX II - Tables of Suggested Label Statements	51

X. APPENDIX III - Sources of Health Hazard Ratinge and 60
Test Methods

XI. APPENDIX IV - Sources of Flammability and Reactivity Ratings 62

I. RECOMMENDATIONS FOR A STANDARD: AN IDENTIFICATION SYSTEM
FOR OCCUPATIONALLY HAZARDOUS MATERIALS

The National Institute for Occupational Safety and Health recommends that employees be informed about the nature of the chemical hazards, both potential and actual, to which they may be exposed. Marking of all hazardous materials in the workplace and the availability of data sheets will help in the education of employees, and provide the data necessary for employers to take proper action to safeguard their employees.

When working in the presence of a hazardous material, hazards are always present even under work situations most carefully designed to eliminate risk. The goal of this recommendation and the intent of the Occupational Safety and Health Act of 1970 is to insure that employees can perform their duties without endangering their safety or health. This recommendation for an identification system for occupationally hazardous materials is an effort to minimize risk by alerting all concerned to the hazards inherent in chemicals found in the workplace.

A "hazardous material" is defined for the purposes of this document as a substance or mixture of substances having intrinsic properties capable of producing adverse effects on the health, or safety of the worker.

"Risk" is an assessment of the probability of adverse effects occurring in a defined set of circumstances. Risk is not a factor in the above definition of a hazardous material.

Section 1 - Applicability

An employer shall not store, distribute, make available, furnish, or supply a hazardous material for use by his employees; or make available or allow to be made available a work area containing a hazardous material as

defined previously, unless such material or work area is labeled in accordance with Sections 2 through 5 below.

Section 2 - Assignment of Hazard Rating

All materials which are determined to be hazardous must be assigned a relative hazard rating in the categories of health, fire, and reactivity in accordance with the criteria contained in Chapter V, Section B, of this document.

Section 3 - Preparation of Warning Information

A Material Safety Data Sheet (MSDS) (Chapter V, Section C), an alert symbol (Chapter V, Section D), and labeling statements (Chapter V, Section E) shall be prepared in accordance with instructions in Chapter V utilizing relative rating information regarding the hazards of the material.

Section 4 - Implementation of the System

Placards and/or labels shall be applied according to the instructions in Chapter VI. The key words shall be printed in English and in the predominant language of non-English-reading workers, unless they are otherwise trained and informed of the hazards. All illiterate workers shall receive such training.

Placards shall be posted at the entrance and within all areas containing hazardous materials in storage or use. Labels shall be applied, affixed, or attached to all containers holding hazardous materials in such a manner and in sufficient number as to be visible to and readable by all potentially exposed workers.

For substances or products containing substances listed in 29 CFR 1910.93, placards on the interior of buildings and labels shall contain the following statement:

"This product (area) contains (list substances in the product which appear in 29 CFR 1910.93) or compounds thereof. According to regulations promulgated under the Occupational Safety and Health Act of 1970, employers using this product must make available to their employees the information required by OSHA regulations."

Placarding or extensive labeling is not required for materials of minimum hazard, ie, those with no relative hazard rating above one (1). For areas containing numerous hazardous materials, only one placard is required. This should reflect the highest hazards of each category contained in the area. Each hazardous material container, however, must bear a label specific to the material within.

Section 5 - Availability of the Data Sheets

A Material Safety Data Sheet (MSDS) shall be filed in the establishment where the corresponding material is in storage or use, in such a location that it shall be readily available for examination by workers. This location is to be made known to the employees to: (a) allow workers to ascertain the hazardous properties; (b) enable management to be informed of appropriate methods of control, worker protection, and disposal; and (c) give first aid and medical personnel rapid access to medical information during emergencies.

The current MSDS shall be made available to the representatives of the Secretary of Health, Education, and Welfare, to the Secretary of Labor, and to potentially exposed employees.

II. INTRODUCTION

This report presents the recommended standard which was developed and prepared by the National Institute for Occupational Safety and Health (NIOSH) to assist in meeting the need to provide adequate information for the safety and health of employees exposed to hazardous materials. The necessary relevant information is made available in accordance with Section 22(c)(1) of the Occupational Safety and Health Act of 1970 which authorizes NIOSH to develop and establish recommended occupational safety and health standards.

Labeling is an important component of a program to ensure a safe and healthful workplace. Since labeling by itself is insufficient, other methods of informing and educating the worker must also be used.

This recommended standard describes a system designed to inform the worker of the presence and nature of, and appropriate response to, such hazardous materials as may be encountered in the workplace.

III. SCOPE AND OBJECTIVE OF THE IDENTIFICATION SYSTEM FOR OCCUPATIONALLY HAZARDOUS MATERIALS

The intent of the Occupational Safety and Health Act of 1970 is to provide a safe and healthful working place for all employees covered by the Act. Section 6(b)(7) of the Act states "Any standard promulgated under this subsection shall prescribe the use of labels or other appropriate forms of warning as are necessary to insure that employees are apprised of all hazards to which they are exposed, relevant symptoms and appropriate emergency treatment, and proper conditions and precautions of safe use or exposure."

The broad objectives of any adequate hazardous warning system for worker protection are:

- (a) To provide immediate warning of potential danger so that injury, illness, or death may be prevented.
- (b) To describe the nature of the hazard.
- (c) To indicate actions to be taken to prevent undue or accidental exposure under conditions of normal use or during emergencies.
- (d) To give instructions to minimize injurious effects in the event of exposure.

Labels, placards, and similar warning devices have been used to warn of potentially hazardous conditions. However, there has never been a uniform and complete system to identify materials found in the workplace. The recommended standard responds to that portion of the Act quoted above. It is designed to inform the employee of potentially hazardous materials as

they are encountered in the workplace by a three-component warning system based on the use of placards, labels, and Material Safety Data Sheets.

These components collectively:

- Identify the hazardous materials

- Indicate the degree and type of hazard(s)

- Describe signs and symptoms from overexposure

- Prescribe safe handling procedures

- Describe the proper emergency care in the event of
overexposure

- Indicate disposal methods

IV. BASIS FOR THE IDENTIFICATION SYSTEM

A single comprehensive labeling system applicable to every hazardous material under all circumstances is a desirable goal. All those affected would come to understand a universal system and recognize hazard potential whether the material was encountered in the home, in the workplace, or in transport. The elimination of confusion from multiple labeling systems and economy of application would be real benefits of a universal system, but was beyond the scope of NIOSH's mandate.

In responding to the need for worker protection, NIOSH first sought to adapt existing systems for use in the workplace. As work progressed, numerous modifications and additions forced the realization that adaption of a single system would not suffice to protect the health of the worker. The identification system presented in this document is specifically tailored for use in the workplace to provide warning and information concerning hazardous materials encountered in the workplace.

(a) Utility of the Identification System for Worker Protection

The Identification System possesses the following characteristics, all of which are considered to be essential to the success of an employee safety and health hazard warning system: (1) The Identification System is comprehensive in that it addresses itself to both safety and health considerations. In the past, labels and placards have stressed job safety with less attention being paid to safeguarding the health of workers from hazardous materials encountered in the workplace. It is essential that delayed or chronic health effects must be given the same attention as are

immediate or acute problems. Thus, it is essential that any information system contain a health hazard component. (2) The warning labels and placards describe levels for potential harm. The employee is able to determine in the work environment, by observation and comprehension of the precautionary labels and placards, the relative injury and illness hazards inherent in the material which may be encountered. (3) The Identification System provides for the furnishing of detailed information on the hazard. The Material Safety Data Sheet contains additional chemical, physical, and medical data to allow adequate preplanning of controls and optimum response to excessive exposure.

