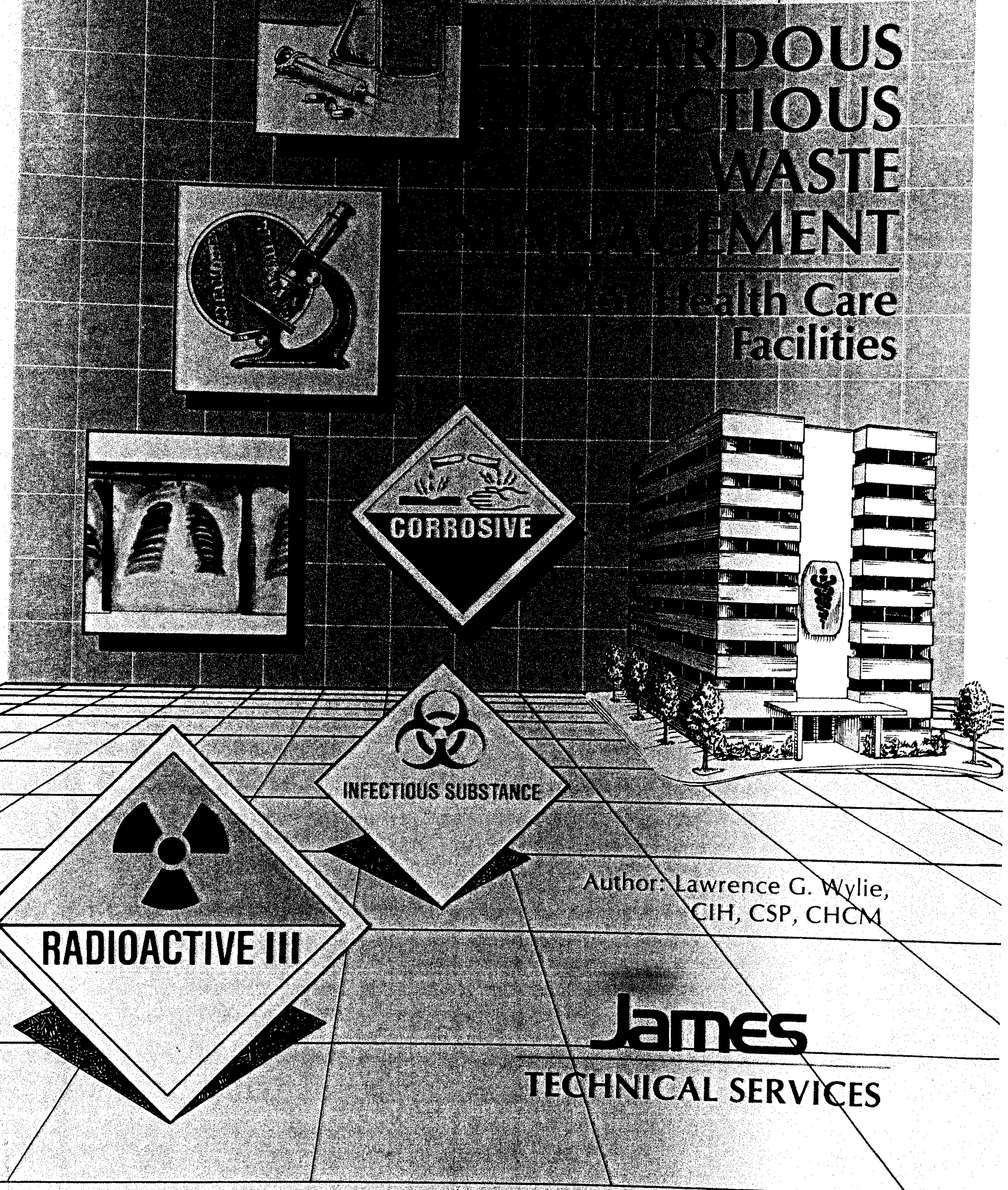

HAZARDOUS INFECTIOUS WASTE MANAGEMENT

for Health Care Facilities

Author: Lawrence G. Wylie,
CIH, CSP, CHCM

James
TECHNICAL SERVICES

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PREFACE

This manual was developed as a practical resource for health care staff faced with the responsibility of managing environmental exposures. The critical areas of liability, statutory requirements, insurances, chemical control, personnel and environmental protection are presented. Since regulations are continually changing and the court's interpretations are in a state of evolution, no resource manual can be expected to cover completely the wide scope of this subject matter in complete detail. It is imperative that the users of this manual consider its contents only as guidelines for reviewing, developing, assessing, and implementing an ongoing hazardous and infectious waste management program specifically tailored to the individual health care facility.

INTRODUCTION

The environmental regulatory process has been hastened by a decade of environmental activism and by the discovery of numerous instances of irresponsible pollution by some generators, transporters, and waste disposal firms. The patchwork of state and federal regulations which have evolved from local and national concerns has created complex risk management problems for the health care industry which must attempt to comply with the many provisions of these various acts in order to avoid potential liability or violations involving harm to the environment.

Hazardous & Infectious Waste Management for Health Care Facilities is designed as a resource to assist Administrators, Risk Managers, and others charged with the responsibility for environmental impairment liability control. This manual identifies the potential sources of health care pollution liability, with special emphasis on the development and implementation of cost effective, integrated risk control programs. An overview of current legal bases including theories of negligence, strict, and statutory liability provides an additional motivation for consideration of the risk control and transfer and transfer methods outlined in the manual. There are sections which describe the insurance coverages available to mitigate the adverse financial consequences of an environmental incident. The risk identification and evaluation process is also described in some detail to allow Risk Managers to consider those steps which must be taken to properly develop control procedures. This manual contains sample forms, an EIL audit, record keeping suggestions, chemical data sheets, and other resources which will enable the Risk Control Staff to understand and respond to the complex subject of Environmental Impairment Liability.

Since federal environmental regulations are generally applicable as minimum standards, the scope of this manual was deliberately restricted to avoid the unique complexities of individual states environmental legislation. James Technical Services can provide, upon request, special state by state supplements and technical updates to this manual. Additionally, James offers its specialized expertise and consultation service to assist both our present and prospective clients in the management of risk arising from environmental exposures.

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Hazardous & Infectious Waste Management for Health Care Facilities

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CHAPTER I

Exposure Awareness

Introduction

Most health care institutions are generators of hazardous and infectious wastes according to definitions under the Resource Conservation and Recovery Act (RCRA). The Center for Disease Control estimates that the typical hospital generates more than ten pounds of solid, potentially harmful wastes per patient each day. These solid wastes may contain etiologic and chemical agents that could cause injury to third parties if proper handling and disposal procedures are not implemented and enforced.

Infectious wastes in health care facilities may be found in the form of excreta, blood, exudates, secretions, and solid wastes such as disposable equipment, linens, paper and plastic products. The most common methods of disposal for these materials are incineration, deposit in sewage systems, and removal by third party contractors for disposal off the premises.

Hazardous chemicals are found throughout most facilities and include known and suspected carcinogens, suspected carcinogens, and highly toxic materials such as asbestos, mercury, PCB's, ethylene oxide, formaldehyde, anesthetic agents, antineoplastics, radioisotopes, benzene, etc. Many of these materials are routinely dumped down drains. This practice is potentially in violation of many regulations.

Administrators and Risk Managers should become fully aware of the institution's exposures through implementation of a comprehensive risk indentification process. Management should effectively address the identified hazards associated with the generation, use, storage, transportation, and disposal of these harmful materials. A hazardous and infectious waste management program should be developed to track and control all hazardous and infectious wastes and to assure compliance with environmental regulations.

Table I-1 Potential Hazardous/Infectious Wastes Partial Listing by Department

- **Blood Bank**
  - Infectious Agents
- **Central Supply**
  - Ethylene Oxide
  - Mercury
  - Asbestos
  - Infectious Agents
- **Dental**
  - Mercury
  - Ethylene Oxide
  - Nitrous Oxide
- **Dialysis**
  - Formaldehyde
  - Infectious Waste
- **Engineering/Maintenance**
  - Asbestos
  - Boiler Compounds
  - Chromate
  - Caustics
  - Mercury
  - Sewage
  - Infectious Waste
  - Flammable Gases
  - Paints & Solvents
  - PCB's
  - Diesel
  - Gasoline
  - Oils
  - Lubrications
  - Pesticides
  - Insecticides
  - Rodenticides
- **Food Service**
  - Infectious Agents
  - Cleaners
  - Pesticides
- **Histology**
  - Formaldehyde
  - Dyes
  - Xylene
  - Alcohols
- **Housekeeping**
  - Infectious Agents
  - Antineoplastic Drugs
  - Chlorine
  - Iodine
  - Bromine
  - Radiation
  - Corrosive Chemicals
  - Glutaraldehye
  - Quatenary Ammonium
- **Laboratory**
  - Carcinogens
  - Mutagens
  - Teratogens
  - Flammable Liquids
  - Flammable Gases
  - Explosives
  - Infectious Agents
  - Radiation
  - Asbestos
  - Mercury
  - Phenols
- **Laundry**
  - Infectious Vectors
  - Corrosive Chemicals
- **Materials Management**
  - Flammables
  - Compressed Gases
  - Corrosives
  - Toxic Chemicals
- **Nursing**
  - Infectious Vectors
  - Pharmacological Agents
  - Antineoplastic Drugs
  - Radiation
  - Formaldehyde
  - Mercury
- **Oncology**
  - Antineoplastic Drugs
- **Pathology**
  - Infectious Agents
  - Formaldehyde
  - Solvents
- **Pharmacy**
  - Antineoplastic Drugs
  - Carcinogens
  - Mutagens
  - Teratogens
  - Flammables
  - Mercury
  - Controlled Substances
- **Printing**
  - Flammables
  - Solvents
  - Inks
- **Radiology**
  - Radioactive Wastes
  - Radioisotopes
  - Silver
  - X-Ray Developing Chemicals
- **Security**
  - Infectious Agents
- **Surgery**
  - Adhesives
  - Anesthetic Gases & Vapors
  - Infectious Agents
  - Formaldehyde
  - Glutaraldehyde
  - Radiation

Table I-2 Potential Hazardous/Infectious Wastes Partial Listing by Agents/Source

- **Blood-handling laboratory wastes**
  unused blood products, specimens, tubes, syringes, machine parts, etc.
- **Dialysis**
  disposable tubes, housekeeping supplies, etc.
- **General patient care items**
  urinary drainage bags, paper/plastic disposable bed protection pads, suction catheters and containers, urinals, bedpans, etc.
- **Isolation wastes**
  disposable dietary materials, bedpans, urinals, linens, housekeeping supplies, etc.
- **Medication and treatment items**
  syringes, bandages, gloves, drapes, etc.
- **Microbiology laboratory waste**
  slides, tubes, petri dishes, disposable instruments, etc.
- **Pathology wastes**
  body parts, disposables, etc.
- **Surgical wastes**
  body parts, disposable drapes, sponges, gloves, scapels, instruments, equipment, etc.
- **Urine chemistry laboratory wastes**
  disposable collection containers, slides, tubes, etc.

Table I-3 Potential Hazardous/Infectious Wastes Partial Listing by Infectious Vectors

- AIDS
- Anthrax
- Botulism
- Cancer
- Chickenpox
- Cholera
- Dengue
- Diphtheria
- Dysentery, amebic
- Dysentery, bacillary
- Encephalitis, infectious
- Epidemic keratoconjunctivitis
- Foodborne, diseases
- Fungus infections, systemic
  - Actinomycosis
  - Blastomycosis
  - Coccidoidomycosis
  - Histoplasmosis
- Hepatitis, infectious
- Hepatitis, serum
- Infectious jaundice
- Leprosy
- Malaria
- Measles
- Meningitis, all forms
  - Aseptic
  - Meningococcal
  - Tuberculous
- Mumps
- Occupational Diseases
- Paratyphoid A
- Paratyphoid B
- Pertussis
- Plague
- Poliomyelitis
- Post partum infections
  - Puerperal streptococcic infections
  - Staphylococcus disease
- Q fever
- Rabies
- Rheumatic fever, acute
- Rocky Mountain spotted fever
- Rubella
- Salmonella infections
- Scarlet fever
  - Streptococcal infections
  - Erysipelas
- Small pox
- Tetanus
- Trachoma
- Trichinosis
- Tuberculosis
- Tularemia
- Typhoid other salmonella cholecystitis
- Typhoid
- Typhus
- Undulant Fever
- Venereal diseases
  - Chancroid
  - Gonorrhea
  - Granuloma inguinale
  - Lymphogranuloma venereum
  - Syphilis
- Yellow Fever

Regulations Impacting Health Care Facilities (Partial Listing)

OSHA	Occupational Health and Safety Act
TSCA	Toxic Substance Control Act
RCRA	Resource Conservation and Recovery Act
CERCLA	Comprehensive Environmental Response Compensation Liability Act
FHSA	Federal Hazardous Substance Act
MCA	Motor Carrier Act
CWA	Clean Water Act
CAA	Clean Air Act
FDCA	Food Drug and Cosmetic Act
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
FHMTA	Federal Hazardous Materials Transportation Act
WPCA	Water Pollution Control Act
SWA	Solid Waste Act
LLW	Low Level Waste Act-NRC
STATE	Various State Environmental Statutes

CHAPTER II

Environmental Impairment Liability Program Audit for Hazardous & Infectious Waste Management

Introduction

A program audit system is provided to assist the institution in ascertaining the current and ongoing status of the Hazardous & Infectious Waste Management Program. A series of questions is provided in eight audit sections which can be used to determine system deficiencies and define areas which may require action. In answering these questions, the institution may find it appropriate to develop a numerical rating system which can be used for program assessment and prioritization of actions to be taken.

To obtain a preliminary determination of the organization's environmental exposure status, it may be beneficial to utilize this audit initially with a minimum of preparation. Upon review of the initial audit results with appropriate technical, insurance, and risk consultants, initial or improved controls may be rapidly implemented. This audit or a subsequent, more detailed audit may indicate the risk controls sufficient for regulatory compliance and suitable for submission to EIL insurance markets.

EIL PROGRAM AUDIT

Hazardous and Infectious Waste Management

Section 1 Risk Management

HIWM Criteria Questions	Yes or No
1. Is a qualified individual assigned responsibility and given the authority for this area?	___ ___
2. Is there a comprehensive, hazardous/infectious waste risk evaluation protocol?	___ ___
3. Are trained and qualified individuals conducting the risk evaluation audit?	___ ___
4. Is the audit qualitatively reviewed annually?	___ ___
5. Are all EIL incidents reported and reviewed?	___ ___
6. Are certificates of insurance obtained for all hazardous and infectious waste handling companies?	___ ___
7. Are appropriate EIL insurance limits provided by those firms?	___ ___
8. Are Hold Harmless Agreements in effect? Has legal council reviewed these contracts?	___ ___
9. Are recommendations for risk control implemented and properly documented?	___ ___
10. Are you protected by adequate EIL insurance?	___ ___
11. Are annual hazardous and infectious waste management summary reports presented to Administration?	___ ___
12. Is there adequate funding for the risk assessment and risk control program?	___ ___
13. Is your facility in compliance with all applicable environmental regulations?	___ ___

Comments: ____

____

____

EIL PROGRAM AUDIT

II Hazardous and Infectious Waste Management

Section 2

Chemicals/Infectious Vectors

HIWM Criteria Questions	Yes or No
1. Do all storage sites for wastes meet applicable standards?	___ ___
2. Is a chemical inventory system utilized?	___ ___
3. Is a waste inventory system utilized?	___ ___
4. Are Material Safety Data Sheets provided for all hazardous materials?	___ ___
5. Are all hazardous and infectious materials and wastes properly labeled?	___ ___
6. Are all hazardous and infectious wastes properly handled or transported internally?	___ ___
7. Is appropriate personal protective equipment utilized when handling hazardous or infectious wastes?	___ ___
8. Is the onsite storage of hazardous materials EPA/State licensed?	___ ___
9. Is an appropriate level of security provided for (use, storage, and disposal) hazardous materials and wastes?	___ ___

Comments: ____

Section 3 Waste Collection and Containerization

HIWM Criteria Questions	Yes or No
1. Are NFPA and DOT requirements met for flammables, corrosives, reactive, or toxic materials?	___ ___
2. Are all containers properly labeled?	___ ___
3. Do handling practices meet all applicable standards?	___ ___
4. Are incompatible wastes properly segregated?	___ ___
5. Are frequent safety inspections conducted to verify proper program implementation?	___ ___
6. Is any commingling of hazardous and nonhazardous wastes permitted?	___ ___
7. Are selected containers impervious to the materials they are storing?	___ ___
8. Are needles and other contaminated sharps stored in puncture proof containers?	___ ___

Comments: ______________________________

Section 4 Hazardous Waste Transportation

HIWM Criteria Questions	Yes or No
1. Is the transportation service company appropriately licensed by EPA and/or State?	___ ___
2. Does transporter maintain appropriate EIL insurance and limits?	___ ___
3. Are certificates of insurance kept on file?	___ ___
4. Are services available on a timely basis?	___ ___
5. Are services available on an emergency basis?	___ ___
6. Are transportation company drivers trained in proper emergency response procedures?	___ ___
7. Does the transporter maintain appropriate records required by EPA and/or State?	___ ___
8. Does the transportation company have appropriate emergency response equipment available?	___ ___
9. Do drivers load wastes in a safe manner?	___ ___
10. Does a member of your staff periodically accompany the wastes to the disposal site?	___ ___

Comments: ____

Section 5 Treatment and Disposal Facilities

HIWM Criteria Questions	Yes or No
1. What wastes are treated or disposed of onsite?	___ ___
2. Are onsite treatment and disposal activities properly controlled or licensed?	___ ___
3. Is the off-site treatment or disposal facility properly licensed?	___ ___
4. Does the treatment or disposal facility carry appropriate EIL insurance?	___ ___
5. Are copies of the certificates of insurance on file at your facility?	___ ___
6. Is the treatment or disposal facility authorized for all types of waste generated?	___ ___
7. Have you inspected their operations annually to insure that disposal methods are appropriate?	___ ___
8. Is the treatment and disposal facility financially sound?	___ ___
9. What is the projected life of the treatment or disposal facility?	___ ___
10. Are any treatment or disposal operations subcontracted to other firms?	___ ___
11. Is any disposal or treatment performed off-shore or in other countries?	___ ___
12. Are alternative treatment or disposal facilities available?	___ ___
13. What is the history of the site?	___ ___
14. Have you obtained copies of all permits?	___ ___

Comments: ____

____

____

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Section 6 Recordkeeping

HIWM Criteria Questions	Yes or No
1. Is the program clearly written to communicate authority, implementation, and emergency procedures?	___ ___
2. Is a designated person(s) responsible for properly maintaining records?	___ ___
3. Are the manifests retained on file indefinitely or for the required three years?	___ ___
4. Are annual reports submitted?	___ ___
5. Are exception reports submitted?	___ ___
6. Is employee training documented?	___ ___
7. Are emergency plans documented?	___ ___
8. Is the record keeping system audited by Risk Management?	___ ___

Comments: ____

Section 7	Training
HIWM Criteria Questions	**Yes or No**
1. Are all affected employees properly trained?	___ ___
2. Is employee training initial, annual, and as exposures change?	___ ___
3. Is the number of employees trained adequate to cover all operations on all shifts?	___ ___
4. Does training include use of personal protective equipment and emergency response?	___ ___
5. Does training encompass all key areas of the hazardous and infectious waste management program?	___ ___
6. Is the trainer qualified to provide environmental hazard control training?	___ ___

Comments: ____

Section 8 Emergency Preparedness Planning

HIWM Criteria Questions **Yes or No**

1. Is a qualified individual assigned the responsibility for emergency preparedness? ___ ___
2. Is there a comprehensive plan developed for all the identified? ___ ___
3. Is an adequate staff provided for emergency response? ___ ___
4. Have provisions been made for appropriate outside assistance in the event of an emergency? ___ ___
5. Is the appropriate type and amount of emergency equipment available? ___ ___
6. Are equipment records adequately maintained? ___ ___
7. Is maintenance and inspection of all emergency equipment performed? ___ ___
8. Do designated employees receive proper drills for all emergency response situations? ___ ___
9. Are emergency plans and response actions reviewed and periodically updated? ___ ___

Comments: ____

____

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EIL AUDIT SUMMARY

Hazardous and Infectious Waste Management

ACTION ITEMS FROM HIWM from Sections (1 - 8)

Item No.	Description of Action Item	Assigned To	Date Assigned	Due Date

CHAPTER III

Legal Basis for Environmental Impairment Liability

Overview

In the past decade many statutes have been promulgated for the regulation of environmental impairment. The rate at which new legislative controls and common law liabilities are evolving can only lead to the conclusion that the future holds no relief from the regulatory schemes which have developed at the federal, state, and local levels.