(b) Evaluation of Other Systems

Several other systems are currently in use to identify, instruct, or warn individuals about potential or actual hazards which may endanger their safety and health. These systems vary greatly in scope, degree of information imparted, visual appearance, and intended uses. Several aspects of existing systems are applicable to the work environment and have been adapted for use in the recommended standard.

The Food and Drug Administration (FDA) has requirements for the labeling of foods and drugs implemented under the provisions of the Federal Food, Drug, and Cosmetic Act. 52 Stat. 1040(1938), 21 USC Sec. 301(1970). They are intended to protect the consumer from misbranded, unwholesome, ineffective, and hazardous products. FDA labeling requirements are consumer-; not worker-; oriented.

The Consumer Product Safety Commission (CPSC) has responsibility for labeling hazardous materials when they appear in consumer goods. The

definitions of hazard as found in the Hazardous Substances Act as amended and the Poison Prevention Packaging Act of 1970 are consumer- and especially child-oriented. The wording of the required warnings are similar to those of the Manufacturing Chemists Association (MCA) [1]

The Environmental Protection Agency (EPA) requires that economic poisons, such as chemical pesticides, sold to the public contain labels that carry health hazard warnings. The basic regulations are given in the Federal Insecticide, Fungicide, and Rodenticide Act. 61 Stat. 163(1947), USC Sec. 121(1970). These labels consist of warning statements without a numerical hazard rating. They are for user protection.

The United Nations (UN) [2] has developed a pictorial system indicating major hazards such as flammability, toxicity, and explosivity. The pictographs give no indication of the degree of hazard and are more suitable for inclusion as part of a more complex system.

The US Department of Transportation (DOT) published a notice in the Federal Register, Volume 39, pages 3022-3241, January 24, 1974, of its intent to promulgate a Hazard Information (HI) system. It is intended to provide a comprehensive and effective method of communication to aid in the protection of the public as well as fire law enforcement, and other emergency response personnel, when transportation incidents involving hazardous materials occur. The proposed HI system is designed to enable fire and police personnel arriving at scenes of hazardous materials transportation emergencies to quickly determine necessary precautions and appropriate actions. This system is not intended to protect the safety and health of employees in general from potentially hazardous materials and conditions present in the workplace. The HI system consists of a diamond

shaped placard containing a UN pictorial in the upper portion, a hazard term in the center, and a two-digit number in the lower half. The number refers to a corresponding data card which contains detailed emergency response data for the hazard class denoted by the two-digit number, where the first digit identifies the hazard class.

The HI system does not assign graduated relative equivalent levels of risk. The HI two-digit number refers the observer to an appropriate response card which contains generic hazard information. Thus, the placard tells the worker the general category of the material involved provided the hazard classifications have been committed to memory, or the HI cards are readily accessible.

In addition, it does not always convey the warning of all hazards. The second digit bears no uniform relationship to the nature of risk of additional hazards. Reference must be made to the appropriate card.

Based on the foregoing discussion, the HI system does not warn the worker of all safety and health hazards to which he may be exposed and therefore does not meet the basic criteria for an adequate warning system for workers.

The National Fire Protection Association (NFPA) has developed the "Recommended System for the Identification of the Fire Hazards of Materials." [3] This system, like the DOT HI system, has numerical ratings but lacks any detailed format for data on specific hazardous materials. It is intended primarily to provide protection for emergency response personnel, particularly firemen, and is limited in scope. It identifies the hazards of chemical materials in terms of three principal categories, ie, health, flammability, and reactivity (instability); and the

order of severity numerically by five divisions ranging from four (4), indicating a severe hazard, to zero (0), indicating no special hazard.

However, the health hazard rating is based on the concept that a fire fighter will normally receive "a single exposure which may vary from a few seconds up to an hour." [3] In contrast, employees routinely working with hazardous materials can be exposed for the duration of their working lives. In addition, the NFPA system recognizes two sources of health hazards, one rising out of the inherent properties of the substance, the other resulting from either combustion or decomposition of the material. The effects of combustion and/or decomposition of a substance are not relevant when assigning a health hazard rating to materials where workers are not exposed to combustion products. The NFPA system stresses that "the hazard degree should be assigned on the basis of the greater hazard that could exist under fire or other emergency conditions." [3] Therefore, a different health hazard rating may be assigned to a hazardous material than is warranted to warn the worker under nonemergency conditions. Thus, the NFPA system may not impart a valid health hazard warning to employees whose jobs are to work with the substance under normal circumstances, ie, in the absence of fire or other emergency. The concept of assigning relative ratings to denote relative risk is a useful one and is used in this NIOSH recommended standard.

Another widely used precautionary labeling system is the "Labels and Precautionary Information (LAPI)" [1] system of the Manufacturing Chemists Association (MCA). The LAPI system recommends the use of precautionary labels bearing such information as the product name; signal words designating the degree of hazard (eg, Danger, Warning, or Caution);

affirmative statement of hazards; precautionary measures covering actions to be followed or avoided; instructions in case of contact or exposure; antidotes and notes to physicians; instructions in case of fire, spill, or leak; and instructions for container handling and storage. MCA Chemical Safety Data Sheets and other forms of information are available to support the precautionary labels for some substances. The system does not provide for the preparation of data sheets for products or a numerical rating system. The LAPI system contains effective worker-oriented statements, many of which are used in a modified form in the NIOSH recommended standard.

Based on the foregoing evaluation, the recommended standard of the National Institute for Occupational Safety and Health draws upon the most effective features of each system. It presents a placard/label/data sheet format designed to inform workers of all potential hazards which may confront them when working with a hazardous material.

V. COMPONENTS OF THE IDENTIFICATION SYSTEM FOR OCCUPATIONALLY HAZARDOUS MATERIALS

This system consists of five parts which contain information and instructions for the development of an alert symbol, label statements, and a Material Safety Data Sheet (MSDS) for any hazardous material or product containing a hazardous material. The five parts are arranged in the order in which they will be used and are entitled:

- (a) Definition of a Hazardous Material
- (b) Criteria for Determination of Degree of Hazard
- (c) Preparation of a Material Safety Data Sheet
- (d) Preparation of a Hazard Alert Symbol
- (e) Selection of Label Statements

Guidelines for implementation of the components may be found in Chapter VI. These include the details of size, location, and quantity for affixing placards and labels.

- (a) Definition of a Hazardous Material

All materials can cause unwanted changes under some circumstances, but a careful assessment of properties and circumstances will classify common substances such as water and sodium chloride as practically nonhazardous materials from the viewpoint of the need for informing the worker.

For the purposes of the recommended standard, a material shall be defined as hazardous if it meets any one of the following criteria:

- (1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect

health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo.

In the absence of human or animal effects data described above, a toxic substance is one that produces death in experimental animals exposed to the substance in quantities and by routes which are reasonable. See Appendix III. The following cut-off points apply to animal exposure data:

A single oral LD50 of up to 5,000 mg/kg.

A single inhalation exposure LC50 of up to 10,000 ppm for gases, or 100,000 mg/cu m by volume for mists or dusts.

A single skin absorption (percutaneous) LD50 of up to 2,800 mg/kg.

Since this is toxicity data, the lower the LD or LC50 value, the more toxic the material.

(2) Flammability A flammable substance is one that will burn in air when exposed to a temperature of 1,500 F (815 C) for a period of five (5) minutes or less. See Appendix IV.

(3) Reactivity - A reactive substance is one that will release hazardous amounts of energy when subject to shock, spark, or light, during uncontrolled polymerization, or when contacted by common substances, eg, water, air, or steel; or is a strong oxidizing or reducing material.

References [4-28] are major sources of information on hazardous materials, but many other sources are equally valuable and should not be neglected.

(b) Criteria for Determination of Degree of Hazard

This section includes a classification scheme which provides relative ratings for the categories of health, fire, and reactivity. To use this section, data on the material should be assembled from reference sources, expert opinion, and direct experience and familiarity with the material or specific combination of materials. A composite statement of the potential hazard from the standpoint of health effect, flammability, and reactivity can then be formulated. The proper relative hazard ratings are then assessed by a comparison of the summary data with the tables and relative rating definitions.

(1) Determination of Degree of Health Hazard

The health hazard rating of a material shall be determined by evaluating the potential for harm and the relative toxicity of the material or mixture of materials as a whole. Table V-1 applies to human effects data. In the absence of human exposure data, Table V-2 shall be used as a guideline. Since the correlation between acute animal toxicity and human effects is frequently poor, human experience should supersede animal data. Where both acute and chronic exposure data are available, the data for the worst effect shall be used to develop the rating.

TABLE V-1

RELATIVE TOXICITY RATING FOR HAZARDOUS MATERIALS
(Human Exposure by Any Route)

Rating	Key Words	Acute (Single Exposure, immediate or delayed effects)	Chronic (Repeated Exposure)
4	EXTREME HEALTH HAZARD	Death	Death*
3	HIGH HEALTH HAZARD	Major temporary or permanent injury May threaten life	Major permanent injury (Includes mutagens and teratogens)
2	MODERATE HEALTH HAZARD	Minor temporary or permanent injury** (Includes nonlife threatening substances which sensitize the majority of exposed workers)	Minor temporary or permanent injury (Includes skin carcinogens)
1	SLIGHT HEALTH HAZARD	Minor injury readily reversible**	Minor injury readily reversible
0	NO SIGNIFICANT HEALTH HAZARD	Materials which produce toxic effects only under the most unusual conditions or by overwhelming dosage.	

*Includes substances which bear a significant relationship to the development of cancer in man, but excluding the common varieties of skin cancer.

**Allergens are rated according to their sensitizing potential rather than the severity of an allergic reaction upon reexposure to a substance by a sensitized worker.

TABLE V-2

RELATIVE ACUTE TOXICITY CRITERIA *

Rating	Key Words	LD50 Single* Oral Dose: Rats mg/kg	LC50 Inhalation* Vapor Exposure: Rats ppm	LD50-Skin* Rabbits: mg/kg
		less than or equal to	less than or equal to	less than or equal to
4	EXTREMELY HAZARDOUS	1	10	5
3	HIGHLY HAZARDOUS	50	100	43
2	MODERATELY HAZARDOUS	500	1,000	340
1	SLIGHTLY HAZARDOUS	5,000	10,000	2,800
0	NO SIGNIFICANT HAZARD	5,000 or greater	10,000 or greater	2,800 or greater

* See Appendix III for the source of these data and test methods.

(2) Determination of Degree of Fire Hazard

The fire hazard rating of a product shall be determined by evaluating the potential for harm and the relative flammability of the material or mixture of materials as a whole, using the criteria which follows. Appendix IV contains a discussion of the basis for these criteria.

The fire hazard rating of a liquid shall be determined from the criteria contained in Table V-3 and based on data using the final product

formulation. The test procedures as found in 29 CFR 1910.106 and 107 are mandatory for liquids.

EXTREMELY FLAMMABLE: Rating 4

Any liquid or gaseous material which is a liquid while under pressure and having a flash point below 73 F (22.8 C).

Materials which on account of their physical form or environmental conditions can form explosive mixtures with air and which are readily dispersed in air, such as dusts of combustible solids and mists or flammable or combustible liquid droplets.

HIGHLY FLAMMABLE: Rating 3

Liquids and solids that can be ignited under almost all ambient temperature conditions. This rating shall include:

Liquids having a flash point at or above 73 F (22.8 C) and below 100 F (37.8 C).

Solid materials in the form of coarse dusts which may burn rapidly but which generally do not form explosive atmospheres with air.

Solid materials in a fibrous or shredded form which may burn rapidly and create flash fire hazards, such as cotton, sisal and hemp.

Materials which burn with extreme rapidity, usually by reason of self-contained oxygen (eg, dry nitrocellulose and many organic peroxides).

Materials which ignite spontaneously when exposed to air or other substances.

MODERATELY COMBUSTIBLE: Rating 2

Materials that must be moderately heated or exposed to realatively high ambient temperatures before ignition can occur. Materials with this rating would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres with air. This rating shall include:

Liquids having a flash point above 100 F (37.8 C) but below 200 F (93.4 C).

Solids and semisolids which readily give off flammable vapors.

SLIGHTLY COMBUSTIBLE: Rating 1

Materials that must be preheated before ignition can occur. Materials with this rating require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur. This rating shall include:

Materials which will burn in air when exposed to a temperature of 1,500 F (815 C) for a period of 5 minutes or less.

Liquids, solids and semisolids having a flash point at or above 200 F (93.4 C).

NONCOMBUSTIBLE: Rating 0

This degree should include any material which will not burn in air when exposed to a temperature of 1,500 F (815 C) for a period of 5 minutes.

The relative ratings are taken from the NFPA 704M [3] booklet, with changes in flash point to reflect current OSHA regulations.

TABLE V-3
RELATIVE FLAMMABILITY CRITERIA
FOR LIQUIDS HAVING A FLASH POINT

Numerical Rating	Key Terms	Flash Point F (C)
4	EXTREMELY FLAMMABLE	below 73 (22.8)
3	HIGHLY FLAMMABLE	at or above 73 (22.8) but below 100 (37.8)
2	MODERATELY COMBUSTIBLE	at or above 100 (37.8) but below 200 (93.4)
1	SLIGHTLY COMBUSTIBLE	at or above 200 (93.4)
0	NONCOMBUSTIBLE	greater than 1,500 (815)

(3) Determination of Degree of Reactivity

The reactivity hazard rating of a material shall be determined by evaluating the potential for harm and the relative reactivity of the material or mixture of materials as a whole, using the criteria which follow.

Materials in this category may be self-reactive by polymerization, decomposition, or condensation, and/or reactive with other materials commonly encountered in the workplace. The reactivity in this category often involves the rapid release of energy in the form of heat and

pressure, and/or the release of highly hazardous products. The assessment of relative reactivity requires specific knowledge of what materials may be encountered in the workplace.

EXTREMELY REACTIVE: Rating 4

Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. This rating should include materials which are sensitive to mechanical or localized thermal shock at normal temperatures and pressures.

HIGHLY REACTIVE: Rating 3

Materials which in themselves are capable of detonation or of explosive decomposition or explosive reaction, but which require a strong initiating source or which must be heated under confinement before initiation. This rating should include materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures or which react explosively with water without requiring heat or confinement.