The health care industry is faced with a prodigious task of coping with the regulations of a host of federal and state agencies. Chief among the agencies which exercise control over the release of harmful materials into the environment is the Environmental Protection Agency (EPA). The health care industry has been provided with extensive environmental standards including the Clean Water Act (CWA), Clean Air Act (CAA), the Toxic Substance Control Act (TSCA), and the Resource Conservation and Recovery Act (RCRA).

The complexity of environmental legislation in particular, RCRA and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) commonly known as "Superfund," has resulted in confusion and poorly coordinated responses by most health care facilities.

Many people have focused attention on the statutory basis of liability under these recent enactments. However, common law grounds for recovery as a result of claims for environmental impairment have been successfully pursued in the past and will continue to offer an alternative basis for liability recovery in the future.

Common Law Basis for Liability Resulting from Environmental Impairment

The following common law theories have been used to enjoin activities which have resulted in damage or imminent danger of harm to the environment and to recover damages in cases where harm has already been caused by a discharge.

Negligence

Liability is imposed on a party who fails to exercise a degree of care commensurate with the apparent risk of a particular operation or activity. In environmental impairment cases, the alleged negligence has ranged from improper design or maintenance of control facilities, human error and failure to warn of known dangers, to ineffective safety devices and improper selection of waste disposal contractors. There is an increased possibility that negligence will be alleged and found by the court where the defendant has already been found to be in violation of a statutory provision establishing a standard of care and conduct. Thus, where a pollutor is found to have deviated from the requirements of RCRA, Superfund, or state statutes, it may be found, conclusively, to be negligent under the common law doctrine of negligence per se.

With respect to the statute of limitations in environmental impairment cases, courts have held that the statute of limitations does not begin until the plaintiff knows, or should have known, that his legal rights have been violated, giving a right to recovery from the defendant.

Nuisance and Trespass

Liability could result from activities which cause discharge of particulate into the atmosphere or a release into a stream where the pollutant is ultimately deposited on the property of a third party. Where physical transmission of the material results in such deposits, the land owner or occupant may bring a lawsuit against the generator under the common law theory of trespass. Trespass is the unauthorized entry upon the land of another which interferes with the quiet enjoyment of his right to occupy the property. Cases involving suspended particulate in the form of stack discharges and solids dumped into streams have been pursued under this theory. Courts have issued orders enjoining the activity which caused the emission or release as well as requiring remedial actions and clean-up of past deposits.

Where there is no physical transmission of materials, but a substantial interference with the plaintiff's use and enjoyment of his property still is shown as a result of another's activities, the courts have found relief through the tort law of nuisance. Neighbors of a facility that uses harmful substances may base a lawsuit on nuisance where such interference is shown to be unreasonable. The most common impairments involved in this type of liability include emanations of noise, odor, and light. Other bases for alleged interference can easily be imagined where microwaves, laser beams, and radiation are used. Courts are likely to be liberal in their interpretation of the activities which may be regarded as a nuisance. Here again, relief may take the form of injunction as well as an order to compensate the plaintiff for economic loss.

Strict Liability for Ultrahazardous Activities

Liability can be imposed even in the absence of any negligence, where the defendant is involved in activities which pose an unreasonable threat of injury, regardless of the degree of care exercised. It is considered that the hazards associated with such activities are so dangerous that no precautions which may be taken can adequately protect third parties from bodily injury or property damage. When strict liability is imposed, the defendant loses his common law defenses of assumption of risk and contributory negligence.

Given the inherently hazardous properties of some of the highly toxic chemicals now in common use in hospitals and the potential for widespread injury as a result of the release of relatively small quantities of those materials the courts may find the use of some of those chemicals constitutes an ultra-hazardous activity.

Evolving case law on apportionment of damages is also important to companies whose activities involve hazardous substances, particularly where they may be discharging wastes into a body of water which is used by other industries to dispose of wastes. If more than one company has generated the wastes disposed of at a single site or dumped into a common site, it may be impossible to determine which company's waste results in subsequent damage to a third party's property or in bodily injury. When faced with such a problem, courts have taken unusual measures to provide some form of recovery to the plaintiff who has demonstrated an injury beyond any reasonable doubt caused by the harmful effects of an environmental impairment. In some cases, all contributors to the waste site may be assessed a portion of the settlement.

In environmental impairment cases there is also danger of small, individual claims mushrooming into serious lawsuits as a result of class actions being certified. This possibility is becoming a more serious threat as environmental activists and public action groups are moving to locate and prosecute organizations which are involved in any activity resulting in environmental damage. Neighborhoods and whole communities can be mobilized by the highly visible and emotionally charged issues which are often involved in environmental impairment cases. Juries can be affected by emotional factors which can work to the detriment of the defendant's company whose fate may depend on the resolution of technically complex issues in an emotionally charged atmosphere.

Court's ruling with respect to the laws concerning statutes of limitations has also tended to result in a recovery against the organization that is found responsible for environmental impairment. The rules of traditional tort law used to require that lawsuits had to be initiated within a specified number of years (usually three to seven years) after the time the incident in question actually occurred. Failure to discover the injury or lack of manifestation of the damage within the time allowed could bar any subsequent claim. However, it can no longer be assumed that the passage of time is a bar to claims based on long past practices of compaines involved in activities resulting in environmental impairment, even when the injury manifests itself twenty years after the first exposure.

Statutory Bases for Liability Resulting from Environmental Impairment

While it is difficult to identify all of the sources of potential statutory liability which threaten a given organization in today's complex environment of regulatory control, the major legislative acts which deal with critical aspects of environmental impairment can be identified. Emphasis will be given to the Resource Conservation and Recovery Act (RCRA) of 1976, since this act deals specifically with the problems associated with hazardous wastes and is clearly the impetus behind the current interest in Environmental Impairment Liability Insurance. Other federal legislation affecting potential liability for damage to the environment includes the following:

The Clean Water Act of 1977 (CWA).

This law is a set of amendments to the Federal Water Pollution Control Act of 1972 which prohibits the discharge of oil or hazardous substances by vessels or facilities (onshore or offshore) into navigable waters, shorelines, or contiguous zones, etc.

Also, under the Clean Water Act the EPA has implemented the National Pollutant Discharge Elimination System (NPDES) which requires permits for all point source discharges into a stream, lake, or watercourse. Point sources are those organizations, industrial facilities, and municipal waste-water treatment plants which discharge pollutants directly into water through pipes and channels. The permit system is designed to monitor and control the amount and characteristics of pollutants which enter the environment from these sources. The EPA or an individual state which is enforcing the NPDES permit system may proceed in a court of competent jurisdiction to restrict or prohibit the introduction of any pollutant by the violating generator or treatment plant.

Toxic Substances Control Act of 1976 (TSCA).

This act specifies that:

a. An inventory be compiled of every chemical manufacturing company's existing stock of commercial chemicals.

b. Manufacturers submit to EPA a PreManufacturing Notice (PMN) ninety days prior to producing any chemical not listed in the initial inventory.

c. EPA's Administrator may prohibit or limit the manufacture, processing, distribution, use, or disposal of a chemical substance or mixture if it is found to present an unreasonable risk of injury to health or to the environment.

The EPA has utilized TSCA to address the problems associated with the continued use and disposal of Polychlorinated Biphenyls (PCB's). The act generally prohibited the manufacture, distribution, and the use of PCBs, except in totally enclosed systems. Most transformers and capacitors have been regarded as totally enclosed system.

Clean Air Act of 1970 (CAA).

This legislation empowered the EPA to establish and enforce ambient air quality standards to protect the public health and welfare. EPA also sets emission standards for new pollution sources and for all sources of certain especially hazardous pollutants (i.e. carbon monoxide, ozone, sulfur dioxide, and oxides of nitrogen, particulates, and hydrocarbons).

Motor Carrier Act of 1980 (MCA).

While the purpose of this amendment to the Motor Carrier Act of 1935 is to promote deregulation of the trucking industry, it also utilizes the insurance industry as a quasi regulator to promote safer trucking operations. This is accomplished by provisions which require truckers regulated by the Interstate Commerce Commission (ICC) to carry minimum levels of liability insurance.

This act mandates three different limits of liability depending upon the degree of hazard represented by various types of trucking hazards.

Automobile Liability policies may contain gaps in coverage which could result in a Motor Carrier becoming obligated to reimburse the insurer if it pays claims which are not covered by the policy. The most notable of these is for restoration in connection with environmental damage from gradual release excluded from most liability policies.

The following is a breakdown of the categories of required levels of financial responsibility under the Act:

The following is a breakdown of the categories of required levels of financial responsibility under the Act:

Use of Vehicle	Minimum Limit of Liability (Effective July 1, 1981)	Minimum Limit of Liability (Effective July 1, 1983)
For transport of hazardous substances in bulk (i.e., in containment systems with capacities of more than 3,500 gallons of water) either Interstate or Intrastate*	$1,000,000	$5,000,000
For hire in interstate transportation of any property (non-hazardous)**	500,000	750,000
For transport of any quantity of extremely hazardous materials (e.g., explosives, poison gas, liquefied petroleum gas, compressed gas, nuclear or radioactive materials, etc.) either Interstate or Intrastate	1,000,000	5,000,000
All Other Uses	500,000	750,000

---

* Dot regulations list nearly 100 pages of hazardous materials. If the amount of the substance transported equals or exceeds the specified reportable quantity, the motor carrier is required to carry the $1,000,000 limit of liability.

** Many firms will be subject to these regulations as a result of activities associated with "Intercorporate Hauling," where one member of a corporate family hauls hazardous materials for another member for a charge. Intercorporate haulers must also satisfy the financial responsibility requirements of the Motor Carrier Act.

CHAPTER IV

Resources Conservation and Recovery Act of 1976 (RCRA)

RCRA — The Law at a Glance

General Intent

RCRA directs the U.S. Environmental Protection Agency (EPA) to institute a national program to control hazardous waste from the time it is generated to its final disposal. Each state is encouraged to develop its own program following EPA guidelines.

Who is Subject?

'Persons' who generate, store, treat, transport, or dispose of hazardous and infectious waste.

Major Provisions

1. **Scope of Hazardous Waste**
   The Act defines and lists solid wastes which are hazardous and thus subject to RCRA controls, establishes criteria for identifying characteristics and for listing hazardous wastes, and delineates specific wastes that are excluded from the RCRA regularory control system.
2. **Standards for Generators and Transporters of Hazardous Waste**
   Generators are required to determine if their wastes are hazardous by consulting the list of hazardous wastes contained in the regulations or by determining if they possess any one of the four characteristics established in the regulations; ignitability, corrosivity, reactivity, or toxicity. The generator must then comply with the RCRA requirements for preparing wastes for shipment, completing the manifest for tracking hazardous waste, assuring through the manifest system that the waste arrives at a treatment, storage, or disposal facility, and submitting an annual summary of activities.

Transporters must comply with regulations developed jointly by EPA and the U.S. Department of Transportation (DOT). By reference, the RCRA regulations incorporate the DOT rules on labeling, marking, packaging, placarding, and other requirements for reporting hazardous discharges or spills during transportation.

3. **A Manifest System to Track Hazardous Waste From Its Generation to Its Final Disposal**
   The record keeping system starts when those who store, transport, treat, or dispose of hazardous wastes notify EPA as required under RCRA. After notification, the EPA will assign an identification number to the notifier.
4. **Permit Requirements for Facilities that Treat, Store, or Dispose of Hazardous Waste**
   The regulations under RCRA set standards for hazardous waste facilities to establish proper treatment, storage, and disposal practices. The specific regulations dealing with facility operations will include standards for waste analysis plants, plant security, inspection of equipment, establishment of emergency procedures, record keeping, and reporting, general operating requirements, special requirements for ignitable, corrosive or incompatible wastes, ground water monitoring, closure and post-closure plans, and control of run-off and run-on from waste disposal sites.
5. **Requirements for State Hazardous Waste Programs**
   Congress clearly prefers that states assume responsibility for controlling hazardous wastes within their borders. RCRA provides financial assistance to states for developing their programs. EPA approval requires that the state plan be "equivalent to and consistent with" the federal program. "Equivalent" has been interpreted to mean "equal in effect." The states may go beyond the minimum requirements of the federal RCRA, but they may not impose any requirement which might interfere with the free movement of hazardous wastes across state boundries to treatment, storage, or disposal facilities issued a RCRA permit.

Financial Responsibility

Specific liability insurance requirements were established by EPA for sudden and non-sudden occurrences. The insurance requirements are as follows:

1. **Sudden Occurrences**
   An owner or operator of a hazardous waste treatment, storage, or disposal facility must maintain liability insurance for sudden and accidental occurrences that cause injury to persons or property in the amount of at least $1 million per occurrence, with an annual aggregate of at least $2 million, exclusive of legal defense costs.
2. **Non-sudden or Gradual Occurrences**
   An owner or operator of a surface impoundment, landfill, or land treatment facility that is used to manage hazardous waste must maintain liability protection for non-sudden and accidental occurrences that cause injury to

persons or property in the amount of at least $3 million per occurrence, with an annual aggregate of at least $6 million, exclusive of legal defense costs. Each facility must have this insurance by prescribed dates. Specific requirements for applicable coverage are described under "Insuring the Environmental Impairment Liability Risk".

In addition to the liability control requirements outlined above, RCRA regulations also require evidence of financial responsibility from owners and operators of treatment, storage, and disposal facilities to assure that site closure and post-closure monitoring and maintenance of such facilities will be carried out in accordance with established regulations.

Analysis of the Major RCRA Provisions

Identification of Wastes

RCRA defines a hazardous waste as a solid waste that may cause or significantly contribute to an increase in mortality or incapacitating reversible illness or pose a substantial present or potential hazard to human health or the environment when it is improperly treated, stored, transported, disposed, or otherwise managed.

It should be noted that under RCRA, a "Solid Waste" may be either a solid, liquid, or gas. The four characteristics of hazardous wastes are noted in Table IV-1.

Characteristics of an EPA Hazardous Waste

Table IV-1

Characteristic	Description
1. Ignitability	Capable of causing fires during routine management or transportation
2. Corrosivity	Aqueous Waste pH ≤ 2 or ≥ 12.5
3. Reactivity	Extreme instability, tendency to react violently or explode
4. Toxicity (EP) Extraction Procedure	A waste when subjected to a leaching procedure contains a substance (100 X) as specified in National Interim Drinking Water Standard or may pose substantial harm to human health or the environment

Extraction Procedure (EP) Toxicity Limits

Table IV-2

Contaminant[1]	Maximum Concentration mg/l*
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0
Endrin	0.02
Lindane	0.4
Methoxychlor	10.0
2,4 D	10.0
2,3,5 - TP	1.0

[1] Contaminants from CWA/NPDES
(Clean Water Act/National Pollution Discharge Eliminations System)

* mg/l - milligrams per liter

Infectious Waste

A waste which contains viable disease causing agents (listed in RCRA R 299.6304) and includes those disease causing agents listed by the United States Public Health Service Center for Disease Control as Class 3, 4, and 5 Etiological agents. Class 3 agents are those involving special hazard and requiring special conditions for containment. Class 4 agents are those that require the most stringent conditions for their containment because they are extremely hazardous to laboratory personnel or may cause serious epidemic disease. Class 5 agents are foreign animal pathogens which are excluded from the United States by the law or whose entry is restricted by the United States Department of Agriculture Administrative Policy. See Appendix G for a partial listing of the EPA Hazardous Materials.

Exempt Categories

Certain wastes, though defined as hazardous by the RCRA criteria, may not be subject to regulation under the act due to statutory exemption. These materials are, in most cases, subject to regulation by some other federal laws.

The RCRA exempt categories include the following:

1. Domestic Sewage
2. Industrial wastewater discharges
3. Nuclear wastes regulated under the Atomic Energy Act by the NRC
4. Household waste
5. Wastes that are reused or recycled, except for the storage and transportation of sludges and listed wastes
6. Utility wastes (fly ash, bottom ash waste, slag waste, and flue gas emission)
7. PCB's which are still regulated by the Toxic Substance Control Act (TSCA)
8. Others

Quantity Exemptions

Many of the EPA regulations incorporate by reference pertinent parts of the Department Of Transportation's (DOT's) rules on labeling, marking, packaging, placarding, and other requirements for reporting hazardous discharges or spills during transportation.

The generator of any waste has the initial responsibility to identify waste characteristics to determine if it is hazardous and, therefore, subject to regulation under RCRA. However, any other entity who handles, transports, stores, treats, or disposes of the waste also has an obligation to know if it is classified as hazardous.

The regulations exempt the small generator from the initial hazardous waste controls under RCRA. In general, less than 1000 kilograms per month of an identified hazardous waste are exempted so long as no more than 1000 kilograms is accumulated on the premises at any time. For extremely hazardous substances a maximum of only 1 kilogram per month is permitted. Practically speaking, however, even the small generator may find that he has to comply with the record keeping and manifest system prescribed by RCRA because most off site storage, treatment, and disposal facilities will not accept unmanifested wastes without EPA identification numbers.

Unexpected events can create problems for generators of hazardous wastes. For example, a generator who would produce less than 1 to 1000 kilograms per month of a listed substance and would ordinarily be exempt under the exclusion exemption may be subject to RCRA by accumulating wastes for more than a 90-day period when the customary transportation firm or disposal facility suddenly loses its ability to accept the waste.

Current EPA quantity exemptions are expressed in Figures IV-1 & 2.

Acutely Hazardous Waste Quantity Exemptions (1 KG)

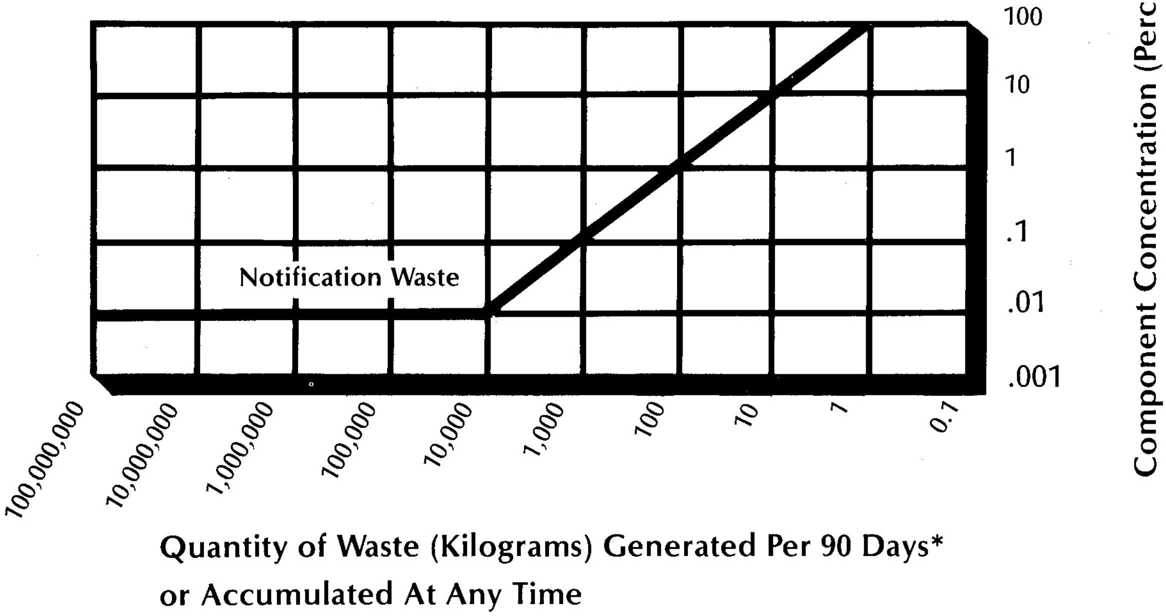
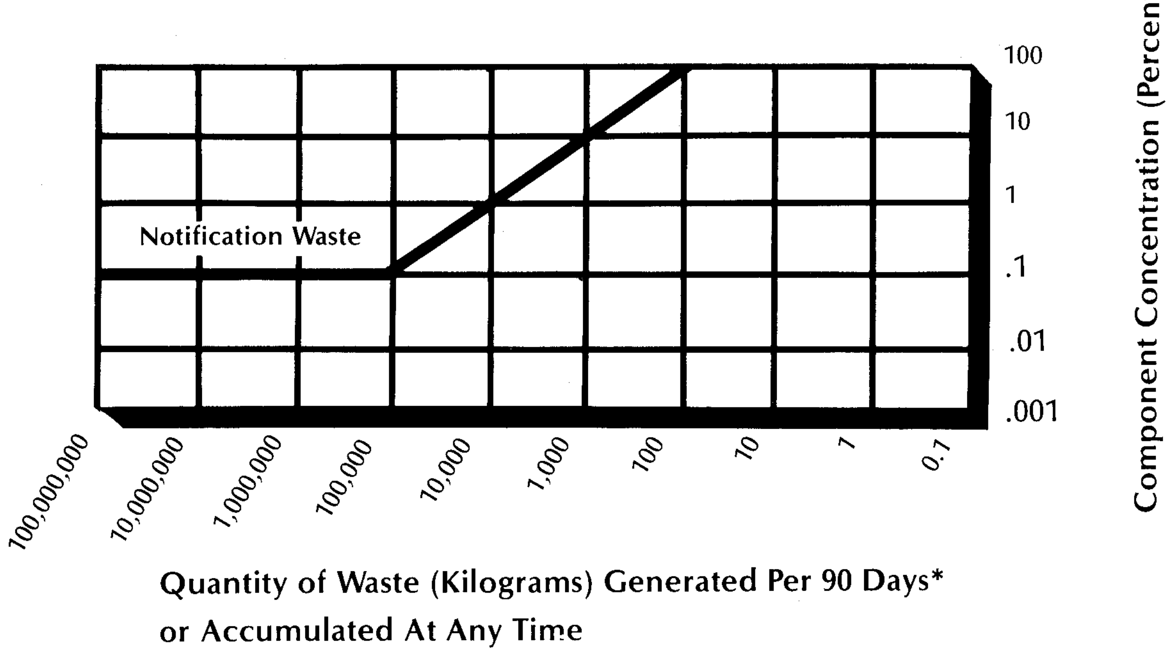


Figure IV-2
Toxic Waste Quantity Exemptions (100 KG)



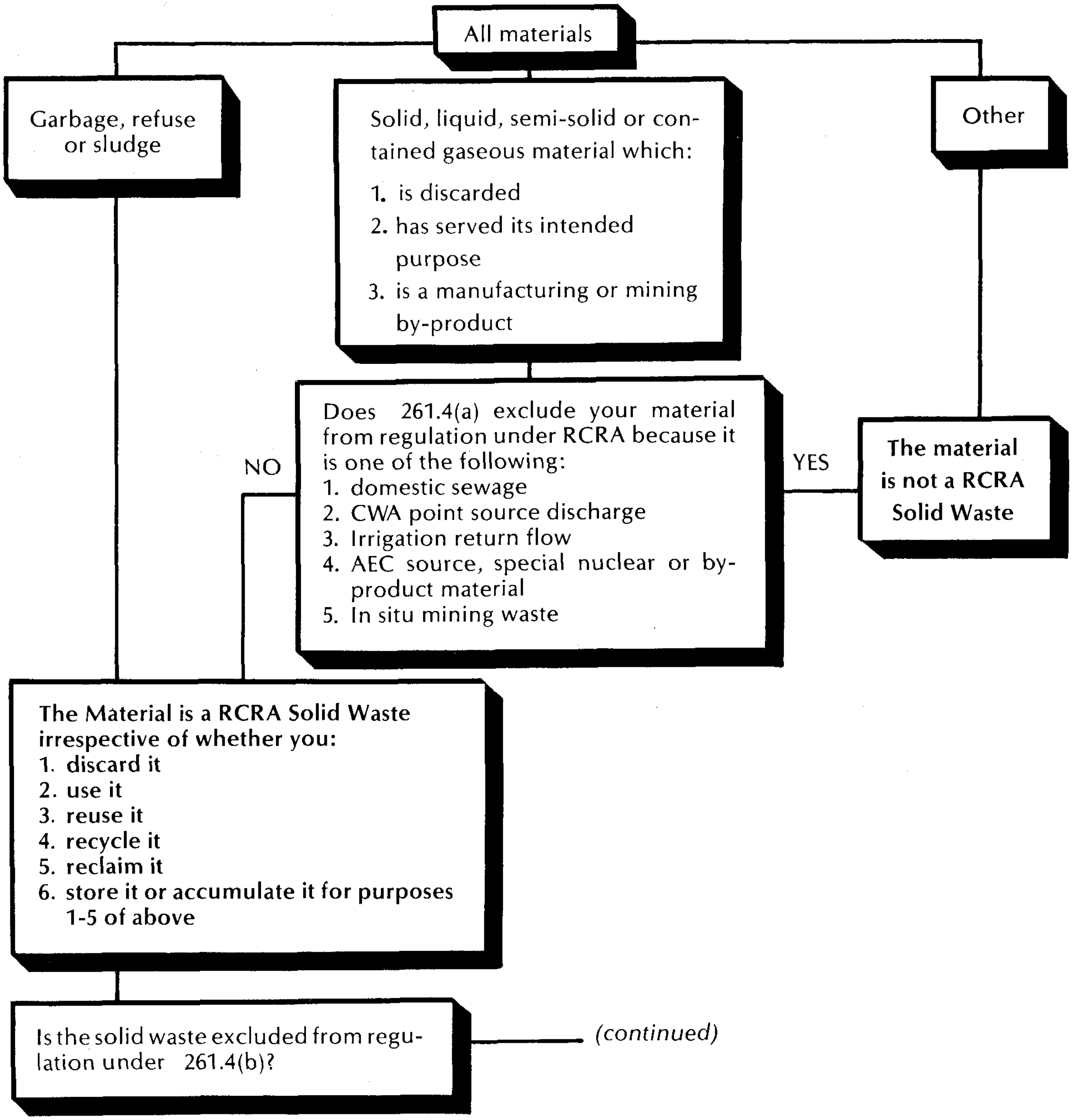
* Some state storage criteria limits the period to 30 days

Criteria For Determination of Hazardous Wastes:

The following three figures, IV-3, 4, & 5, provide a schematic logic diagram for determining whether a material is a RCRA solid hazardous waste and what, if any, parts of the regulations apply.

Figure IV-3

RCRA Definition of a "Solid Hazardous" Waste



(continued)

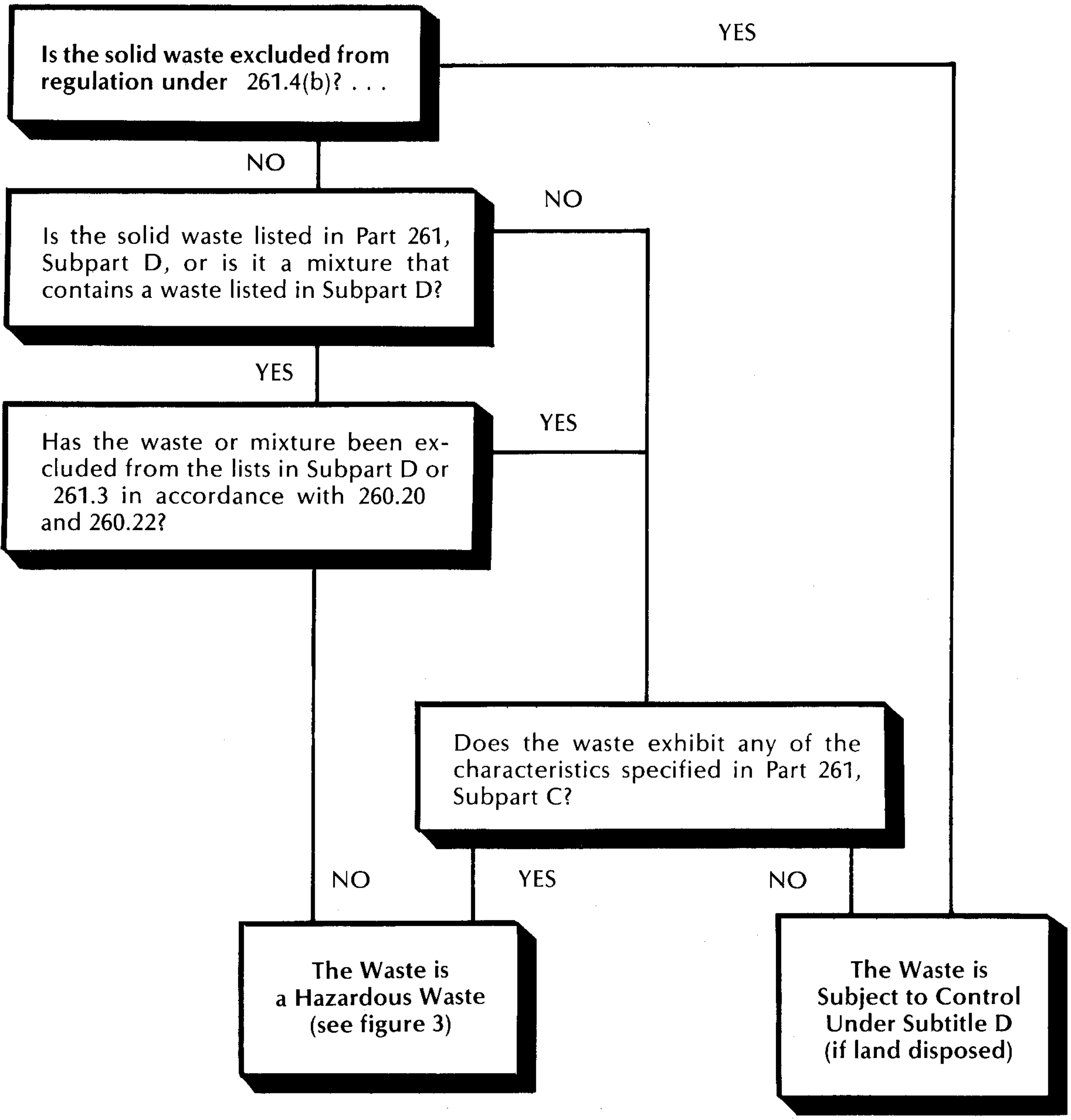

Is the solid waste excluded from regulation under 261.4(b)? . . .
YES
NO
Is the solid waste listed in Part 261, Subpart D, or is it a mixture that contains a waste listed in Subpart D?
NO
YES
Has the waste or mixture been excluded from the lists in Subpart D or 261.3 in accordance with 260.20 and 260.22?
YES
Does the waste exhibit any of the characteristics specified in Part 261, Subpart C?
NO
YES
NO
The Waste is a Hazardous Waste (see figure 3)
The Waste is Subject to Control Under Subtitle D (if land disposed)

Figure IV-4

Special Provisions for Certain Hazardous Waste

(Amended by 48 FR 14153, April 1, 1983)

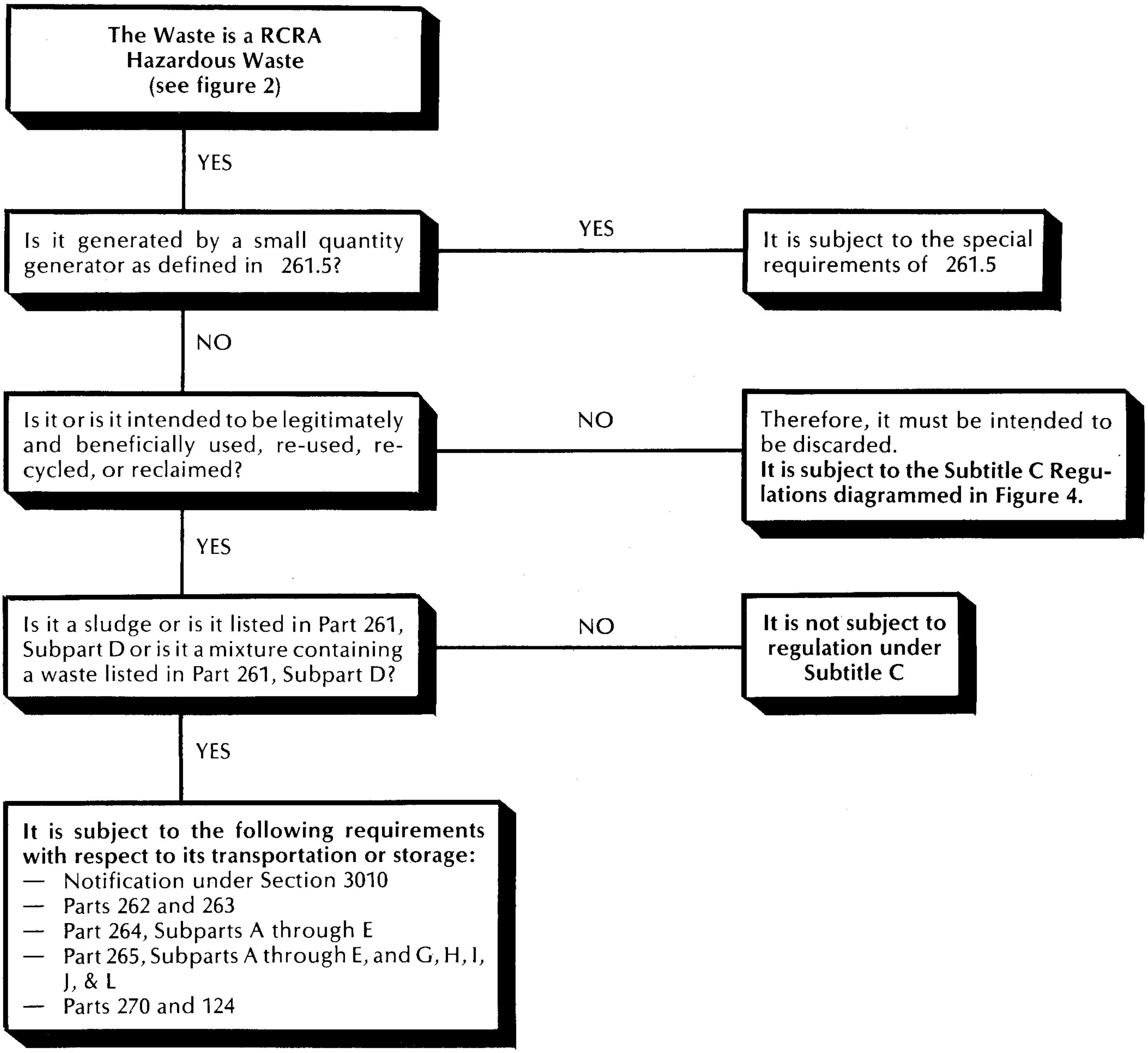
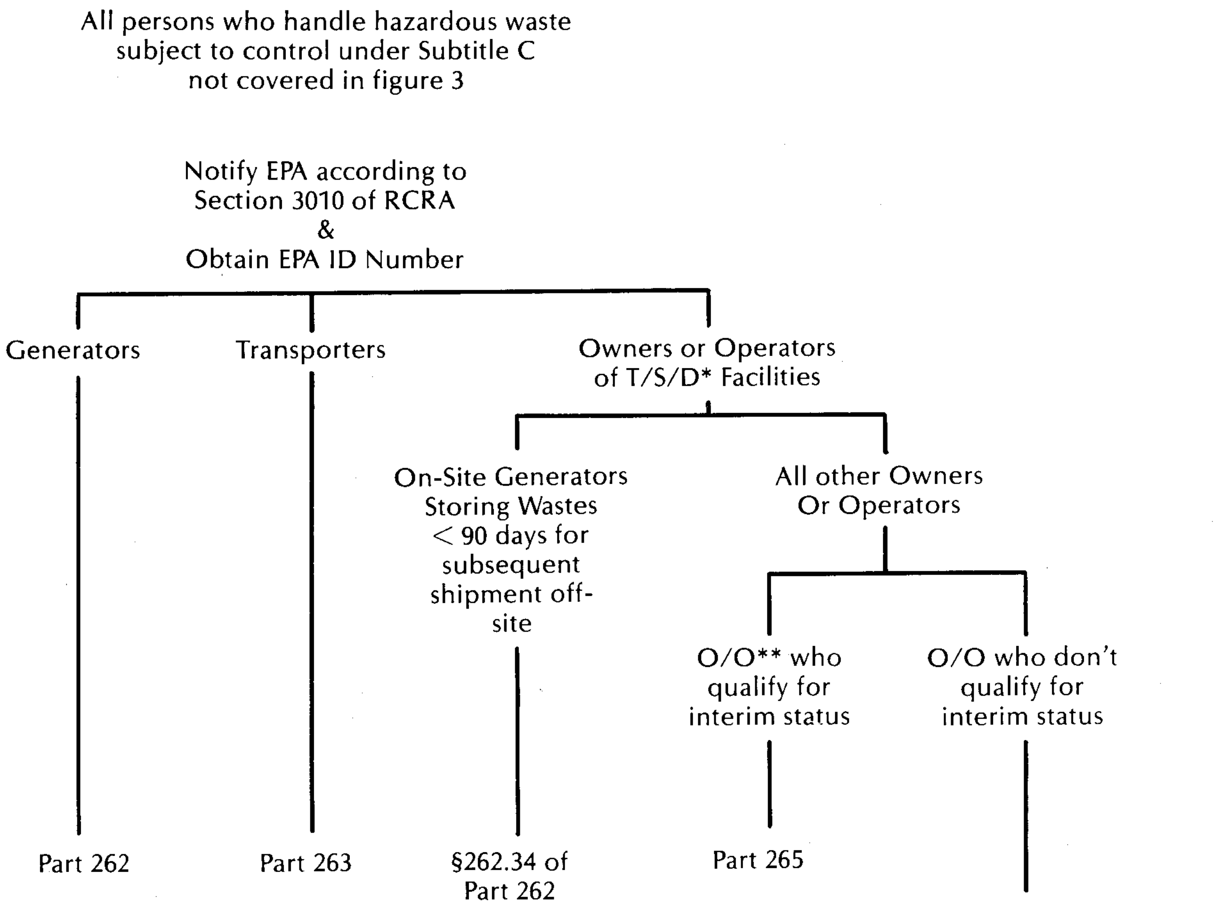