MODERATELY REACTIVE: Rating 2

Materials which in themselves are normally unstable and readily undergo rapid chemical change but do not detonate. This rating should include materials which can undergo chemical change with rapid release of energy at normal temperatures and pressures. It should also include those materials which may react violently with water or which may form potentially explosive mixtures with water.

SLIGHTLY REACTIVE: Rating 1

Materials which in themselves are normally stable but which can become unstable at elevated temperatures and pressures or which may react violently with water with some release of energy but not violently.

NONREACTIVE: Rating 0

Materials which in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.

(c) Preparation of a Material Safety Data Sheet

A Material Safety Data Sheet (MSDS) must be completed for each hazardous material or mixture of hazardous materials which meet the criteria contained in Part (a).

Information that pertains to materials or products with similar ingredients that pose identical hazards may be recorded on a single MSDS. Those sheets which cover a group may be developed from trade association recommendations on an industry-wide basis, but must accurately reflect the total hazard of any product to which they are applied. A list of all products covered by such a data sheet shall be included on the sheet.

Not all divisions of the MSDS will be applicable in every instance. At a minimum, only the Health Hazard Data and Special Precautions Divisions shall be used, since these divisions are of major importance for worker protection.

When a division or part of a division is not applicable to a particular material, it should be noted by "not applicable" If a thorough search of the literature and trade sources fails to provide data, the words

"no data" should be inserted. In the absence of experimental data, opinion based on experience or analogy with similar products may be included in divisions V through IX, with a notation reflecting that the information is unverified.

Figure V-1 is an example of the MSDS format.

Figure V-1 - MSDS Format

MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

MANUFACTURER'S NAME

REGULAR TELEPHONE NO.
EMERGENCY TELEPHONE NO.

ADDRESS

TRADE NAME

SYNONYMS

II HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT

%

HAZARD DATA

III PHYSICAL DATA

BOILING POINT, 760 MM HG

MELTING POINT

SPECIFIC GRAVITY (H₂O=1)

VAPOR PRESSURE

VAPOR DENSITY (AIR=1)

SOLUBILITY IN H₂O, % BY WT.

% VOLATILES BY VOL.

EVAPORATION RATE (BUTYL ACETATE =1)

APPEARANCE AND ODOR

IV FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD)		AUTOIGNITION TEMPERATURE	
FLAMMABLE LIMITS IN AIR, % BY VOL.	LOWER		UPPER
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARD			

V HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA	
ROUTES OF EXPOSURE	
INHALATION	
SKIN CONTACT	
SKIN ABSORPTION	
EYE CONTACT	
INGESTION	
EFFECTS OF OVEREXPOSURE	
ACUTE OVEREXPOSURE	
CHRONIC OVEREXPOSURE	
EMERGENCY AND FIRST AID PROCEDURES	
EYES:	
SKIN:	
INHALATION:	
INGESTION:	
NOTES TO PHYSICIAN	

VI REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY

INCOMPATIBILITY

HAZARDOUS DECOMPOSITION PRODUCTS

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

NEUTRALIZING CHEMICALS

WASTE DISPOSAL METHOD

VIII SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY (SPECIFY IN DETAIL)

EYE

GLOVES

OTHER CLOTHING AND EQUIPMENT

IX SPECIAL PRECAUTIONS

PRECAUTIONARY
STATEMENTS

OTHER HANDLING AND
STORAGE REQUIREMENTS

PREPARED BY: _____

ADDRESS: _____

DATE: _____

The following items of information which are applicable to a specific product or material shall be provided in the appropriate block of the Material Safety Data Sheet.

MATERIAL SAFETY DATA SHEET

The product designation is inserted in the block in the upper left corner of the first page to facilitate filing and retrieval. Print in upper case letters in as large type size as possible. It should be printed to read upright with the sheet turned sideways. The product designation is that name or code designation which appears on the label, or by which the product is sold or known by employees. The relative numerical hazard ratings and key statements are those determined by the rules in Chapter V,

Part B. The company identification may be printed in the upper right corner if desired.

I PRODUCT IDENTIFICATION	
MANUFACTURER'S NAME	REGULAR TELEPHONE NO. EMERGENCY TELEPHONE NO.
ADDRESS	
TRADE NAME	
SYNONYMS	

The manufacturer's name, address, regular and emergency telephone number (including area code), are inserted in the appropriate blocks of Section I. The company listed here should be a source of detailed backup information on the hazards of the material(s) covered by the MSDS. The listing of suppliers, or wholesale distributors is discouraged. The trade name should be the product designation or common name associated with the material. The synonyms are those commonly used for this product, especially formal chemical nomenclature. Every known chemical designation or competitor's trade name need not be listed.

II HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	%	HAZARD DATA

The "materials" listed here shall be those substances which are part of the hazardous product covered by the MSDS and individually meet any of the criteria defining a hazardous material. Thus one component of a multi-component product might be listed because of its toxicity, another component because of its flammability, while a third could be included both for its toxicity and its reactivity. Note that a MSDS for a single component product must have the name of the material repeated in this section to avoid giving the impression that there are no hazardous ingredients.

Chemical substances should be listed according to their complete name derived from a recognized system of nomenclature. Where possible, avoid using common names and general class names such as "aromatic amine," "safety solvent," or "aliphatic hydrocarbon" when the specific name is known.

The % may be the approximate percentage by weight or volume (indicate basis) which each hazardous ingredient of the mixture bears to the whole mixture. This may be indicated as a range or maximum amount, ie, 10-40% vol. or 10% max. wt. to avoid disclosure of trade secrets.

Toxic hazard data shall be stated in terms of concentration, mode of exposure or test, and animal used, ie, 100 ppm LC50 oral rat, 25 mg/cu m LD50 skin-rabbit, 75 ppm LC man, or permissible exposure from 29 CFR 1910.93, or if not available, from other published sources such as the ACGIH TLV list. [16] Flammable or reactive data could be flash point, shock sensitivity, or other brief data indicating nature of the hazard.

III PHYSICAL DATA

BOILING POINT, 760 MM HG		MELTING POINT
SPECIFIC GRAVITY (H ₂ O = 1)		VAPOR PRESSURE
VAPOR DENSITY (AIR = 1)		SOLUBILITY IN H ₂ O, % BY WT.
% VOLATILES BY VOL.		EVAPORATION RATE (BUTYL ACETATE = 1)
APPEARANCE AND ODOR		

The data in this section should be for the total mixture and should include the boiling point and melting point in degrees Fahrenheit (Centigrade in parentheses); vapor pressure, in millimeters of mercury; vapor density of gas or vapor (air = 1); solubility in water, in parts per hundred parts of water by weight; specific gravity (water = 1); percent volatile, indicate if by weight or volume, at 70 Fahrenheit (15.5 Centigrade); evaporation rate for liquids or sublimable solids; and

appearance and odor. These data are useful for the control of toxic vapors. Boiling point, vapor density, % volatiles, vapor pressure and evaporation are useful for designing proper ventilation equipment.

This information is also useful for design and deployment of adequate fire and spill containment equipment. The appearance and odor may facilitate identification of substances stored in improperly marked containers, or when spilled.

IV FIRE AND EXPLOSION DATA				
FLASH POINT (TEST METHOD)			AUTOIGNITION TEMPERATURE	
FLAMMABLE LIMITS IN AIR, % BY VOL.	LOWER		UPPER	
EXTINGUISHING MEDIA				
SPECIAL FIRE FIGHTING PROCEDURES				
UNUSUAL FIRE AND EXPLOSION HAZARD				

This section should contain complete fire and explosion data for the product, including flash point and autoignition temperature in degrees Fahrenheit (Centigrade); flammable limits, in percent by volume in air; suitable extinguishing media or materials; special fire fighting procedures; and unusual fire and explosion hazard information. If the product presents no fire hazard, insert "NO FIRE HAZARD" on the line labeled "Extinguishing Media."