Figure IV-5

Regulations for Hazardous Waste Not Covered in Figure IV-4



- Stop operations, if any
- Send waste inventory, if any, to a facility whose owner or operator has interim status, or a permit, following the Part 262 rules
- Apply for permit under Part 270 and resume or commence operations only after permit is issued by EPA under Parts 270, 124 and 264, or by a State with an EPA approved hazardous waste permit program.

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* T/S/D stands for Treatment, Storage, or Disposal
** O/O stands for Owners or Operators

The Manifest System — "Cradle to Grave"Tracking System

Generators

Generators have the primary responsibility in the transport control system. Under the RCRA regulations they must:

1. Determine the hazardous nature of their waste
2. Obtain an EPA identification number to transport treat, store or dispose of hazardous waste
3. Obtain a facility permit if waste is accumulated on the generator's property for periods of more than 90 days
4. Originate a transport manifest describing the amount, composition, origin, routing and destination of each individual shipment of regulated waste
5. Use approved, appropriate containers and label them properly for shipment (see sample labels)
6. Select a responsible company to transport the waste (must have EPA identification number also)
7. Specify the facility to which the waste is to be delivered and assure that it has a valid permit
8. Prepare the manifest for tracking the hazardous waste (sample provided)
9. Assure, through the Manifest System, that the waste arrives at the designated facility
10. Keep records of information in the Manifest and report it to an authorized state agency or to the EPA in the required annual summary of activities
11. Notify authorities of any proposed international shipments of regulated wastes

Manifest Information

The Manifest must contain the following information:

1. Name and address of generator
2. Names of all transporters
3. Name and address of the permitted facility designated to receive the waste
4. EPA identification numbers of all who handle the waste
5. U.S. Department of Transportation (DOT) description of the waste
6. Quantity of waste and number of containers
7. The generator's signature certifying that the waste has been properly labeled, marked, and packaged in accordance with DOT and EPA regulations

The generator prepares the Manifest, then signs the certification, including one copy for each person handling the waste. The transporter then signs and dates the Manifest and returns one copy to the generator who retains it until a copy is received from the designated facility following delivery of the waste.

Generators must obtain the uniform manifest form from the state where the waste is to be sent (consignment state). If the consignment state does not require its use, the generator must use his own states' form, and if neither require or use the uniform manifest, the generator must obtain it from other sources. A sample copy of the two part manifest is included in this section.

Transporters

The regulation of transporters of hazardous waste under the authority of Section 3003 of RCRA was developed jointly by EPA and the U.S. Department of Transportation (DOT). The EPA regulation on transporters incorporates by reference pertinent parts of DOT's rules on labeling, marking, packaging, placarding, and other requirements for reporting hazardous discharges or spills during transportation. The regulations require a transporter to:

1. Obtain an EPA identification number
2. Comply with the Manifest System for tracking of hazardous wastes
3. Deliver the entire quantity of hazardous waste to the facility designated by the generator on the Manifest
4. Retain a copy of the Manifest for three years
5. Comply with DOT regulations pertaining to reporting of discharges or spills
6. Clean up any hazardous waste discharged during transportation

The transporter must not accept any shipment of regulated waste without a Manifest properly prepared by the generator. The transporter signs and dates the Manifest and returns one copy to the generator. The transporter carries the Manifest to the designated facility. When the shipment arrives, an agent for the facility signs and dates each copy and retains one copy. One copy is given to the transporter who must retain it for three years, and another copy is returned to the generator by the facility agent.

Storage, Treatment, and Disposal of Hazardous Wastes

Permit Requirements:

Owners and operators of facilities that treat, store, or dispose of hazardous waste must comply with minimum standards promulgated under Section 3004 of RCRA for assuring that the facilities operate safely. These standards cover containing, testing, and destroying wastes so that they cannot contaminate ground water, surface water, or the atmosphere. There are also standards for safety and emergency measures to be used if hazardous waste is accidently discharged, for training personnel in emergency procedures, and for keeping records and filing reports. The operator must:

a. Notify EPA of its operations and apply for an EPA identification number.

b. Submit a detailed application form to EPA.

c. Meet all requirements of interim and permanent status standards as promulgated by EPA.

Please print or type (Form designed for use on elite (12 pitch) typewriter.)

Form Approved OMB No 2000 0404 Expires 7 31 86

UNIFORM HAZARDOUS WASTE MANIFEST	1. Generator's US EPA ID No. Manifest Document No.	2. Page 1 of	Information in the shaded areas is not required by Federal law.

GENERATOR

3. Generator's Name and Mailing Address

4. Generator's Phone ( )

5. Transporter 1 Company Name

6. US EPA ID Number

7. Transporter 2 Company Name

8. US EPA ID Number

9. Designated Facility Name and Site Address

10. US EPA ID Number

A. State Manifest Document Number

B. State Generator's ID

C. State Transporter's ID

D. Transporter's Phone

E. State Transporter's ID

F. Transporter's Phone

G. State Facility's ID

H. Facility's Phone

11. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	**I. Waste No.**
a.					
b.					
c.					
d.					

J. Additional Descriptions for Materials Listed Above

K. Handling Codes for Wastes Listed Above

15. Special Handling Instructions and Additional Information

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national governmental regulations.

Printed/Typed Name	Signature	Date Month Day Year

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date Month Day Year

18. Transporter 2 Acknowledgement or Receipt of Materials

Printed/Typed Name	Signature	Date Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	Date Month Day Year

EPA Form 8700-22 (3-84)

CONTACT YOUR LOCAL EPA COORDINATOR FOR USE AND DISTRIBUTION OF MANIFEST FORM

EPA Approach To Regulated Storage:
Storage is defined as the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere. EPA has determined that the requirements for storage facilities should be aimed at containment of the hazardous waste during the storage period. Under this scheme significant releases of hazardous waste will occur only under carefully controlled conditions where the facility owners, EPA, the States, and the public can be assured that human health and the environment will be protected.

The containment approach used in the storage regulations focuses on prevention of releases to the soil and to ground and surface waters. This containment strategy has been translated into a regulatory approach which requires a primary containment device designed to prevent leakage and overflow as long as the wastes will remain on site. Additionally, an inspection program is required to monitor deterioration in primary containment facilities so that repairs or replacement can be made before any contents are released to the environment, or failing that, to detect leaks before they result in significant contamination. Secondary containment devices are required where primary containment devices can be easily damaged and/or are difficult to inspect.

EPA Approach to Regulated Treatment:
Treatment operations are defined as any method, technique, or process designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or so as to render such waste nonhazardous, safer for transport, amenable for recovery, amenable for storage, or reduced in volume. EPA is currently developing additional standards for chemical, physical, and biological treatment facilities.

Summary of RCRA Facility Requirements:
The detailed facility requirements of RCRA are beyond the scope of this document. However, the various topics which these regulations address can be summarized as follows:

1. **Administrative and Non-Technical Requirements:**
    a. Waste Analysis - Detailed chemical analysis, waste analysis plan and documentation of testing procedures with specific requirements for each type of facility (i.e., landfill, impoundment, chemical processing, etc.)

    b. Security - Artificial or natural barriers with controlled entry or 24-hour surveillance and warning signs.

    c. Personnel Training - Classroom and/or experience requirements, annual review of training activities, records on individual employees and their training.

    d. Preparedness and Prevention - Alarm systems, emergency equipment, arrangements with local and state authorities, preparedness and contingency plans.

   - e. Manifest System Procedures - To comply with the "Cradle-To-Grave" Tracking System.
   - f. Operating Records Required by the Regulations - Manifest information, Waste Analysis Records, Testing and Analytical Data, Testing and Monitoring Records.
   - g. Reporting Requirements - Annual reports, reports on unmanifested waste, etc.

2. **General Facility Requirements:**
   - a. Facility Location Requirements - Special restrictions with respect to facilities located in earthquake fault, flood plain, etc.
   - b. General Operating Requirements.
   - c. Special requirements for ignitable, reactive, and incompatible waste.
   - d. Ground Water Monitoring.
   - e. Closure and Post-Closure Plans - For landfill, lagoons, etc., only.
3. **Specific Facility Requirements:**
   - a. Disposal of liquids in landfills or containers.
   - b. Control of run-off from waste piles, landfills, and land treatment facilities.
   - c. Land Treatment facilities' monitoring and restrictions on growing food chain crops.
   - d. Requirements for incinerators and treatment facilities.
   - e. Requirements for underground injection.

Requirements For EPA Approval Of Individual State Hazardous Waste Programs

RCRA provides the mechanism for implementing a hazardous waste management program operating under "Interim" approval from EPA. RCRA generally directs that to receive EPA "final" approval State Hazardous Waste Programs must be "Equivalent To And Consistent With" the Federal program. "Equivalent" is interpreted to mean "Equal In Effect." Thus, the Federal regulations provide *minimum* requirements while the states are allowed to set more stringent standards. However, states may not impose any requirement that might interfere with the free movement of hazardous wastes across state boundaries to treatment, storage, or disposal facilities holding a RCRA permit.

State programs must include the following:

a. Controls a nearly indentical list of wastes as is controlled by the federal program.

b. Cover all types of hazardous waste facilities in the state.

c. Be based on standards that provide the same or an increased degree of protection to human health and the environment as do the federal standards.

d. Be administered through procedures that are substantially equivalent to these used in the Federal program.

Enforcement of RCRA Regulations

Overview

Generally, the RCRA system of hazardous waste management has several means of enforcing its regulations.

RCRA contains methods for assuring that corporations and individuals comply with its technical standards by means of compliance orders, provisions for injunctive relief, civil penalties of up to $5,000 a day, and criminal penalties of as much as $250,000 or two years in jail. These penalties can be increased in the case of violations involving knowing endangerment of human life.

RCRA also provides authority to compel those owners and operators of treatment, storage, and disposal facilities, not previously subject to RCRA and not meeting the regulations, to monitor areas surrounding the site. Clean up of facilities can also be ordered where RCRA standards are not being met or have not been met in the past.

Under RCRA, the EPA Administrator may bring an action to enjoin any person handling, transporting, storing, treating, or disposing of hazardous waste from further activities with such materials where there may exist an imminent and substantial endangerment to health or the environment. This authority appears to provide for both negative and positive injunctive relief by which the court can order not only a cessation of activities but also direct measures which are felt necessary to prevent the threatened harm. Use of this "Imminent Hazard" provision could be coupled with the monitoring, testing, and analysis provisions to impose a substantial burden on facilities where violations are suspected. Many questions as to how this injunctive power can be used will have to await the test cases which are certain to occur within the next few years.

The liabilities which can result from violations of the RCRA requirements cannot all be insured by the policies currently available in the insurance marketplace. A Risk Manager who must plan his organization's response to these liabilities must determine how he will deal with all sources of liability which may arise under the Act.

EPA Enforcement

The EPA enforcement guidelines, to be followed by Regional Administrators with respect to interim status RCRA requirements, classify violations as Class I, II, or III:

> **Class I** - violations include those which pose a direct or immediate threat of harm to public health or the environment.

Class II - violations are those which reflect noncompliance with statutory requirements but which present no immediate danger.

Class III - violations include procedural violations which do not pose a threat to public health or safety.

Initially, only Class I or II violations will be enforced through the compliance provisions of RCRA. The EPA has also indicated its intention to pursue criminal penalties in cases involving egregious violations.

Hazardous Waste Violations

The Imminent Hazard provisions of RCRA have been utilized in an effort to broaden the Department of Justice/Environmental Protection Agency's control over hazardous waste management. These cases raise interesting questions with respect to what potential sources of pollution may be regulated by RCRA, who can be found liable for violations which occurred in the past, and who may bring suite under the Act. These cases also show that DOT and EPA have sought to establish a broad spectrum of possible relief where violations are shown to exist. In addition to negative injunctive relief where the order is given to stop certain activities which result in pollution, many cases have sought to have the defendant prevent further pollution by taking some positive action to reduce the immediate threat of harm. These measures include testing to determine the degree of contamination of ground water sources, monitoring and testing to determine the direction and rate of migration of the leachate plume, providing alternate water supplies and testing to establish the chemical content of discharges to anticipate probable consequences of chemical and byproduct reactions. The Department of Justice and the EPA have also asked the courts to order monitoring of waste disposal sites in perpetuity, remove improperly disposed wastes, provide site security, establish clean-up and maintenance trust funds, monitor the health of workers involved in clean-up operations and residents of neighboring communities, and reimburse the federal and state governments for testing and remedial activities. State enforcement of environmental protection laws has proceeded at the same pace as these federal actions.

CHAPTER V

Superfund - The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

Superfund - The Law at a Glance

General Intent

CERCLA, generally known as Superfund, provides a source of funds for emergency response to and clean-up of hazardous substances released into the environment. The emergency measures may be necessitated by a release or emission which is sudden or from a gradual, steady-state release. The government may then recover the costs of the clean-up operation if the persons responsible can be identified and have the financial capability of repaying the expenses. A second fund is created to accept a transfer of the post-closure maintenance costs and liability for waste disposal sites managed in accordance with the provisions of RCRA. Taxes on oil refineries, hazardous chemicals manufacturers, and waste disposal facilities will provide the finances required to operate these two funds.

Major Provisions

The major provisions under the Superfund legislation for controlling environmental impairment due to the release of hazardous substances are:

1. **Identification of Hazardous Waste Disposal Sites**
   The Act requires owners of active or abandoned waste disposal facilities to notify the EPA of the existence of such facilities and the amount and type of substances to be found there. From this notification procedure, the EPA is ordered to evaluate the existing facilities to determine which present a danger of environmental damage.
2. **Occurrences for Which Notification is Required**
   The legislation established criteria for identifying quantities of hazardous materials, the release of which will require notification of the National

Response Center, established under the Clean Water Act. Releases may originate from a land facility where hazardous substances are generated, stored, treated or disposed, or from a vessel or other means of transportation. Upon receipt of notification of a discharge, the EPA, in conjunction with the state where damage has occurred or is threatened, and the owner of the facility, will determine that response is required and how it will be provided.

3. **Emergency Response Fund**
The Act provides for the establishment of a $1.6 billion fund for payment of removal and remedial actions and for compensation for damages to natural resources resulting from the release of harmful substances into the environment. This fund will be developed from a tax on oil, on forty-two specific chemical compounds, and from general tax revenues. When the government expends money from this fund, it is subrogated to the rights of claimants against an owner or operator of a vessel or facility to recover the costs of any remedial actions.

4. **Post-Closure Liability Fund**
A second fund of $200 million is to be created to assume the post-closure liability for hazardous waste disposal facilities which have been operated and closed in accordance with the permit system and regulations under RCRA. Monies from the fund may be used for monitoring the area surrounding the site as well as for paying the costs associated with claims arising from a release of hazardous materials from a site for which liability has been assumed. A tax on hazardous waste facilities, imposed on shipments received after September 30, 1983, will provide the source of funds for the Post-Closure Liability Trust.