V HEALTH HAZARD INFORMATION	
HEALTH HAZARD DATA	
ROUTES OF EXPOSURE	
<div>INHALATION</div> <div>SKIN CONTACT</div> <div>SKIN ABSORPTION</div> <div>EYE CONTACT</div> <div>INGESTION</div>	
EFFECTS OF OVEREXPOSURE	
ACUTE OVEREXPOSURE	
CHRONIC OVEREXPOSURE	
EMERGENCY AND FIRST AID PROCEDURES	
<div>EYES:</div> <div>SKIN:</div> <div>INHALATION:</div> <div>INGESTION:</div>	
NOTES TO PHYSICIAN	

The "Health Hazard Data" should be a combined estimate of the hazard of the total product. This can be expressed as a time-weighted average

concentration, permissible exposure, or by some other indication of acceptable standard. Other data, such as lowest LD50, are acceptable.

Under "Principal Routes of Absorption" comments in each category should reflect the potential hazard from absorption by this route. Comments should indicate the severity of the effect and the basis for the statement if possible. Basis might be animal studies, analogy with similar products, or human experiences. Comments such as "yes", or "possible" are not helpful. Typical comments might be:

Skin Contact single short contact-- no adverse effects likely.

Prolonged or repeated contact - mild irritation and possibly some blistering.

Eye Contact some pain and mild transient irritation. No corneal scarring.

Effects of Overexposure should include relevant signs, symptoms, and disease entities that could arise from acute and chronic exposure to the hazardous agent.

The "Emergency and First Aid Procedures" should be written in lay language, and should primarily be first aid treatment that could be provided by paramedical personnel or individuals trained in first aid.

Information in the Notes to Physicians section should include any special medical information which would be of assistance to an attending physician including required or recommended preplacement and periodic medical examinations, diagnostic procedures, and medical management of overexposed workers.

VI REACTIVITY DATA
CONDITIONS CONTRIBUTING TO INSTABILITY
INCOMPATIBILITY
HAZARDOUS DECOMPOSITION PRODUCTS
CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

The comments in this section relate to safe storage and handling of hazardous, unstable substances. It is particularly important to highlight instability or incompatibility to common substances or circumstances such as water, direct sunlight, steel or copper piping, acids, alkalies, etc. "Hazardous Decomposition Products" shall include those products released under fire conditions. It must also include dangerous products produced by aging such as peroxides in the case of some ethers. Where applicable, shelf life should be indicated here.

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

NEUTRALIZING CHEMICALS

WASTE DISPOSAL METHOD

Detailed procedures for clean-up and disposal should be listed with emphasis on precautions to be taken to protect workers assigned to the clean-up detail. Specific neutralizing chemicals or procedures should be specified in detail. Disposal methods should be explicit including proper labeling of containers holding residues and ultimate disposal methods such as "sanitary landfill", "incineration". Warnings to comply with local, State, and Federal anti-pollution ordinances are proper but not sufficient. Specific procedures shall be identified.

VIII SPECIAL PROTECTION INFORMATION	
VENTILATION REQUIREMENTS	
SPECIFIC PERSONAL PROTECTIVE EQUIPMENT	
RESPIRATORY (SPECIFY IN DETAIL)	
EYE	
GLOVES	
OTHER CLOTHING AND EQUIPMENT	

This section requires specific information. "Yes", "No", or "If Necessary" are not informative. Ventilation requirements should be specific as to type and preferred methods. Respirators shall be specified as to type and NIOSH or US Bureau of Mines approval class, ie, "Supplied Air", "Organic vapor canister", "Suitable for dusts not more toxic than lead", etc. Protective equipment must be specified as to type and materials of construction.

IX SPECIAL PRECAUTIONS

PRECAUTIONARY
STATEMENTS

OTHER HANDLING AND
STORAGE REQUIREMENTS

"Precautionary Statements" shall consist of the label statements selected for use on the container or placard. Additional information on any aspect of safety or health not covered in other sections should be inserted here. The lower block can contain references to published guides or in-house procedures for handling and storage. Department of Transportation markings and classifications and other freight, handling, or storage requirements and environmental controls can be noted here.

PREPARED BY: _____

ADDRESS: _____

DATE: _____

Finally, the name and address of the responsible person who completed the MSDS and the date of completion are entered. This will facilitate correction of errors and identify a source of additional information.

The MSDS shall be filed in a location readily accessible to workers potentially exposed to the hazardous material. The MSDS can be used as a training aid and basis for discussion during safety meetings and training of new employees. It should assist management by directing attention to the need for specific control engineering, work practices, and protective measures to ensure safe handling and use of the material. It will aid the safety and health staff in planning a safe and healthful work environment and suggesting appropriate emergency procedures and sources of help in the event of harmful exposure of employees.

(d) Preparation of the Hazard Alert Symbol

A hazard symbol can be developed once the relative numerical index of a hazardous material or product containing one or more hazardous materials has been determined by comparison of its properties with the criteria in Part (b). Figure V-2 depicts the symbol for a substance of Rating 4 Health Hazard, Rating 3 Flammability, and Rating 2 Reactivity. The signal words to the right of the boxes are governed by the signal words of the rating assigned to the material.

4	Extreme Health Hazard
3	Highly Flammable
2	Moderately Reactive

FIGURE V-2 - HAZARD ALERT SYMBOL

(e) Selection of Label Statements

Label statements are intermediate in information content between the hazard symbol and the detailed Material Safety Data Sheets. It is stressed that the requirements detailed in this section are minimal because of the complexity and diversity of hazardous materials. Additional warnings and detailed medical and other information may be desirable on labels attached to containers of new or unusual materials. In addition, the manufacturer or user may supply additional cautions on ecological or other matters, as appropriate.

Appendix II contains tables of suggested label statements. They are supplied for guidance only. Label wording should be tailored specifically for each material or combination of materials.

For health hazards, the major considerations are modes of entry, speed of attack, and whether the effects are acute or chronic.

For fire hazards, considerations include vapor pressure and vapor density, autoignition temperature, explosive limits, viscosity, products of combustion, and extinguishing media.

Reactivity hazards require knowledge of sensitivity to detonation by shock or heat, tendency to rapid polymerization, reactivity with common substances, ability to supply oxygen in a fire situation, and other special harmful properties.

The number of statements used will depend on the hazard involved. Extremely dangerous materials may require extensive warnings and detailed instructions for safe use and disposal. Minimally hazardous substances may require little more than the hazard statement. Specific and more detailed first aid statements including notes to physicians may be necessary for

extremely hazardous materials. These statements are best formulated by physicians familiar with the hazards of the specific material and aware of the capabilities of industrial paramedical personnel and facilities.

VI. USE OF PLACARDS, LABELS, AND MSDS

Three outputs can result from the data developed in Chapter V: (a) a placard, (b) a label, and (c) a Material Safety Data Sheet.

(a) A placard may be simple or detailed, large or small, depending on its intended area of effectiveness. It may contain a hazard symbol only, a hazard symbol and label statements, or only label statements. The placard is used in three major ways:

(1) On exterior tanks, buildings, and fenced-in areas. This use requires large lettering visible from considerable distances and contains the minimum of information.