5. **Limitation on Liability**
The liability for damage to natural resources of owners and operators of vessels, off shore and on shore facilities responsible for discharges is limited under Superfund to the following amounts:

   a. For vessels carrying hazardous substances as cargo or residue — $300 per gross ton or $5 million.

   b. Any motor vehicle, rolling stock, aircraft, or pipeline — $50 million.

   c. Any other facility — $5 million.

   It should be noted that the liability for clean-up and remedial action is not limited by the Act.

6. **States' Role in Operation of Superfund**
The Superfund legislation does not preempt state liability laws or other laws that set forth requirements for controlling hazardous substances. The states are not expected to operate the federal Superfund program but may establish a similar program on a state level. Emergency response by the federal government cannot be affected without consultation with the state in which damage occurs or is threatened.

Financial Responsibility

Financial responsibility requirements for facilities involved in the production, transportation, treatment, storage, or disposal of hazardous substances are to be established by regulations consistent with the degree of risk associated with the particular operation. The earliest of these regulations would not become effective before December 11, 1988.

Motor carriers are to establish evidence of financial responsibility as determined by the provisions of the Motor Carrier Act of 1980.

Analysis of Major Superfund Provisions

Identification of Hazardous Waste Disposal Sites and Occurences

A hazardous substance under Superfund is defined as a substance designated as a pollutant or contaminant under other federal legislation including the Federal Water Pollution Control Act, the Clean Air Act, the Solid Waste Act and the Toxic Substances Control Act. The Act also charges the EPA with responsibility to promulgate other regulations which will designate additional hazardous substances other than those identified in other federal enactments. Penalties of up to $10,000, or imprisonment for up to one year, or both may be imposed for failure to report a release.

Superfund legislation also requires persons who own or operate, or who at the time of disposal owned or operated hazardous waste disposal facilities to notify the EPA of the existence of such facilities. This reporting requirement also extends to transporters who accept or have accepted hazardous substances, and who select or were responsible for selection of a facility for treatment, storage, or disposal. In addition to the existence of such a site, the owner, operator, or transporter must also report the amount and type of substances to be found there and any known, suspected, or likely releases of such hazardous substances from the facility. Failure to comply with this provision may result not only in a fine or imprisonment as stated above, but may also cause a person who knowingly fails to provide the required notice to lose the protection of a limit on liability created under the Act as well as the defenses to liability.

There is a further provision which prohibits the knowing destruction of any records which contain information with respect to the location, title, or condition of a disposal facility and the identity, characteristics, quantity, origin or condition of any hazardous substance deposited in a facility when such records were created pursuant to regulations promulgated under the Act. Such records must be retained for a period of fifty years.

Emergency Response Fund

The Superfund legislation provides for the establishment of an Emergency Response Trust Fund of $1.6 billion for payment of removal costs of remedial actions, and for compensation for damages to natural resources resulting from the release or substantial threat of release into the environment of any "pollutant" or "contaminant" that may present an imminent and substantial danger to the public health, welfare, or environment. Pollutants and contaminants include any elements, substances, compounds, or mixtures which, after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, will, or may reasonably be anticipated to, cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions, or physical deformations in any organism or their offspring.

The response may include investigations, monitoring, surveys, and tests to determine the existence and extent of the release, the source or nature of the hazardous substances, and the extent of danger to the public or environment. EPA inspectors or other government officials may enter any facility where hazardous substances are or have been generated, transported, stored, treated, or disposed of, to inspect and obtain samples of any such substance. Reports, records, or other information obtained will be available to the public, unless otherwise proven that it should be protected as confidential.

In addition to a response action taken to remove a hazardous substance already released or where release is imminent, the Superfund legislation provides authority for the President to require the Attorney General to secure relief necessary to abate an imminent and substantial hazard to the public health or environment. The federal district court in the district where the threat occurs will have jurisdiction to grant the relief requested if it is determined that abatement is required.

The Act also provides for a revision of the National Contigency Plan, originally prepared pursuant to Section 311 of the Federal Water Pollution Act, to reflect the new responsibilities of the EPA, the President, and the states under Superfund.

The procedures and standards for responding to releases of hazardous substance covered by the revised national plan will include the following:

1. Methods for discovering and investigating facilities where hazardous sustances have been disposed or otherwise come to be located.
2. Methods for evaluating and remedying any release, or threatened release, including the relative cost of alternative remedial actions and the cost effectiveness of such actions.
3. Methods and criteria for determining the appropriate extent of removal, remedy, and other action.
4. Appropriate roles for the federal, state, and local governments and for interstate as well as nongovernmental agencies and entities.
5. Provision for identification, procurement, maintenance, and storage of emergency response equipment and supplies.
6. Method for reporting releases on federally owned or controlled properties.
7. Criteria for ranking priorities in response where more than one emergency may exist.

The National Contingency Plan also requires the listing of top priority sites for clean-up and remedial action. The National Priorities List (NPL) of Ranked Sites is included in Appendix F.

Post-Closure Liability Fund

A second fund of $200 million is to be created under the Superfund legislation. This fund will assume the post-closure liability for hazardous waste disposal facilities which have been operated and closed in accordance with the permit system. Facility operators who have provided monitoring of the area surrounding the site and can demonstrate that there is no substantial likelihood of migration off site or release of hazardous substances from confinement may apply for transfer of their liability five years after closure.

Sources of Funds for Response and Liability Trusts

The $1.6 billion Emergency Response Trust Fund will be made up over a period of five years from an estimated $1.3 billion of environmental taxes imposed on the operators of refineries receiving, using, or exporting crude oil, and from a tax on manufacturers, producers, or importers of 42 listed chemicals.

The Post-Closure Liability Trust Fund is to be created from a tax imposed on the facilities which dispose of hazardous wastes under the permit system. If private insurance becomes available to cover the liabilities imposed on owners and operators of hazardous waste facilities for post-closure monitoring and maintenance, they may avoid payment of the taxes on all wastes received after the date on which such coverage is purchased and becomes effective.

Liabilities Under Superfund

The liabilities created by the Superfund legislation arise primarily with respect to the operation of the Emergency Response regulations rather than with the Post-Closure provision. The Act does not excuse responsible persons from liability for actual or threatened releases of hazardous substances into the environment. The fund is intended only for the action required in emergency situations. When money is expended from the Emergency Response Trust Fund by the U.S. Government, it is subrogated to all rights of claimants against owners or operators of vessels and offshore or land-based facilities to recover all costs associated with clean-up of releases of hazardous substances and damage to natural resources.

Under Superfund a new federal cause of action is created by which owners and operators of facilities releasing or threatening to release hazardous substances may be held liable for the damages resulting from a discharge or the cost of actions taken to prevent a discharge. This liability extends also to persons who at the time of disposal of hazardous substances owned or operated the facility where such materials were disposed, persons who contracted for or otherwise arranged for disposal, transportation, or treatment of hazardous substances, and the person(s) who accepts or accepted such substances for transport to disposal facilities which the transporter selected and from which there was or is a release or threatened release. This provision is broad enough to include persons in any of these categories whose past actions may have violated the standards of the Superfund legislation.

Persons found liable under Superfund may be responsible for the costs associated with:

1. Federal, state, and local government removal or remedical actions.
2. Response costs as spelled out in the National Contingency Plan of the Water Pollution Control Act, as may be appropriate for the responsible persons to bear.
3. Damages to natural resources caused by releases occurring after the enactment of Superfund.

There are no provisions in the legislation for compensation for individual, third party damages such as the property damage, personal injury or loss of use of property experienced by those affected by the release of hazardous substances into the environment. A few states do provide for personal injury damages. Third persons, however, are not barred from bringing suit against the owners and operators of vessels and offshore or onshore facilities for such damages under other federal or state laws.

Defenses and Limitations of Liabilities Under Superfund

There are only a few defenses recognized under the Superfund legislation:

1. An Act of God
2. An Act of War
3. An Act or Omission of a Third Party other than an employee of or a person having a contractual relationship with the owner or operator of a facility from which a hazardous substance was released under certain circumstances.

Where a third party is found to have been the sole cause of the release, the owner or operator must establish that due care has been exercised with respect to the hazardous substance involved and that precautions were taken against foreseeable acts or third party omissions and are the forseeable consequences of such acts or omissions. While the provisions in the Act do not expressly state that joint and several strict liablility is intended, the legislative history indicates that it was the intent of Congress to apply such liability to all parties who may be responsible. Ultimate resolution of this question will require interpretation by the courts.

Limits of Liability

Superfund provides limits to the liability of owners and operators of vessels, and offshore and onshore facilities responsible for discharges. The limits for vessels carrying any hazardous substances such as cargo or residue are the greater of $300 per gross ton or $5,000,000. For any other vessel, the limits are the greater of $300 per gross ton or $500,000. The limit for motor vehicles, aircraft, pipelines, or rolling stock is $50,000,000 or such lesser amount as may be established by regulation, but in no event less than $5,000,000. The minimum liability where a spill of hazardous substances into navigable waters is involved is $8,000,000. For any facility other than those identified above, the limit of liability is $50,000,000 plus all costs of removal. The unlimited liability for removal costs and the extremely liberal conditions under which the limitations on liability may be breached will be a most difficult aspect for risk managers of facilities subject to Superfund to deal with.

Unlimited Liability

There are other conditions which can lead to an owner or operator of a facility or vessel losing the limitations on liability specified in the legislation. Unlimited liability will be imposed if:

1. The release or threat of release of a hazardous substance is the result of willful misconduct or willful negligence within the privity or knowledge of the owner or operator.
2. The primary cause of the release is a violation of applicable safety, construction or operating standards or regulations.
3. The owner or operator fails or refuses to provide all reasonable cooperation and assistance requested by responsible officals in connection with response activities under the National Contigency Plan.

Treble Damages

In addition, punitive damages of up to three times the costs incurred by the Emergency Response Trust Fund may be imposed if owners or operators of facilities or vessels responsible for a release refuse to provide remedial or removal action upon order by the federal government.

Financial Responsibility Provisions of Superfund

The owners or operators of vessels over 300 gross tons using any port or offshore facility of the United States or within its navigable waters must establish and maintain evidence of financial responsibility of the greater of $300 per gross ton or $5,000,000. This may be established by insurance, guarantee, surety bond, qualification as a self-insurer, or any combination of these means.

Motor carriers are to establish evidence of financial responsibility as determined under Section 30 of the Motor Carrier Act of 1980. The regulatory requirements for motor carriers were published by the Department of Transportation. These rules require owners or operators of vehicles with a gross weight of 10,000 pounds to show evidence of financial responsibility with a level of $5,000,000 for the transportation of hazardous materials and $750,000 for all other transporters.

Certain aspects of the Superfund legislation provide disincentives to insurers who might be asked to consider covering the liabilities of owners or operators of vessels or facilities. The Act contains a direct action provision that allows any claim against the insurer or guarantor providing evidence of financial responsibility. Since guarantors are not allowed to assert any defenses which would not be available to the owner or operator, insurers will have to carefully assess their willingness to underwrite the liabilities created by Superfund.

A further disincentive to insurers is the potential for liability in excess of the policy limits upon a finding that they did not act in good faith in handling the claims asserted against them as a guarantor. This possibility arises under Section 108(d) of the Act which limits the liability of an insurer to the monetary limits of the policy where he has acted in good faith. It is not entirely clear what is meant by this condition, but the floor debate in the House of Representatives has indicated that its purpose was to preserve the common law or contractual liability of an insurer to his insured. This could result in an insurer becoming liable for all claims authorized by the Act and covered by the policy.

States' Role in the Operation of Superfund

Superfund does not preempt state liability laws or other laws that set forth requirements with respect to the release of hazardous substances into the environment. However, no person receiving compensation under the provisions of the Act can claim recovery for the same claim under other federal or state laws. Superfund also eliminates duplicate state compensation funds and financial responsibility requirements.

With respect to actions taken pursuant to the emergency response provisions, the law specifies that states must be notified and consulted before the federal government begins to clean up a site from which a discharge has occured or is threatened. Barring an emergency where necessary abatement is not likely to be provided by others, the federal government cannot continue after $1,000,000 has been spent or six months have elapsed, unless the state agrees to pay a part of the cost. A state's share will be 10 percent if the site is privately owned and 50 percent if the site is owned by the state or a local government. In a case where clean up is mandated, the state must assure the EPA of off site disposal in a federally approved facility.

CHAPTER VI

Insuring the Environmental Impairment Liability Risk

RCRA Liability Coverage Requirements List

1. Coverage is for bodily injury and property damage to third parties caused by accidental occurrences arising from operations of hazardous waste management facilities.
2. All facilities involved in the EPA regulatory system must have coverage for sudden accidental occurrences.
3. Surface impoundments, landfills, and land treatment facilities must also have coverage for non-sudden or gradual accidental occurrences.
4. Minimum amounts:

   For Sudden Accidental Occurrence —

   $1 million per occurrence
   $2 million annual aggregate

   For Non-Sudden Accidental Occurrences —

   $3 million per occurrence
   $6 million annual aggregate

   (Higher limits should be considered for most facilities).
5. Coverage may be demonstrated by:

   Proof of insurance (policy endorsement or certificate of insurance with exact wording prescribed in regulations);

   Passing the financial test for liability coverage;

   Part of coverage may be shown using the test, and the rest with insurance. (See Financial Test Alternative 1)

6. Requirements for non-sudden occurrences is phased in over three years:

   January 6, 1983 - owners or operators with sales of $10 million or over.

   January 6, 1984 - those with sales of $5-$10 million.

   January 6, 1985 - remainder.
7. Insurance must meet the following requirements:

   Required amounts of coverage must be exclusive of defense costs.

   Insurer must be licensed or eligible as excess or surplus lines underwriter; a Best Rating should be obtained;

   Insurer operates in one or more states;

   Insurers must notify EPA or the governing state when the insurance is to be cancelled or terminated.

FINANCIAL TEST ALTERNATIVE 1

1. Amount of annual aggregate liability coverage to be demonstrated ____________

2. Current assets ____________

3. Current liabilities ____________

4. Net working capital (line 2 minus line 3) ____________

5. Tangible net worth ____________

6. If less than 90% of assets are located in the U.S., give total U.S. assets ____________

YES NO

7. Is line 5 at least $10 million? ______ ______

8. Is line 4 at least 6 times line 1? ______ ______

9. Is line 5 at least 6 times line 1? ____________

10. Are at least 90% of assets located in the U.S.? If not, complete line 11. ____________

11. Is line 6 at least 6 times line 1? ____________

Environmental Impairment Liability Insurance

The 1973 Standard Comprehensive General Liability Exclusions

In 1973, a new standard CGL form was adopted throughout the insurance industry. This form excluded pollution under the following terms:

> It is agreed that the insurance does not apply to bodily injury or property damage arising out of the discharge, dispersal, release or escape of smoke, materials or irritants, contaminants or pollutants into or upon land, the atmosphere, or any watercourse or body of water, but this exclusion does not apply if such discharge, dispersal, release or escape is sudden and accidental.

This is the wording found in virtually all CGL policies written by the carriers which make up the U.S. domestic marketplace. It excludes coverage for claims arising from damage that results from gradual leakage or the steady-state discharge of pollutants.

Introduction of EIL Insurance

In 1975 Environmental Impairment Liability (EIL) policies designed to fill some of the gaps in the CGL were first introduced by the insurance carriers. Although this coverage does nothing directly to solve the pollution problems facing the health care industry, it provides a way to distribute the costs of gradual environmental impairment and allows the industry to continue to seek long-range solutions to environmental problems without unnecessary interruptions of key procedures involving hazardous materials.

Insuring Agreement

A typical insuring agreement of an EIL policy in its current form typically contains the following provisions:

1. To pay on behalf of the Insured all sums which the Insured shall become obligated to pay for damages as a result of claims first made against the Insured during the policy period or within the discovery period, if applicable for:
    a. Personal Injury;
    b. Property Damage;
    c. Impairment or diminution of or other interference with any other environmental right or amenity protected by law;

   caused by Environmental Impairment and arising out of, or in the course of the Insured's business and/or locations, both as specifically designated in the Policy Declarations.
2. The Insurer shall further reimburse the Insured for costs and expenses of operations designed to remove, neutralize or clean up outside of the Insured's premises any substance released or escaped which has caused or

could cause Environmental Impairment if not removed, neutralized or cleaned up to the extent that such costs and expenses have become payable by the Insured as a result of a legal obligation or in an endeavor to avert a loss covered by this policy, provided that such costs and expenses, except in respect of emergency measures undertaken to avert loss, are incurred with prior written consent not to be unreasonably withheld.

Costs, as used in these provisions, have been interpreted as also including legal and defense expenses associated with environmental claims.

Recent legislation which contains financial responsibility requirements has prompted the underwriters to modify the insuring agreements to allow recovery of defense costs in addition to the limit of liability. The most recently introduced forms include a further provision which generally reads as follows:

3. In addition to the applicable limit of liability stated in Policy Declarations, the Insurer shall, with respects to the coverage afforded by this policy, pay for defense costs and expenses incurred from the defense of any suit against the Insured including appeal thereof. The Insurer shall further have the right and duty to defend such suits whether or not the allegations of such suits are goundless, false, or fraudulent and may make such investigation and settlement of any claim or suit as it deems expedient.

Definition of "Environmental Impairment"

One of the key provisions of the EIL policy is its definition of Environmental Impairment. The most recent forms use the following two part definition:

1. The emission, discharge, dispersal, disposal, seepage, release, or escape of any liquid, solid, gaseous or thermal irritant, contaminant or pollutant into or upon land, the atmosphere, or any watercourse or body of water.
2. The generation of smell, noises, vibrations, light, electricity, radiation, changes in temperature or any other sensory phenomena, arising out of or in the course of the Insured's operations, installations or premises as designated in the Declarations.

Typical Exclusions from the EIL Policy

The broad scope of this coverage is then narrowed by exclusions which make the EIL policy an appropriate complement to the CGL policy. Together these policies provide protection against both sudden and gradual releases which result in environmental impairment. Some of the exclusions typically found in the EIL policy include:

1. War, invasion, acts of foreign enemies, confiscation, nationalization, etc.
2. Liability arising from nuclear contamination or radiation (sometimes limited to claims involving only nuclear fuels, fuel wastes or explosive devices).
3. Liabilities under Worker's Compensation Law or personal injury to any employee of the Insured arising out of and in the course of employment.

4. Liability for environmental impairment which results from a known violation of a valid statute, regulation or written instruction relating to environmental impairment.
5. Fines or penalties imposed under statute, sometimes punitive damage.
6. Liability for or costs associated with:
   a. Correcting pre-existing conditions at owned, leased, or rented premises.
   b. Clean up operations considered to be routine.
   c. Upgrading, monitoring, neutralizing, restoring, land-filling, cleaning-up, or inactivating any waste disposal site.
7. Dumping of toxic or radioactive substances into the open sea.
8. Liability arising from Environmental Impairment due to sudden, unintended and unexpected happenings (covered under a CGL policy).
9. Contractual liability.
10. Products' and completed operations' liability.
11. Liability in respect of damage to property owned, occupied, rented or used by the Insured, or in the care, custody, and control of the Insured.

Risk Assessment Requirements

The underwriter may require a detailed, technical risk assessment survey of a prospective Insured's premises and operations prior to the inception of coverage and, in most cases, prior to presenting a quotation for coverage. The survey includes an examination of the operations involved, the current state of technical knowledge of the substances being used, the current state of compliance with applicable environmental regulations and the ability of management regarding pollution control. In most instances, this cost will be borne by the prospective Insured, but a portion may be deducted from the first years' premium if coverage is purchased.

Hospitals have been generally accepted by underwriters without having to undergo the risk assessment process.

While Environmental Impairment Liability Insurance is designed to assist the health care industry comply with the financial requirement provisions of RCRA, the Superfund Act, and the various state Acts, and to afford protection against the liability for environmental impairment which exists under federal and state legislation and common law, it should not be regarded as complete protection against the liability which may be imposed for pollution damage. In the first place, the limit of liability available in the marketplace may be inadequate to pay for all liability imposed by the federal legislation. Cleanup costs under Superfund, for example, are not limited under the Act. Punitive and exemplary damages and fines are not recovered under most EIL policies. Coverage for damage to the Insured's own property and claims resulting from bodily injury to employees are also excluded. Some policies also exclude genetic damage and antenatal injury.

It is apparent that giving consideration to the purchase of insurance coverages for environmental impairment is only one of the steps which the Risk Manager must take to deal with the potential liability exposures arising from the use of hazardous and infectious substances. The risk management plan should also include analysis of operations to identify hazards, quantify the exposures, develop safety and loss control procedures, keep proper records, train employees, and monitor the program's implementation effectiveness.

EIL Policy Form Comparison

A chart is provided in the following section. Five EIL Insurance markets were selected to illustrate differences in coverages, policy terms, conditions, exclusions, etc. No claims are made as to the current accuracy of this information by individual underwriting companies, and is not a substitute for carefully reviewing your own issued policy as specific terms and conditions may differ from those shown.

Environmental Impairment Liability Policy Form Comparison (as of 11/1/83)

1. Underwriter	International Surplus Lines Insurance Company	Evanston Insurance Company	Pacific Insurance Company	Great American Surplus Lines Company	The Hartford Insurance Comapny
2. Broker/Company	2. London/Wigham Poland Howden Agencies.	2. Shand, Morahan & Co.	2. Swett & Crawford.	2. Stewart Smith.	Hartford Specialty Company
3. 1983 Best's Rating	3. A XII	3. A XII	3. A+ XIV	3. A+ XI	3. A+XV
4. Basic Coverages:					
a. General Form	a. Claims made.	a. Claims made.	a. Claims made.	a. Claims made.	a. Claims made.
b. Coverage For	b. BI/PD/Clean Up caused by Environmental Impairment in connection with the business of the Insured at the locations specified.	b. BI/PD/Clean Up caused by Environmental Impairment in connection with the business of the Insured and is a sustained after the retroactive date.	b. BI/PD/Clean up caused by Environmental Impairment arising out of or in the course of the Insured's business and/or locations as specifically designated in Declarations page.	b. Loss as a result of claims for Environmental Impairment occurring during the policy period, excluding pollution intended or expected by Insured.	b. All sums the Insured is legally obligated to pay as damages for BI/PD/Clean Up which are caused by pollution hazard neither intended nor expected by the Insured.
c. Extended Discovery Period	c. If policy cancelled or non-renewed by Co., named Insured shall have the right to extend the reporting provisions if requested within 30 days of cancellation & additional premium is paid, except for non-payment. Claims must arise from impairment which occurred prior to cancellation effective date.	Not offered.	c. If policy non-renewed by Co., 6 month extension may be granted at Insurer's discretion for premium to be agreed. Claims must arise from impairment which occurred prior to expiration/cancellation date of the policy.	c. Except for cancellation by non-payment of premium, insured is entitled to 12 month extension upon payment of an A.P. of 25% of premium shown on Declarations. For the purpose of continued reporting of claims existing or originating during the policy period.	c. Usually annual. (i) If policy cancelled or non-renewed by Co. for any reason (except non-payment of premium) the insured may elect for a A.P. not to exceed 50%. Claims must have been caused before the cancellation date.
(ii) Retroactive Date Offered?	(ii) Full retroactive coverage.	(ii) Yes, back to incorporation.	(ii) Yes.	(ii) No.	(ii) Yes, back to incorporation.
d. Indemnity or Pay on Behalf of Insured	d. To idemnify.	d. To pay on behalf of.	d. To pay on behalf of.	d. To indemnify.	d. To pay on behalf of.
e. Limits of Liability	e. 20,000,000 any one claim, 40,000,000 aggregate.	e. 30,000,000 any one claim, 60,000,000 aggregate.	e. 10,000,000 any one claim, 20,000,000 in the aggregate.	e. 15,000,000 any one claim, 30,000,000 aggregate.	e. 10,000,000 any one claim, 20,000,000 aggregate.
f. Minimum Deductible	f. 2,500 per claim.	f. 5,000 per claim.	f. 2,500 per claim.	f. 10,000 per claim.	f. No min. deductible.
g. Minimum Premium	g. 2,500	g. 5,000	g. 2,500	g. 1,000 (1mm/2mm)	g. No min. premium.
h. Premium Computation	h. May be adjustable with annual reporting of exposure.	h. Not specifically addressed.	h. May be adjustable with exposure.	h. Not specifically addressed.	h. "Advance Premiums" are deposit only and may be adjustable depending on exposure.
i. Insuring Agreement:					
(i) Personal Injury	(i) Yes.	(i) Yes.	(i) Yes.	(i) Yes.	(i) No, BI only.
(ii) Property Damage	(ii) Yes.	(ii) Yes.	(ii) Yes.	(ii) Yes.	(ii) Yes.

Environmental Impairment Liability Policy Form Comparison (as of 11/1/83)

Underwriter	International Surplus Lines Insurance Company	Evanston Insurance Company	Pacific Insurance Company	Great American Surplus Lines Company	The Hartford Insurance Comapny
(iii) Impairment or Dimunition of Enjoyment or other Interference.	(iii) Yes.	(iii) Yes.	(iii) Yes.	(iii) Yes.	(iii) No.
j. Defense Costs included in Limit of Liability	j. Yes.	j. Yes.	j. No - "Unlimited" Defense costs for full defense posture if settlement or judgment awarded and pd. Co. may drop further defense.	j. Yes.	j. No - In addition to applicable limit of liability - Co. will pay all expenses for defense.
k. (i) Off Premises Clean Up	(i) Yes, with prior written consent of Underwriters.	(i) Yes, with prior written consent of Underwriter.	(i) Yes, with prior written consent.	(i) Yes, under definition of loss, clean up costs.	(i) Yes, by government action or prior written agreement at sole discretion of Company.
(ii) On Premises	(ii) No, PD exclusion of CCC.	(ii) No, excluded.	(ii) No, PD exclusion under CCC.	(ii) Yes, up to 10% of limit.	(ii) P.D. & environmental damage excluded on premises question as to clean up costs.
l. Supplementary Pymts.	l. No further reimbursement specifically addressed in policy.	l. No further reimbursement specifically addressed in policy.	l. No further reimbursement specifically addressed in policy.	l. No further reimbursement specifically addressed in policy.	l. All costs taxed against Insured in any suit defended, interest on judgments, premiums on appeal bonds, first aid expenses incurred by Insured at Co. request including lost earnings not to exceed $100/day.
m. Territorial Limits	m. Negotiable & Named in Declarations page.	m. Claims brought in US or Canada arising from EIL in US or Canada.	m. Claims arising from & brought in US or Canada.	m. Claims arising from & brought in US or Canada.	m. Pollution caused by & arising from Insured site on land in US, Puerto Rico & Canada.
n. Policy Definitions:					
(i) Environmental Impairment:					
a. Caused by discharge release, dispersal, etc. of any solid, liquid, gas or thermal contaminant, irritant, pollutant into the environment.	a. Yes, land, atmosphere, watercourse, or body of water specifically mentioned.	a. Yes, land, atmosphere, watercourse, or body of water specifically mentioned.	a. Yes, land, atmosphere, watercourse, or body of water specifically mentioned.	a. Yes, land, atmosphere, watercourse, or body of water specifically mentioned.	a. Yes, by pollution hazard definition.
b. Also generation of smells, noise, vibrations, light, electricity, radiation, changes in temperature & any other sensory phenomona.	b. Yes, but not fire or explosion. Arising out of or in the course of Insured's operations, installations, or premises as designated.	b. Yes.	b. Yes. Arising out of or in the course of Insured's operations, installations, or premises as designated.	b. Yes. Arising out of Insured's operations, provided either are gradual, fortuitous, neither expected nor intended.	b. No.

Environmental Impairment Liability Policy Form Comparison (as of 11/1/83)

Underwriter	International Surplus Lines Insurance Company	Evanston Insurance Company	Pacific Insurance Company	Great American Surplus Lines Company	The Hartford Insurance Comapny
(ii) Claim - Any single claim or series of claims from 1 or more claimants resulting from an ISO-related, repeated or continuing environmental impairment.	(ii) Yes.	(ii) Demand for money or services, including service of suit 2 or more claims arising out of each environmental impairment shall be treated as one claim. (See Multiple Insureds, Claims, page 3, paragraph 3).	(ii) Yes.	(ii) Loss defined as monetary awards, or settlement of damages or costs, expenses incurred in defense; loss arising from related circumstances, or from one site shall be considered a single loss. (See page 3, paragraph 6, Limit of Liability).	(ii) "Occurrence" defined as an accident including continuous or repeated exposures to substantially the same general conditions.
(iii) Insured Site:					
a. The specific location named in deepage	a. Operations, installations, premises as designated (in EIL definition).	a. Yes. Operations, installations, premises as designated (in EIL definition).	a. Operations, installations, premises as designated (in EIL definition).	a. Insured's premises & operations mentioned in EIL definition, no scheduling language.	a. Yes.
b. Any site on land to which wastes are legally consigned by Named Insured and is permitted by governmental authority.	b. Not specifically defined waste disposal site excluded in policy however, EIL arising away from any such premises or outside of disposal site is covered. (See exception to Exclusion 6).	b. Not included as an insured site, waste disposal sites specifically excluded.	b. Not included in definition waste disposal site specifically excluded; however, EIL which occurs away from or outside of such premises could be covered.	b. Waste disposal site specifically excluded; however, EIL which occur away from the waste disposal site is covered. (See exception to Exclusions L & M).	b. Yes.
o. Named Insured:	o. Unqualified work "Insured".	o.	o.	o.	o.
(i) Directors, Officers, Shareholders, Partners.	(i) Yes, if partnership named.	(i) Yes, if partnership named.	(i) Yes, if partnership named, include partner.	(i) Yes.	(i) Yes.
(ii) Employees	(ii) Yes.	(ii) Yes.	(ii) Yes.	(ii) Yes.	(ii) Yes.
(iii) Personal Reps.	(iii) Yes.	(iii) Yes, legal reps.	(iii) Not mentioned, trust officer or estate administrator.	(iii) Legal reps.	(iii) Not mentioned.
(iv) Heirs	(iv) No, Estate Trustee named.	(iv) Yes.	(iv) Not mentioned, trust officer or estate administrator.	(iv) Yes.	(iv) Not mentioned.
(v) Real Estate Manager	(v) Yes.	(v) Not mentioned.	(v) Yes.	(v) Not mentioned.	(v) Not mentioned.
p. Policy Exclusions:					
(i) War	(i) Yes, except in U.S. or Canada.	(i) No specific excl.	(i) Excluded.	(i) Excluded.	(i) Not excluded.
(ii) Nuclear	(ii) Yes, excluded.	(ii) No specific excl.	(ii) Excluded.	(ii) Excluded.	(ii) Excluded - Broad form exclusions.

Environmental Impairment Liability Policy Form Comparison (as of 11/1/83)

Underwriter	International Surplus Lines Insurance Company	Evanston Insurance Company	Pacific Insurance Company	Great American Surplus Lines Company	The Hartford Insurance Comapny
(iii) W.C. including P.I. to employees arising out of and in the course of employment.	(iii) Yes, excluded.	(iii) Yes, excluded.	(iii) Excluded.	(iii) Excluded.	(ii) Excluded.
(iv) Knowing noncompliance with any statute, etc., for EIL.	(iv) Excluded.	(iv) Excluded.	(iv) Excluded.	(iv) Willful or deliberate noncompliance excl.	(vi) Not specifically excluded; however, intended or expected exclusion probably operative.
(v) Sudden & Accidental Environmental Impairment	(v) Excluded.	(v) Excluded - may be bought back.	(v) Excludes sudden, unintended & unexpected happenings.	(v) Excluded.	(v) Not excluded.
(vi) Ownership, possession, operations or use of:					
a. Automobiles	a. Excluded.	a. Excluded - may be bought back.	a. Excluded.	a. Not excluded.	a. Not excluded.
b. Watercraft	b. Excluded.	b. Excluded - may be bought back.	b. Excluded.	b. Not excluded.	b. Not excluded.
c. Aircraft	c. Excluded.	c. Excluded - may be bought back.	c. Excluded.	c. Not excluded.	c. Not excluded.
(vii) Products/Completed Operations Hazards.	(vii) Excluded.	(vii) Excluded.	(vii) Excluded.	(vii) Excluded.	(vii) Not excluded.
(viii) Contractual Liability	(viii) No.	(viii) Excluded - may be bought back.	(viii) Excluded.	(viii) Excluded.	(viii) Excluded.
(ix) Property owned, used or occupied or otherwise in the Care, Custody, or Control of the Insured.	(ix) Excluded.	(ix) Excluded - may be bought back.	(ix) Excluded.	(ix) Excluded.	(xi) P.D. & Environmental damage excluded.
(x) Genetic or Antenatal damage to humans or animals.	(x) Excluded - may be bought back.	(x) Not excluded.	(x) Not excluded.	(x) Not excluded.	(x) Not excluded.
(xi) Joint & Several Liability	(xi) Covered by specific clause in insuring agreement, including contractual obligation.	(xi) Insuring agreement says "all sums" contractual may be excluded. Policy is silent on specific issue.	(xi) Insuring agreement says "all sums" legally obligated to pay. Policy is silent on specific issue.	(xi) Loss means monetary awards or damages incurred by Insured with contractual excluded. Policy is silent on specific issue.	(xi) All sums legally obligated to pay. Policy silent on specific issue.
(xii) Punitive Damages Fines, Penalties	(xii) Fines, penalties named only.	(xii) Fines, statutory penalties excluded by definition of damages.	(xii) Punitive damages & exemplary damages excl. in insuring agreement, fines, penalties are exclusions.	(xii) Fines, penalties excluded by definition of loss.	(xii) a Not excluded where allowed by law. b Excluded.

Environmental Impairment Liability Policy Form Comparison (as of 11/1/83)

Underwriter	International Surplus Lines Insurance Company	Evanston Insurance Company	Pacific Insurance Company	Great American Surplus Lines Company	The Hartford Insurance Comapny
(xiii) Costs or Expenses incurred in connection with:					
a. Pre-existing Conditions at any Premises owned, leased or rented by Named Insured.	a. Excluded.	a. Excludes any conditions on premises of Insured.	a. Excluded.	a. Excluded.	a. Excluded by C.C.C.
b. Any cleaning up reasonably regarded as normal.	b. Excluded.	b. Excludes maintenance operations.	b. Excluded.	b. Excluded.	b. Excluded by definition on Company's sole discretion.
c. Upgrading, monitoring, neutralizing, restoring, landfilling, cleaning up or inactivating any waste disposal sites used either directly by the Insured unless designated in the Declarations page.	c. Excluded, not providing scheduling caveat in basic form.	c. Excluded with no provision for scheduling.	c. Excluded with no scheduling provision.	c. Clean up of waste disposal site of Insured closed prior to effective date; clean up of an non-owned disposal site.	c. Not excluded for BI, PD, Environmental Damage excluded by definition of Insured site exclusion question on Clean Up, BI as to operation of Environmental Damage Exclusion.
(xiv) Dumping toxic wastes into international waters.	(xiv) Excluded.	(xiv) Excluded.	(xiv) Excluded.	(xiv) Excluded.	(xiv) Excluded by policy territory.
5. Engineering Survey Required?	5. Yes.	5. Yes, will give indication subject to.	5. Yes, but will usually give indication subject to survey.	5. 99% of applications usually will not require survey - underwriter's discretion.	5. Yes, Co. will usually give indication subject to survey.
6. Reimbursement of Survey Costs?	6. Underwriters generally agree to reimbursement up to a limit with policy.	6. No, fee not built into premium, presumably some consideration is given.	6. Yes, up to 10% of premium or cost of survey, whichever is less.	6. No.	6. Credit may be allowed depending on risk.
7. Accept Engineering of Other Independents?	7. Not usually - must use ERAS - Environmental Risk Assessment Service, Boston.	7. Prefer Clement & Assoc. Will accept Harding & Lawson, CH2M Hill, Pilko & Assoc., Versar.	7. C-Tek required, will audit outside consultant for a fee.	7. Negotiable, if necessary.	7. Yes, Risk Science Inc., Versar, Inc., Ecology & Environment, Fred C. Hart, Malcolm Tirney.
8. Cancellation Provisions	8. 10 day notice for non-payment - silent as to underwriting reasons.	8. Company may cancel for: a. Non-payment. b. Insured's failure to comply with terms, conditions. 10 days written notice, short rate/pro rata provision.	8. Company may cancel for non-payment (10 day notice or for underwriting reasons) with 30 day written notice. Short rate/pro rata formula.	8. Company may cancel for non-payment & underwriting reasons with 60 day written notice (10 for non-payment). Short rate/pro rata formula.	8. Cancellation for Underwriting reasons with 90 day notice. Pro rata cancellation plus 10% of pro rata unearned.
9. Willingness to Provide Excess of Others	9. Negotiable.	Negotiable, only if carrier has used full limit 10/20 available subject to engineering submission.	9. Negotiable.	9. Negotiable.	9. Not usually.