(2) On signboards or affixed to interior areas to warn of hazardous areas. This use requires lettering sized in relation to the work area so that the warning can be clearly seen by all workers involved. More detailed warning information may be included.

(3) On doors or machinery to warn workers of immediate hazards. This use requires the most detailed warnings and action statements because of the proximity of the hazard and the regular use of the hazardous material.

Color, if used, letter size, and style shall be determined by reference to 29 CFR 1910.144. Suggested colors for the numerical relative degrees of hazard and key words are:

Health - blue numerals or letters on white background or
black numerals or letters on a blue background
Fire - red on white or black on red
Reactivity - yellow on white or black on yellow

Figure V-3 is an example of a placard for exterior use.

4	Extreme Health Hazard
3	Highly Flammable
2	Moderately Reactive

Fatal if swallowed, inhaled, or absorbed through the skin.

Causes severe eye burns.

Protect from all sources of ignition.

Subject to violent polymerization.

FIGURE V-3 - PLACARD

(b) The label shall include the trade name of the product, or be positioned near the trade name. It must appear near the bung or opening on drums or on the major or front side of the container. It shall be sized and separated so as to be readily identified as a hazard warning and at least as legible as any other printed material on the container, excepting the product name.

The label to be affixed to every container holding hazardous materials shall bear the hazard alert symbol, statements on the nature of the hazard, appropriate action statements, and first aid statements where useful. If overexposure requires unusual treatment or specific counteractive drugs, this must be noted on the label. Where applicable, specific clean-up and disposal statements shall be included.

The label shall contain the relative numerical ratings and associated key words, appropriate amplifying and precautionary statements, first aid statements, and a reference to the appropriate MSDS. Labels, when colored, should use the same color formats as for placards.

Figure V-4 is an example of a complete label.

4	Extreme Health Hazard
4	Extremely Flammable
2	Moderately Reactive

Fatal if swallowed, inhaled, or absorbed through the skin.

Causes severe eye burns.

Protect from all sources of ignition.

Subject to violent polymerization.

Do not breathe vapor or get in eyes, on skin, on clothing.

When possibility of contact exists:

Wear full neoprene suit, rubber boots, rubber gloves, and self-contained breathing apparatus.

Avoid contact with acid, organic compounds, or water.

FIRST AID

CALL A PHYSICIAN AS SOON AS POSSIBLE

Immediately upon exposure flush skin and eyes with water for 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Discard contaminated shoes.

Refer to Data Sheet on file.

FIGURE V-4 - EXAMPLE LABEL

VII. REFERENCES

1. Guide to Precautionary Labeling of Hazardous Chemicals. Manual L-1, ed 7. Washington, DC. Manufacturing Chemists Association, 1970
2. Transport of Dangerous Goods, United Nations publication ST/ECA/81 Rev. 1, E/CN.2/CONF. S/10/Rev. 1, 31 Dec 1966. New York, United Nations, 1966, p 491
3. Recommended System for the Identification of the Fire Hazards of Materials, NFPA 704M. Boston, National Fire Protection Association, International, 1969, pp 5, 16
4. Hodge HC, Sterner JH: Tabulation of Toxicity Classes. Am Ind Hyg Assoc Q 10: 93-96, 1949
5. Hine CH, Jacobsen NW: Safe handling procedures for compounds developed by the petro-chemical Industry. Am Ind Hyg Assoc Q 15: 141-44, 1954
6. Spector WS (ed): Handbook of Toxicology, WADC Technical Report 55-16. Wright-Patterson Air Force Base, Wright Air Development Center, Air Research and Development Command, Vol 1, 1955
7. Gleason MN, Gosselin HC, Hodge HC, Smith RP: Clinical Toxicology of Commercial Products -- Acute Poisoning, ed 3. Baltimore, Williams and Wilkins Co, 1969
8. Deichmann WB, Gerarde HW: Toxicology of Drugs and Chemicals. New York, Academic Press, 1969
9. Thienes CH, Haley TJ: Clinical Toxicology, ed 5. Philadelphia, Lea and Febiger, 1972
10. Smyth HJ Jr: Tables of Chemical Hazard Information in Steere FV (ed): Handbook of Laboratory Safety, ed 2. Cleveland, The Chemical Rubber Company, 1971, pp 668-829
11. Christensen HE (ed): The Toxic Substances List 1974 edition, HSM73-11020. US Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health
12. Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids. NFPA 325M. Boston, National Fire Protection Association, International, 1969
13. Flash Point Index of Trade Name Liquids, NFPA 325A. Boston, National Fire Protection Association, International, 1968

14. Hazardous Chemicals Data, NFPA 49. Boston, National Fire Protection Association, International, 1969
15. Manual of Hazardous Chemical Reactions. NFPA 491M, Boston, National Fire Protection Association, International, 1968
16. American Conference of Governmental Industrial Hygienists: Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1973. Cincinnati, ACGIH, 1973
17. Mellan I: Industrial Solvents Handbook 1970. Park Ridge, NJ, Noyes Data Corp, 1970
18. Chemical Safety Data Sheets. Washington, DC, Manufacturing Chemists Association
19. The Condensed Chemical Dictionary, ed 8 (revised by GG Hawley). New York, Van Nostrand Reinhold Co, 1971
20. The Merck Index, ed 8. Rahway, NJ, Merck & Co, Inc, 1968
21. SOCMA Handbook -- Commercial Organic Chemical Names, 2nd printing. Washington, DC, American Chemical Society, 1966
22. Chemical Safety References, Data Sheet 486, rev A. Chicago, National Safety Council, Chemical Section, 1968
23. Committee on Hazardous Materials Advisory to the US Coast Guard: Evaluation of the Hazard of Bulk Water Transportation of Industrial Chemicals -- A Tentative Guide, revised ed. Washington, DC, National Academy of Sciences, National Research Council, Division of Chemistry and Chemical Technology, 1970
24. MCA Chem-Card Manual. Washington, DC, Manufacturing Chemists Association, 1968
25. Laboratory Waste Disposal Manual, revised Sept 1973. Washington, DC, Manufacturing Chemists Association, 1973
26. IATA Restricted Articles Regulations, ed 12. Montreal, International Air Transport Association, 1969
27. Hommel G: (Handbook of Dangerous Substances). New York, Springer-Verlag, 1970 (Ger)
28. Sax NI: Dangerous Properties of Industrial Materials, ed 3. New York, Van Nostrand Reinhold Co, 1968
29. Committee on Toxicology (AJ Lehman, Chmn): Principles and Procedures for Evaluating the Toxicity of Household Substances, publication 1138.

Washington, DC, National Academy of Sciences, National Research Council, Div of Chemistry and Chemical Technology, 1964, 29pp

30. Appraisal of the Safety of Chemicals in Foods, Drugs, and Cosmetics, ed 2. Topeka, Kan, The Association of Food and Drug Officials of the United States, 1965

VIII. APPENDIX I

GLOSSARY OF TERMS

Acute	A short time period of action measured in seconds, minutes, hours, or days.
Acute Effect	Applies to injuries which rapidly follow exposure to a hazardous material without implying degree of severity.
Chronic	Applies to long time period of action in weeks, months, or years.
Chronic Effect	Applies to injuries which are delayed after exposure to a hazardous material without implying degree of severity.
Container	A drum, box, can, tube, or the like which confines a material.
Hazardous Material	A substance or mixture of substances having intrinsic properties capable of producing adverse effects on the health, physical integrity, or well-being of the worker.
Label	Any display of written, printed or graphic matter on the immediate containers holding a hazardous material or in any manner affixed to the container.
LC50	The air concentration which is required to produce death in 50% of the exposed animals.
LD50	The dose which is required to produce death in 50% of the exposed animals.
Placard	A sign posted in a work area for notification of the worker that hazardous materials are being used in that work area or are being held in storage.
Risk	An assessment of the probability of adverse effects occurring in a defined set of circumstances. Risk is not a factor in the above definition of a hazardous material.
Sensitizer	A substance which can cause an allergic-like response.

IX. APPENDIX II

TABLES OF SUGGESTED LABEL STATEMENTS

TABLE IX-1
HEALTH RELATED STATEMENTS

Fatal if swallowed
Fatal if inhaled
Fatal if absorbed through the skin
Harmful if swallowed
Harmful if inhaled
Harmful if absorbed through the skin
Can cause allergic respiratory reaction
Can cause allergic skin reaction
Vapor (gas) may cause suffocation
Causes eye burns
Causes eye irritation
Causes burns
Causes irritation
Can be fatal or cause blindness if swallowed
Cannot be made nonpoisonous
Repeated absorption can cause bladder tumors
Rapidly absorbed through skin
Inhalation can be fatal or cause delayed lung damage
Harmful if inhaled and can cause delayed lung damage
Can cause delayed effect
Vapor extremely irritating
Extremely irritating gas and liquid under pressure
Gas extremely irritating
Lung injury and burns may be delayed
Contact with water or moist air liberates irritating gas
Contact with acid liberates poisonous gas
Contact with water or acid slowly liberates poisonous and flammable hydrogen sulfide gas
Liberates gas which may cause suffocation
Repeated inhalation or skin contact can, without symptoms, increase hazard
Causes severe burns which may not be immediately painful or visible
Can cause rash or external sores
Can cause burns of external sores
Liquid or vapor causes burns which may be delayed
May cause eye injury-effects may be delayed
Liquid penetrates shoes and leather causing delayed burns
May cause sterility
May affect unborn children
Cancer suspect agent

TABLE IX-2
HEALTH HAZARD ACTION STATEMENTS

Do not breathe dust
Do not breathe vapor
Do not breathe mist
Do not breathe gas
Do not get in eyes, on skin, on clothing
Prevent contact with food, chewing or smoking materials
Wash thoroughly after handling
Use only in well ventilated area
Keep container closed
Avoid prolonged or repeated contact with skin
Do not enter storage areas unless well ventilated
Avoid breathing dust or solution spray or vapor
Avoid prolonged or repeated breathing of vapor
Use special protective clothing and gloves
Wear goggles; neoprene, butyl rubber, or vinyl gloves,
neoprene shoes or boots; and clean protective outer clothing
Wear goggles; neoprene, butyl rubber, or vinyl gloves
Always wear a self-contained breathing apparatus or full-face
air-line respirator when using this product
Have available emergency self-contained breathing apparatus
or full-face air-line respirator when using this product
Wear respirator approved by NIOSH or the US Bureau
of Mines for organic vapor, dust, etc.
Wear goggles or face shield, rubber gloves, and protective
clothing when handling
Do not wear ordinary rubber protective clothing, including
gloves and boots
Do not taste
This gas deadens the sense of smell. Do not depend on odor
to detect presence of gas
Use fresh clothing daily. Take hot shower at end of work shift
using plenty of soap
POISON (with skull and crossbones symbol)
Avoid exposing women of child-bearing age

TABLE IX-3
FIRE AMPLIFYING STATEMENTS

Strong Oxidizer - contact with other materials may cause fire
Catches fire if exposed to air
Spillage may cause fire or liberate dangerous gas
Highly volatile
Contact with water or acid slowly liberates flammable gas
Contact with water may cause flash fire
May ignite if allowed to become damp
Heat, shock, or contact with other materials may cause fire
or explosive decomposition
Contact with other materials may cause fire or explosion,
especially if heated

TABLE IX-4
FIRE HAZARD ACTION STATEMENTS

Keep away from fire, sparks and open flame
Keep from contact with clothing and other combustible materials to avoid fire
Drying of this product on clothing or combustible materials may cause fire
Spills on clothing or combustible materials may cause fire
Contents packed under water will ignite if water is removed
Avoid friction or rough handling because of fire hazard
Keep wet in storage--dry powder may ignite by friction, static electricity or heat
Wear goggles or face shield and fire-retardant clothing when handling
Clothing and vegetation contaminated with chlorate or its solutions are DANGEROUSLY FLAMMABLE. Remove clothing and wash thoroughly in water. Keep persons and animals off treated areas
Store in cool place
Keep container tightly closed
Loosen closure cautiously before opening
Store in cool dry place
Store in a cool place in original container and protect from direct sunlight
In case of fire, stop flow of gas. Use dry chemical or carbon dioxide when necessary to gain access to valve
Avoid spillage and contact with moisture or combustion
In case of spillage, flush with plenty of water and remove contaminated articles
Flush area with water spray
In case of fire, smother with dry sand, dry ground limestone or dry powder type materials specially designed for metal powder fires.
Spillage may cause fire. Do not get on floor. Sweep up and remove immediately

TABLE IX-5
REACTIVITY AMPLIFYING STATEMENTS

Powerful Oxidizer
Strong Oxidizer
Strong Acid
Strong Caustic (alkali)
Causes severe burns which may not be immediately painful or visible
Heat, shock, or contact with other materials may cause fire or explosive, especially if heated
Contact with other material may cause fire or explosive, especially if heated
Reacts violently with water liberating and igniting hydrogen
May form explosive peroxides
Forms shock-sensitive mixtures with certain other materials
May explode if water content is 10% or below
Contamination may result in dangerous pressure
Liquid and gas under pressure
Extremely hazardous liquid and vapor under pressure
Extremely cold ((F (C) below zero))
High Explosive
Explosive
Inhibited monomer subject to violent polymerization
Liquid and gas under pressure
Gas under pressure

TABLE IX-6
REACTIVITY HAZARD ACTION STATEMENTS

Keep from contact with oxidizing materials, highly oxygenated or halogenated solvents, organic compounds containing reducible function groups, or aqueous ammonia

Keep from contact with oxidizing materials

Keep from contamination from any source including metals, dust, and organic materials. Such contamination can cause rapid decomposition, generation of high pressures, or formation of explosive mixtures

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

Keep from any contact with water

Use only dry, clean utensils in handling

While making solutions, add slowly to surface to avoid violent splattering

Keep wet in storage--dry powder may ignite by friction, static electricity, or heat

Do not add to hot materials; do not grind or subject to frictional heat or shock--explosive decomposition may result

Prevent contamination with readily oxidizable materials and polymerization accelerators

Do not allow to evaporate to near dryness. Addition of water or appropriate reducing materials will lessen peroxide formation

Do not add water to contents while in a container because of violent reaction and possible flash fire

Do not attempt to loosen or remove material from container with any tool

Wear goggles and DRY gloves when handling

Put nothing else in this container

Keep dry and handle only in suitable equipment to prevent metallic contamination. Consult manufacturer

Keep container tightly closed and away from water or acids

Keep container tightly closed; flush container clean before discarding

Do not put in stoppered or closed container

Note: Suck-back into cylinder may cause explosion. Under no circumstances should the cylinder entry tube be inserted in a liquid or gas without a vacuum break or other protective apparatus in the line to prevent suck-back