Health Care Facility Application for Environmental Impairment Liability Insurance

(Claims Made Basis)

Applicant's Instructions

1. Answer all questions. If the answer to any question is NONE, please state NONE.
2. Application must be signed and dated by Administrator or Assistant Administrator.
3. Complete a separate application for each site or facility.
4. Please read carefully the statements at the end of this application.
5. NOTE: Completion of this application DOES NOT bind coverage.

(Please Type or Print)

General Information

1. Applicant

a. Full name of all entities to be named Insureds: ________________

____

b. Principal address: ________________

____

c. Location of site or facility: ________________

____

d. Business conducted: ________________

e. Corporation ☐ Other ________________

f. Years in business at this location: ________ Total years in operation ________

g. Present affiliation with other firms: ________________

____

h. State number of licensed beds: ________________

i. State the number of employees (FTE'S): ________ State annual payroll: ________

j. State annual income: ________________

k. State Workers Compensation experience modification: ________________

2. Insurance Specifications

a. Policy inception date: ________________

b. Limits desired (in millions): Specific: ________ Aggregate: ________

c. Deductible Desired: ________________

d. Retroactive Date Desired (Request if Necessary): ________________

e. Coverage modifications Requested: ________________

____

f. Do you have other off site Real Estate holdings? Yes ☐ No ☐
If yes attach a description of activities past and present and exact location of the properties.

3. Claim History

a. Individual losses including deductibles and/or defense costs:

Date of Claim	Describe Impairment and Injury or Damage	Amount Paid and Reserved	Date Evaluated

b. Are there any other incidents or conditions which may result in claims? Yes ☐ No ☐
If yes, give details (Attach all pertinent information): ____________________

c. Has the facility or its staff been accused or prosecuted for failure to comply with any federal, state, or local statute or regulation relating to the protection of the environment? Yes ☐ No ☐

If yes, please describe: ____________________

d. What is the environmental compliance status of the facility? Please describe: ____________________

4. Loss Prevention & Control

a. Person(s) responsible for environmental protection and their title(s):

i) At this facility: ____________________

ii) Corporate official: ____________________

b. Is there a written plan to minimize damage in the event an incident takes place? Yes ☐ No ☐

Please describe: ____________________

c. Is there a written procedure for obtaining information concerning complaints from workers?

Yes ☐ No ☐ Please describe: ____________________

d. Is a formal health and safety program conducted for employees? Yes ☐ No ☐

If yes, please describe: ____________________

5. Hazardous/Infectious Waste Permitting

a. State EPA Generator No. ____________________ None ☐

b. State EPA Treatment No. ____________________ None ☐

c. State EPA Disposal No. ____________________ None ☐

d. State EPA Transporter No. ____________________ None ☐

Specific Environmental Exposures

1. Air Pollution

a. What is the potential source of air pollution? Incineration ☐ Process ☐ Other ☐

____

b. List types of operations generating air pollutants: ______________________________

____

c. Are the pollutants: Solids ☐ Vapors ☐ Gases ☐ Liquids ☐ Fumes ☐

d. Are the pollutants: Corrosive ☐ Toxic ☐ Radioactive ☐ Biological ☐

e. List air pollutants: ______________________________

____

f. Describe the controls (equipment, monitoring devices, tests) for pollutants listed above: __________

____

____

g. Are records kept of the effects of the controlling devices? Yes ☐ No ☐

h. Is area primarily: Industrial ☐ Commercial ☐ Farmland ☐ Residential ☐ Other ☐

i. Are there any unusual climate conditions, such as inversion, that would increase pollutants?
Yes ☐ No ☐

j. Are air emissions regulated, permitted, or licensed by governing authority? Yes ☐ No ☐

2. Water Pollution

a. What is the potential source of water pollution? Processes ☐ Sanitary Waste ☐ Other ☐

____

____

b. If sewers are used, is there written permission from the governing authority? Yes ☐ No ☐

c. Are there any other operations that contribute to water pollution in the area? Yes ☐ No ☐

d. Is the pollutant: Radioactive ☐ Biological ☐ Chemical ☐ Other ☐

e. List contaminants: ______________________________

f. Describe the controls (equipment, monitoring devices, tests) they have for these pollutants: __________

____

____

____

g. Do you keep records of the effects of the controls? Yes ☐ No ☐

h. Are disposal practices licensed or permitted by governing authority? Yes ☐ No ☐

i. Submit a sketch showing what (rivers, lakes, streams, sewer systems, etc.) are being potentially polluted. Show operations on adjoining premises and exposures downstream of any body of water. Describe any unusual conditions that may influence liability exposures: ______________________________

____

3. Solid Wastes

a. What are the types of solid wastes? Chemical ☐ Radioactive ☐ Biological ☐ Sanitary ☐ Other ☐

b. Name the pollutants: ____________________

____

c. How are these wastes disposed? ____________________

____

d. Describe the exposures surrounding the place the wastes are discarded: ____________________

____

e. Is there written approval of the governing authority for the method and location of waste disposal? Yes ☐ No ☐

f. Describe the controls (equipment, monitoring devices, tests) for these pollutants: ____________________

____

____

g. Are records kept of the effects of the controls? Yes ☐ No ☐

4. Transportation

a. What is the method of waste transportation? Self ☐ Contractor ☐ Other ____________________

b. What types of vehicles do you utilize for waste transportation? (Specify) ____________________

____

c. What controls exist for transportation exposure? ____________________

____

5. Transporters (for contracted services only)

a. Describe the wastes transported, means of transportation for each, method of containment during transport, and quantity of waste materials expected to be transported during the coming year.

Wastes Transported (Give chemical name, if known)	Transporter or Co. (Name of Firm)	Containment Method (drums, containers, etc.)	Estimated Quantity (tons, drums, gal., etc. Specify)

b. Describe occupancy of the areas through which each waste type is transported (i.e. towns, residential, rural, agricultural, etc.): ____________________

c. Are vehicles used in transportation of waste used for other activities? Yes ☐ No ☐

If yes, please describe use: ____________________

____

d. Do the waste transportation activities described in this application have formal approval by an agency of government? Yes ☐ No ☐ If yes, describe the form of approval (local permit to operate, etc.)

____

6. Generator Site Activity

a. Describe waste materials stored on site for more than 24 hours before ultimate disposal.

Waste Type	Nature of Storage	Maximum Storage Periods	Method of Disposal

b. Describe each disposal category:

Disposal Method	On-Site Yes or No	Quantity Per Day (lbs., gal., etc.)
Autoclave		
Incinerator		
Sanitary Sewer		
Well (Specify)		
Sanitary Landfill		
Hazardous Waste Landfill		
Lagoon		
Reclamation		
Other		

c. Do non-owned and operated transport, storage, treatment, or disposal contractors have EPA approval permit? Yes ☐ No ☐

b. Has there been a satisfactory investigation of the TSD or Transporter's practices? Yes ☐ No ☐

e. Has this facility utilized any disposal site listed in the current United States EPA National Priorities List? Yes ☐ No ☐

If yes, provide specific details: ____________________

____

____

Supplemental Documents

Attach a copy of the following:

1. A map or sketch of this location and surrounding areas.
2. Applicant's last annual report or financial statement.
3. Other appropriate support material describing your facilities, operations, controls, claims, etc.
   a. Copy of EPA 3510 or equivalent state form (5-80) Hazardous Waste Permit and 8700-13 (5-80) Annual Facility Report, if filed:

Notice To Applicant

The coverage applied for is solely as stated in the insurance company's policy, which provides coverage on a "CLAIMS MADE" basis only for those claims that are first made against the insured during the policy period.

The undersigned, authorized administrative officer of the Applicant represents that to the best of their knowledge the statements herein are true, and that no material facts have been misstated or suppressed and it is agreed that this application shall be the basis of the contract and shall be deemed incorporated therein should the insurer evidence its acceptance of this application by issuance of a policy. It is agreed that this application shall be on file with the Insurer, and that it shall be deemed to be attached to and made part of the policy, if issued.

The EIL Underwriter selected is hereby authorized to make any investigation and inquiry in connection with this application as it deems necessary.

The Undersigned Administrative officer hereby authorizes the release of loss information from any prior insurer to the Fred.S.James & Company or the Underwriter.

Application must be signed and dated to be considered for quotation. Signing of this form does not bind the applicant, the insurer, or the underwriter to complete the insurance.

Dated this ______ day of ____________ , 19____

____
(Exact Corporate Name of Applicant)

By______________________________
(Signature of Administrative Officer)

____
(Title of Administrative Officer)

Broker: FRED.S.JAMES & CO., INC.

SAMPLE EIL POLICY

This policy was provided through the courtesy of Stuart Smith of Mid-America, Inc.

This policy is subject to change without notice.

GREAT AMERICAN SURPLUS LINES INSURANCE COMPANY (herein called the company) agrees with the Named Insured, named in the Declarations made a part hereof, in consideration of the payment of the premium and in reliance upon the statements made in the application forming a part hereof and subject the Limits of liability, exclusions, conditions and other terms of this policy.

I. INSURING AGREEMENT

To indemnify the INSURED:

A. against LOSS incurred by the INSURED, in excess of the Retained Limit as shown in Item 2 of the Declarations, as a result of CLAIMS first made against the INSURED during the Policy Period and reported to the Company during the Policy Period or within 30 days immediately following or during the EXTENDED DISCOVERY PERIOD if applicable, from an ENVIRONMENTAL IMPAIRMENT, for which the INSURED is legally liable.

B. for CLEAN UP COSTS, mandated by a governmental authority or incurred with the consent of the Company to avoid or reduce a LOSS under Insuring Agreement A, in excess of the Retained Limit as shown in Item 2 of the declarations, caused by an ENVIRONMENTAL IMPAIRMENT occurring on and confined to the INSURED'S premises but subject to a maximum amount of $500,000 any Single Loss and $1,000,000 Total All Losses during Policy Period from CLAIMS first made against the INSURED during the Policy Period reported to the Company during the Policy Period or within 30 days immediately following or during the EXTENDED DISCOVERY PERIOD if applicable, arising from an ENVIRONMENTAL LIABILITY.

SAMPLE

II. DEFINITIONS

A. INSURED means the NAMED INSURED designated as such in the DECLARATIONS, and any director, officer, partner, employee or stockholder thereof acting within the scope of his/her duties as such, including heirs, administrators, executors, assigns and legal representatives of each INSURED in the event of their death, incapacity, or bankruptcy.

B. LOSS means:

1. monetary awards or settlements of damages not including fines or penalties imposed by law or otherwise, arising from:
    - a. PERSONAL INJURY as defined herein, and/or
    - b. PROPERTY DAMAGE as defined herein, and/or
    - c. impairment or diminution of or interference with any other environmental right or amenity protected by law, and/or
    - d. CLEAN UP COSTS as defined herein.
2. costs, charges and expenses incurred in the investigation and adjustment or defense of CLAIMS for such damages, excluding all salaries of employees and office expennses of the INSURED or the Company incurred.

C. PERSONAL INJURY means bodily injury, sickness, disease, mental anguish, shock or disability sustained by any person, including death resulting therefrom.

D. PROPERTY DAMAGE means:

   1. injury to or destruction of tangible property, including the resulting loss of use therof, and

   2. loss of use of tangible property which has not been injured or destroyed, provided such loss of use is caused by an ENVIRONMENTAL IMPAIRMENT.

E. POLICY PERIOD means the period set forth in the Declarations, or any shorter period arising as a result of cancellation.

F. ENVIRONMENTAL IMPAIRMENT means damage to the environment caused by:

   1. the emission, discharge, disposal, dispersal, release, seepage, or escape of smoke, vapors, soot, fumes, acids alkalis, toxic chemicals, liquids or gases, waste materials or other irritants, contaminants or pollutants, into or upon land, the atmosphere or any watercourse or body of water, or

   2. the generation of odor, noises, vibrations, light, electricity, radiation, changes in temperature, or any other sensory phenomena arising out of or in the course of the INSURED'S operations provided (1) and (2) are gradual and fortuitous and any resultant injury or damage is neither expected nor intended by the INSURED.

SAMPLE

G. CLEAN-UP COSTS means costs and expenses of operations designed to remove, neutralize, or clean up any released or escaped substance which has caused ENVIRONMENTAL IMPAIRMENT or could cause ENVIRONMENTAL IMPAIRMENT if not removed, neutralized or cleaned up. The costs associated with closure or post closure of a WASTE DISPOSAL SITE as regulated by 40 CFR 264.110-120 and 265.110-120, or equivalent state regulations, are not included hereein.

H. WASTE DISPOSAL SITE means the physical location at which hazardous waste was or is intentially placed into or on any land or water and at which waste will remain after closure.

I. CLAIM means an oral or written demand made on the NAMED INSURED for monetary damages or costs. A CLAIM under either INSURING AGREEMENT-A or INSURING AGREEMENT-B must be separately made; a CLAIM for CLEAN-up COSTS under INSURING AGREEMENT-B constitute a CLAIM under INSURING AGREEMENT-A.

III. TERRITORY

This policy applies only to CLAIMS arising from ENVIRONMENTAL IMPAIRMENTS in the United States, its territories or possessions and Canada, and to CLAIMS or suits brought in the United States, its territories or in Canada.

IV. EXCLUSIONS

This insurance does not apply to either LOSS or CLEAN-UP COSTS:

A. arising from ENVIRONMENTAL IMPAIRMENT which is sudden and accidental;

B. based upon or attributable to any INSURED'S willful or deliberate non-compliance with any statute, regulation, ordinance or instrucction of any governmental body relating to ENVIRONMENTAL IMPAIRMENT, provided always that this exclusion shall not apply where the INSURED is operating under conditions of non-compliance under a permit or order of governmental authority and with good faith efforts to comply as soon as can reasonably be expected of the INSURED with any applicable statute, regulation, ordinance or instruction of any governmental body;

C. arising from the ownership or operation of any "offshore facility" as defined in the Outer Continental Shelf Labor Act Amendments of 1978 or the Clean Water Act of 1977 as amended 1978, or any "deepwater port" as defined in the Deepwater Port Act of 1974 as amended, nor shall there be any coverage for liability resulting from emissions of drilling fluid, oil, gas or other fluid from any oil, gas, mineral, water, or geothermal well of any nature whatsoever;

D. arising out of any obligation for which the INSURED or its insurer may be held liable under any Workers' Compensation, unemployment compensation, or disability benefits law or under any similar law;

E. arising from injury to any employee of the INSURED if such injury occurs during and in the course of said employment;

F. except as provided by INSURING AGREEMENT - B for damage to property:

   1. owned, occupied or rented to the INSURED;

   2. used by the INSURED;

   3. in the care, custody or control of the INSURED or over which the INSURED is for any purpose exercising physical control;

G. under any coverage afforded under this policy:

   1. with respect to which an INSURED under this policy is also an INSURED under a nuclear energy liability policy issued by the Nuclear Energy Liability Insurance Association, Mutual Atomic Energy Liability Underwriters or Nuclear Insurance Association of Canada, or would be an INSURED under any such policy but for its termination upon exhaustion of its limit of liability; or

   2. resulting from the hazardous properties of nuclear material and with respect to which (a) any person or organization is required to maintain financial protection pursuant to the Atomic Energy Act of 1954, or any law amendatory thereof, or (b) the INSURED is, or hadd this policy not been issued would be, entitled to indemnity from the

SAMPLE

United States of America, or any agency thereof, under any agreement entered into by the United States of America, or any agency thereof, with any person or organization; or

3. resulting from the hazardous propeties of NUCLEAR MATERIAL, if

a. the NUCLEAR MATERIAL (i) is at any NUCLEAR FACILITY owned by, or operated by or on behalf of, an INSURED or (ii) has been discharged or dispersed therefrom;

b. the NUCLEAR MMATERIAL is contained in SPENT FUEL or WASTE at any time possess handled, used, processed, stored, transported or disposed of by or on behalf of an INSURED; or

c. the LOSS arises out of the furnishing by an INSURED of services; materials, parts or equipment in connection with the planning, construction, maintenance operation or use of any NUCLEAR FACILITY, but if such facility is located within the United States of America, its territories or possessions or cnada, this exclusion (c) applies only to PROPERTY DAMAGE to such NUCLEAR FACILITY and any property thereat.

As used in this exclusion:

"HAZARDOUS PROPERTIES" means SOURCE MATERIAL, SPECIAL NUCLEAR MATERIAL OR BYPRODUCT MATERIAL;

"SOURCE MATERIAL", "SPECIAL NUCLEAR MATERIAL", and "BYPRODUCT MATERIAL" have the meanings given them in the Atomic Energy Act of 1954 or in any law amendatory thereof;

SAMPLE

"SPENT FUEL" means any fuel element or fuel component, solid or liquid, which has been used or exposed to radiation in a NUCLEAR REACTOR;

"WASTE" means any waste material (1) containing BYPRODUCT MATERIAL other than the trailings or WASTES prodduced by the extraction or concentration of uranium or thorium from any ore processed primarily for its SOURCE MATERIAL content and (2) resulting from the operation by any person or organization of any NUCLEAR FACILITY included under the first two paragraphs of the definition of NUCLEAR FACILITY under paragraph 1 or 2 thereof;

"NUCLEAR FACILITY" means

1. any NUCLEAR REACTOR,

2. any equipment or device designed or used for (a) separating the isotopes of uranium or plutonium, (b) processing or utilizing SPENT FUEL, or (c) handling, processing or packaging WASTE,

3. any equipment or device used for the processing, fabricating or alloying of SPECIAL NUCLEAR MATERIAL if at any time the total amount of such material in the custody of the INSURED at the premises where such

equipment or device is located consists of or contains more than 25 grams of plutonium or uranium 233 or any combination thereof, or more than 250 grams of uranium 235,

4. any structure, basin, excavation, premises or place prepared or used for storage or disposal of WASTE,

and includes the site on which any of the foregoing is located, all operations conducted on such site and all premises used for such operations;

"NUCLEAR REACTOR" means any apparatus designed or used to sustain nuclear fission in a self-supporting chain reaction or to contain a critical mass of fissionable material;

"PROPERTY DAMAGE" includes all forms of radioactive contamination of property;

H. arising by reason of liability assumed by the INSURED under any contract or agreement, oral or written, but this exclusion does not apply to liability which the INSURED may have in the absence of such contract or agreement;

SAMPLE

I. due to PROPERTY DAMAGE to goods or products manufactured, dold, handled, or distributed by the INSURED, or due to PROPERTY DAMAGE to work performed by or on behalf of the INSURED;

J. directly or indirectly occassioned by, happening through or in consequence of war, invasion, acts of foreign enemies, hostilities (whether war be declared or not), civil war, rebellion, revolution, insurrection, military or usurped power or confiscation or nationalization or requisition or destruction of or damage to property by or under the order of any government or public or local authority;

K. arising out of:

   1. any condition or circumstance that gives rise to a CLAIM and such condition or ccircumstancce was disclosed in answers to question 10. 11, or 12 of part 1 in the original policy application form;

   2. any condition or circumstance that gives rise to CLAIM and was known to the INSURED and not disclosed to the Company in the original policy application form and any subsequent renewal policy application forms thereof;

   3. any clean up operation reasonably considered to be routine and normal in connection with the business of the INSURED;

   4. the dumping of toxic or radioactive substance in international waters;

This insurance does not apply to CLEAN UP COSTS:

L. as provided under INSURING AGREEMENT - B, incurred in connection with cleaning up any WASTEE DISPOSAL SITE which closed prior to the effective date of this policy or any consecutive preceeding policy or policies issued by the Company;

M. incurred in connection with cleaning up any WASTE DISPOSAL SITE which is not owned or operated by the INSURED;

but these exclusions do not apply to any ENVIRONMENTAL IMPAIRMENT which occurs away from such WASTE DISPOSAL SITES.