Store in original vented container

Store in cool place

Keep drum in upright position. Do not roll drum on side

Handle under inert gas atmosphere in DRY equipment

Keep from freezing

Loosen closure cautiously before opening

Store separately from, and avoid contact with, dehydrating materials and other materials

Keep away from fire

Open container carefully and only in dry oxygen-free or inert atmosphere

TABLE IX-6 (continued)
REACTIVITY HAZARD ACTION STATEMENTS

Store in cool dry place
Store in cool place in original container and protect from direct sunlight
Keep container closed to prevent drying out
Do not heat cylinders
Keep away from acids and heat
Never return unused HYDROGEN PEROXIDE to container. Dilute
with plenty of water
Avoid spillage and contact with moisture or combustibles
Fire or high temperatures may cause explosive decomposition if confined
In case of fire, smother with dry sand, dry ground limestone,
or dry powder type materials specially designed for metal
powder fires. Do not use carbon tetrachloride, carbon dioxide
extinguishers, or water
Do not use air pressure to transfer

TABLE IX-7
FIRST AID STATEMENTS

First Aid CALL A PHYSICIAN AS SOON AS POSSIBLE

 If swallowed, induce vomiting by sticking finger down throat or by giving soapy or strong salty water to drink. Repeat until vomit is clear. Never give anything by mouth to an unconscious person.

First Aid CALL A PHYSICIAN AS SOON AS POSSIBLE

 In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. (Discard contaminated shoes.)

First Aid CALL A PHYSICIAN AS SOON AS POSSIBLE

 If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen.

First Aid CALL A PHYSICIAN AS SOON AS POSSIBLE

 In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses if worn.

First Aid CALL A PHYSICIAN AS SOON AS POSSIBLE

 In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Flush skin with water. (Wash clothing before reuse.)

First Aid

 In case of contact, immediately wash skin with soap and plenty of water.

First Aid

 Do NOT induce vomiting. Call a physician as soon as possible.

Antidote: (indicate commonly available antidote.)

Note to Physicians: (Give detailed specific treatment including drug dosage.)

Call the Life Squad or local emergency unit.

TABLE IX-8
STATEMENTS SPECIFYING SPECIFIC DISPOSAL INSTRUCTIONS

Flush spill area with water spray.
Soak up spill with sand or earth. Do not use water.
Flush away spill by flooding with water applied quickly to entire spill.
Keep upwind of leak: Evacuate enclosed places until gas has dispersed.
Dike spill and decontaminate by...
Do not flush into sewers.
Dispose of sodium by burning carefully in an open fire.
Sweep up spillage with strong calcium hypochlorite solution.
Treat spillage with strong calcium hypochlorite solution and flush to sewer.
In case of spillage, keep wet and remove carefully.
Soak up with rags and dispose in covered metal containers.
Consult local solid waste regulations for safe disposal.
Do not sweep. Use vacuum cleaning equipment only.

X. APPENDIX III

SOURCES OF HEALTH HAZARD RATINGS AND TEST METHODS

The numerical ratings for assessing the relative toxicity of a material or product are listed in Table V-2. The criteria are derived from articles published in 1949 by Hodge and Sterner [4] and as extended in 1954 by Hine and Jacobsen [5]. Both publications list a sixth category called "Relatively Harmless" which was deleted since it was considered inapplicable.

The rating scheme was selected because it is comprehensive and has been accepted and regularly cited in succeeding years as a useful rating scheme. The table was reproduced by Spector [6] in 1955, Deichmann and Gerarde [8] in 1969, and Thienes and Haley [9] in 1972. Gleason et al [7] used the same criteria with a change in the "super" toxic oral level to less than 5 mg/kg from less than 1 mg/kg. In their Table VI-1, however, the ratings were applied to human ingestion by a 70-kg (150-lb) man rather than to LD50 for rats.

Smyth [10] used a similar rating scheme with a general elevation of the numbers to powers of 10. For example, Smyth uses for the oral rating of extremely toxic the range 10-99 mg/kg rather than 5-50 mg/kg. Given the variability of toxicological data, Smyth's ratings are essentially in agreement with those of Hodge and Sterner. [4]

Table V-1 is an expression of the most severe human effects which could result from exposure to a material. It includes carcinogens and sensitizers as well.

A variety of test methods exist in the literature for determining LD50 and LC50 values. The acute toxicity data obtained from published sources is based on animal studies done by different methods at different times with different species and strains of animals. Since these values are used in the system for rating in broad categories, it is unreasonable to specify a particular test method for published data. The appropriate test method is the one which gives the best appraisal of the hazard of the material with respect to its nature and the ways it will be encountered by employees.

In the interest of standardization, the animal testing procedures of the National Academy of Sciences [29] or of The Food and Drug Administration as published by The Association of Food and Drug Officials of the United States [30] are recommended.

XI. APPENDIX IV

SOURCES OF FLAMMABILITY AND REACTIVITY RATINGS

Classifying all burnable materials into five categories which will be useful to employees presents two major difficulties: a) how to rate liquids based on flash point data and b) how to rate all other materials.

In Table V-3 flammable liquids are divided into two flammable and two combustible categories. These are based on the definitions in 29 CFR 1910.106 as amended by publication in the Federal Register by OSHA, September 28, 1973, Volume 38, pages 27047-27049. The basic division at 100 F between flammable and combustible was also adopted by the Department of Transportation by publication in the Federal Register on January 24, 1974, Volume 39, pages 2768-2771.

OSHA divides Class I flammable liquids into subclasses A, B, and C. Class IA and B liquids are grouped in rating 4 since they have the same flash point cutoff of 73 F. They differ in boiling point which is considered secondary, since industrial operations may involve using liquids at elevated temperatures and provide numerous hot surfaces. Separation of class by boiling point is most useful for storage considerations where ambient temperature is a controlling factor in assessing the evaporation rate.

Rating 3 includes Class IC liquids classifying them as highly flammable in agreement with the OSHA revised cut-off of 100 F.

The combustible liquids are divided into two ratings. Rating 3 includes Class II and Class III A liquids which are generally treated the

same for storage requirements except in respect to volume stored (Tables H-12, 14, 15, 16, and 17 in 29 CFR 1910.106 as amended by 37 FR, October 18, 1972, pages 22177-22179, as modified by 38 FR of September 28, 1973, pages 27048-27049).

The basic structure and text for the relative rating criteria for flammability and reactivity were taken from the NFPA 704M system [3]. Many of the NFPA fire codes were adopted by OSHA (37 FR, October 18, 1972, page 22231). The 704M system was developed under standard procedures which are described by the first page of the 704M manual as:

"This material has been developed in the interest of safety to life and property under the published procedures of the National Fire Protection Association. These procedures are designed to assure the appointment of technically competent Committees having balanced representation from those vitally interested and active in the areas with which the Committees are concerned. These procedures provide that all Committee recommendations shall be published prior to action on them by the Association itself and that following this publication these recommendations shall be presented for adoption to the Annual Meeting of the Association where anyone in attendance, member or not, may present his views."

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
RM 532 U S POST OFFICE, CINCINNATI, OHIO 45202

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300

POSTAGE AND FEES PAID
U S DEPARTMENT OF HEW
HEW 396



HEW - 399

HEW Publication No. (NIOSH) 75-126