V. EXTENDED DISCOVERY PERIOD

The provisions of this clause shall apply only if a period of at least 12 months has elapsed from the Company's original Effective Date as set forth in the Declarations of this policy or a previous consecutive policy issued by the Company when the NAMED INSURED seeks to exercise the option hereunder.

Except for cancellation for non-payment of premium, the NAMED INSURED shall be entitled to purchase 12 months extension from the date of termination of this policy upon payment of 25% of the premium shown in the Declarations.

The extension of coverage granted hereunder shall apply only for the purpose of reporting CLAIMS arising from an ENVIRONMENTAL IMPAIRMENT existing or originating during the period when the policy was in full force and effect and otherwise covered unde this policy.

It is a condition precedent to the execution of the right granted under this clause that payment of the appropriate premium shall be made no later than 10 dys after expiration in the case of non-renewal or prior to cancellation in the case of cancellation.

SAMPLE

VII. LIMITS OF LIABILITY AND RETAINED LIMIT

The Company shall only be liable for LOSS in excess of the Retained Limit stated in Item 2 of the Declarations and then up to but not exceeding its Limits of Liability as stated in Item 1 (a) of thee declarations. ClAIMS made in any one policy period arising out of ENVIRONMENTAL IMPAIRMENT AT any one site or arising from related circumstances shall be considered as a single loss and only one Retained Limit shall apply thereto.

Subject to the foregoing, the Company's Limits of Liability for all Losses during the Policy Period and inclusive of the EXTENDED DISCOVERY PERIOD, if that right is excercised by the NAMED INSURED, shall not exceed the Limits off Liability as stated in Item 1 (b) of the Declarations.

In no event shall the inclusion of CLEAN-UP COSTS as provided in INSURING AGREEMENT-B increase the Company's Limits of Liability as stated in Items 1 (a) and (b) of the Declarations nor shall the inclusion of more than one INSURED serve to increase the Company's Limits of Liability as stated therein.

The INSURED shall not insure the Retained Limit as stated in Item 2 of the Declarations.

VII. CLAIM OR SUIT PROVISIONS

A. This policy shall apply only to CLAIMS or suits which are covered hereunder and which are first made against the INSURED during the Policy Period and reported to the Company during the EXTENDED DISCOVERY PERIOD if applicable.

B. A CLAIM is first made within the meaning of this policy when the Company receives notice as required herein.

C. In the event of a CLAIM or suit, immediate written or oral notice containing particulars sufficient to identify the INSURED, and reasonably obtainable information with respect to the time, place and circumstances thereof and the names and addresses of the injured and of available witnesses, shall be given by or for the INSURED to the Company. In the event of oral notice, the INSURED agrees to furnish a written report as soon as possble.

D. If CLAIM is made or suit is brought against the INSURED, the INSURED shall immediately forward to the Company every demand, notice, summons or other process received by him or his representative.

E. No costs, charges or expenses shall be incurred without the Company's consent, which shall not be unreasonably withheld. The Company shall have the right but not the duty to designate legal counsel to associate in the investigation of CLAIMS and the defense of suits. The Company shall be informed of all settlement discussions. If the Company recommends settlement of any CLAIM or suit andd the INSURED refuses to consent to such settlement, liability for LOSS shall be limited to that portion of the amount of the settlement recommended by the Company and the costs, charges and expenses which exceed the Retained Limit and fall within the Limits of Liability as of the time of the INSURED'S refusal. THE INSURED shall not settle any CLAIM or suit without the Company's consent. The INSURED shall not admit liability.

SAMPLE

F. The Company shall have the right but not the duty to assume the adjustment of any CLAIM or the defense of any suit. In case of the exercise of that right, the INSURED, on demand of the Company, shall promptly reimburse the Company for any element of LOSS incurred by the Company falling within the INSURED'S retained Limit. The INSURED shall assist and cooperate with the company.

VIII. CONDITIONS

A. INSPECTION AND AUDIT - The Company shall be permitted but not obligated to inspect the INSURED'S property and operations at any time. Neither the Company's right to make inspection nor the making thereof nor any report thereon shall constitute an undertaking, on behalf of or for the benefit of the INSURED or others, to determine or warrant whether such property or operations are safe or healthful, or are in compliance with any law, rule or regulation.

The Company may examine and audit the INSURED'S books and records at any time during the Policy Period and extension thereof and within three years after the final termination of this policy, as far as the aforesaid books and records relate to the subject matter of this insurance.

B. PREVENTION OF LOSSES - In the event of any ENVIRONMENTAL IMPAIRMENT or knowledge of any circumstances, not previously disclosed that might reasonably be expected to result in an ENVIRONMENTAL IMPAIRMENT, the INSURED, at its own expense shall promptly take all reasonable steps to prevent or limit the injury or damage arising out of the impairment or circumstances and immediately notify the Company of such circumstances or preventative measures. Reimbursement under this insurance for any such costs shall be subject to the Company's review and approval as provided herein of the reasonableness of the action taken and the charges therefore.

C. cancellation - Except as provided by EPA Forms CFR 264, 147 or CFR 265, 147, as applicable, this policy may be cancelled by the NAMED INSURED by surrender thereof to the Company or any of its authorized representatives, or by mailing to the Company written notice stating when thereafter the cancellation shall be effective. This policy may be cancelled by the Company by mailing, to the NAMED INSURED at the address shown in this policy, written notice stating when such cancellation shall be effective, not less than 60 days (10 days for non-payment of premium) thereafter. The mailing of notice as aforesaid shall be sufficient proof of notice. The time or surrender, or the effective date and hour of cancellation, stated in the notice shall become the end of the Policy Period. Delivery of such written notice either by the NAMED INSURED or by the Company shall be equivalent to mailing.

SAMPLE

If the NAMED INSURED cancels, earned premium shall be computed in accordance with the customary short-rate procedure. If the Company candels, earned premium shall be computed pro rata. Premium adjustment may be made either at the time cancellation is effected, or as soon as practicable after cancellation becomes effective, but payment or tender of unearned premium is not a condition of cancellation.

D. WARRANTY - By acceptance of this policy, the INSURED warrants that the statements in the Declarations and Application, a copy of which is attached to and constitutes part of this policy, are his agreements and representations and that this policy is issued in reliance upon the truth of such representations and that this policy embodies all agreements existing between itself and the Company or any of its representatives relating to this insurance.

E. ACTION AGAINST COMPANY - No action shall lie against the Company unless, as a condition precedent thereto, there shall have been full compliance with all of the terms of this policy, nor shall have been full compliance with all of the terms of thispolicy, nor until the amount of the INSURED'S obligation to pay shall have been finally determined either by judgement against the INSURED after actual trial or by written agreement of the INSURED, the claimant and the Company.

Any person or organization or the legal representative thereof who have secured such judgement or written agreement shall thereafter be entitled to recover under this policy to the extent of the insurance afforded by this policy. No person or organization shall have any right under this policy to join the Company as a party to any action against the INSURED to determine the INSURED'S liability. Bankruptcy or insolvency of the INSURED or the INSURED'S estate shall not relieve the Company of any of its obligations hereunder.

F. ASSIGNMENT - Assignment of interest under this policy shall not bind the Company until its consent is endorsed thereon.

G. ASSISTANCE AND CO-OPERATION - The Company shall not be called upon to assume charge of settlement or defense of any CLAIM made or proceeding instituted against the INSURED, but the company shall have the right and opportunity to associate with the INSURED in the defense and control of any CLAIM or proceeding reasonably likely to involve the Company. In such event, the INSURED and the company shall cooperate fully.

H. SUBROGATION - In the event of any payment under this policy, the Company shall be subrogated to all the INSURED'S right of recovery therefore against any person or organization, and the INSURED shall execute and deliver instruments and papers and do whatever else is necessary to secure such rights. The INSURED shall do nothing after loss to prejudice such rights.

SAMPLE

I. CHANGES - Notice to any agent or knowledge possesed by any agent or by any other person shall not effect a waiver or a change in any part of this policy or estop the Company from asserting any right under the terms of this policy nor shall the terms of this policy be waived or changed, except by endorsement issued to form a part of this policy.

J. OTHER INSURANCE - This insurance shall be excess of the amount of the applicable Retained Limit of this policy and any other valid and collectible insurance available to the INSURED whether such other insurance is stated to be primary contributory, excess, contingent or otherwise, unless such other insurance is written only as specific excess insurance over the limits of Liability provided in this policy.

K. SOLE AGENT - The INSURED first named in the Declarations shall act on behalf of all INSUREDS for payment or return premium, receipt and acceptance of any endorsement issued to form a part of this policy, giving and receiving notice of cancellation or non-renewal, and the exercise of the rights provided in the EXTENDED DISCOVERY PERIOD clause.

L. ACQUISITION OR OPERATIONAL CHANGES - If at any time after signing the Application the INSURED shall become aware of any material change in any of the facts declared or undeclared to the Company or if the INSURED shall subseuqently receive information indicating a material increase in the exposure to which this policy relates, the INSURED shall, within 30 days or as soon as practicable, advise the Company in writing of such change or such exposure increase.

The terms of this policy shall then be subject to renegotiation with regard to any new, additional or increased exposures resulting from such changes.

M. RENEWAL - There are no rights express or implied other than as set out in Section V. EXTENDED DISCCOVERY PERIOD, to extend or renew this policy. The Company may, at its option, offer to renew the policy at any premium Retained Limit, Limit of Liability or on other conditions which it imposes.

SAMPLE

CHAPTER VII

Risk Assessment & Control

The Risk Assessment Process

The risk which a health care institution faces from hazardous substances created as an intended product, necessary by-product, or waste in its operations can be defined as the uncertainty in predicting the potential liability which may arise from releases of harmful materials resulting in environmental impairment. The process of identifying and evaluating this risk is not only an essential prerequisite for obtaining quotations for Environmental Impairment Liability (EIL) insurance, but also a necessary step in managing the risks associated with any operation which generates materials capable of causing damage to the environment.

The risk audit, materials inventory, and risk control approaches provide an overview of hazardous and infectious wastes for the risk assessment process. This will provide the administration and the risk manager with an appreciation for the scope of services which may be required in order to evaluate the risk potential for environmental impairment. More detailed information on sources of environmental expertise, hazardous materials data, and emergency response is provided in other sections.

Risk Assessment Techniques

The Risk Assessment process addresses the potential for environmental impairment arising from the operations of the insured. The specific expertise essential for a proper evaluation of impairment potential includes toxicology, public health, ecology, chemistry, industrial hygiene, infection control, medical, engineering, and safety. Generally, much of the requisite talent is available in most health care facilities. The health care staff may also need the assistance of consultants who are more familiar with environmental regulations and hazardous and infectious waste control. This multidisciplinary staff should evaluate the potential of gradual environmental impairment arising from specific operations or facilities and base the analysis on five major factors:

1. The inherent hazard of materials generated, handled, transported, or disposed. Figure VII-1 illustrates typical components of the material use cycle.
2. Environmental pathways that may result in human or environmental exposure.
3. The nature and characteristics of potentially exposed populations (including patients, visitors, neighbors, employees, and aquatic life, etc.)
4. Management policies, practices, and other activities specific to a particular facility.
5. Sociopolitical factors.

The analysis is directed at assessing the likelihood that health or environmental risks will occur. This is accomplished by identifying pathways of movement for those materials known or suspected to be hazardous that might be brought into contact with biological populations in the surrounding areas and result in gradual injury to those populations or the environment. Figure VII-2 illustrates the areas for potential environmental impact.

Several forms are provided in the manual to assist in development of qualitative and quantitative determination of chemicals in use, hazardous and infectious material generated, stored, and/or disposed.

Qualitative Environmental Risk Assessment

The media and means through which humans, animals, or other species are exposed to hazardous and infectious substances introduced into the environment are termed environmental pathways. Typical pathways include air, soil, water, and organisms moving into and out of the site. The pathway by which a chemical substance moves through the environment depends upon both physical and chemical properties of the substance and of the environment.

The interdisciplinary, professional assessment procedure considers separately the hazards from acute and chronic exposures. A matrix is used as a structure for displaying and analyzing appropriate combinations of each hazard with the affected environmental pathway. Rating criteria must be standardized but is subject to professional judgment. After all significant combinations are analyzed, separate results can be conceptually overlayed on a Risk Assessment Matrix, illustrated in Figure VII-3.

Figure VII-1 Typical Components of the Material Use Cycle

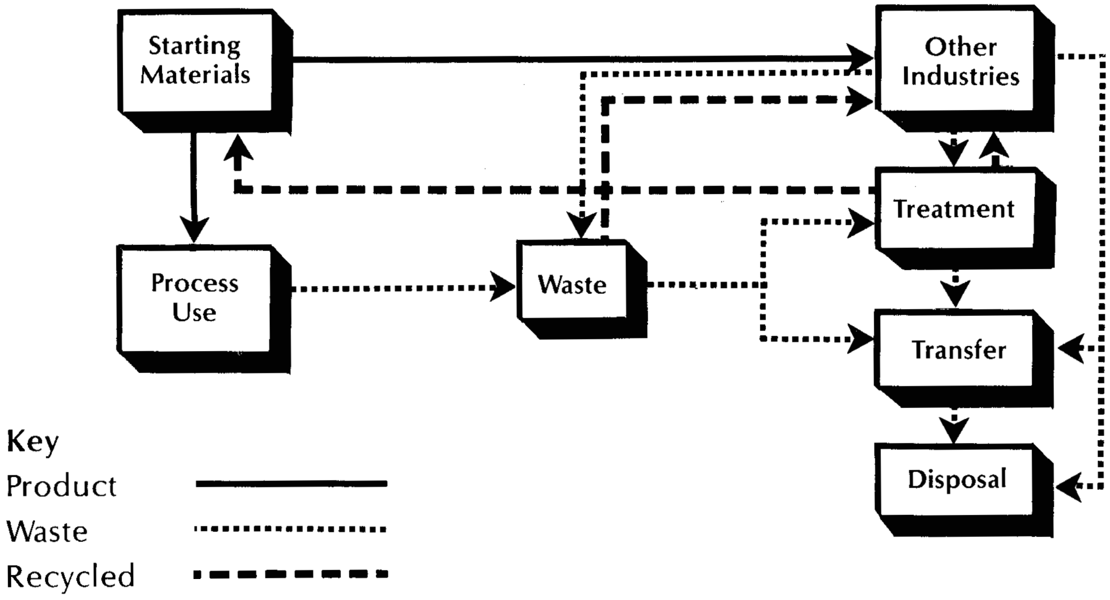


Figure VII-2 Potential Environmental Impacts

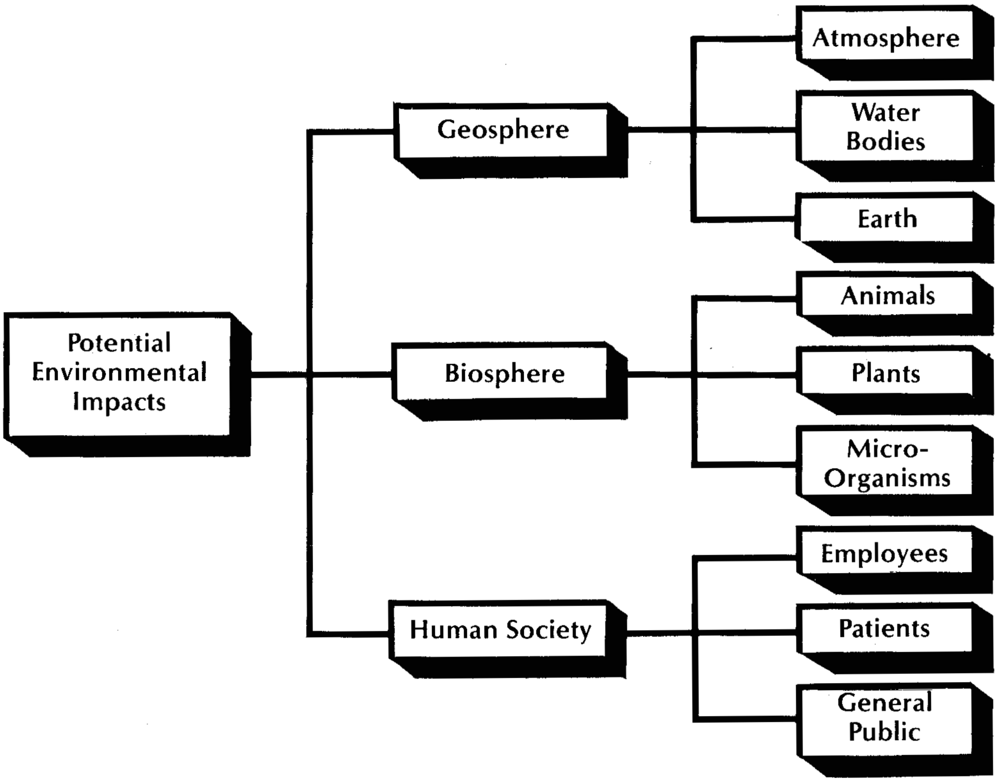
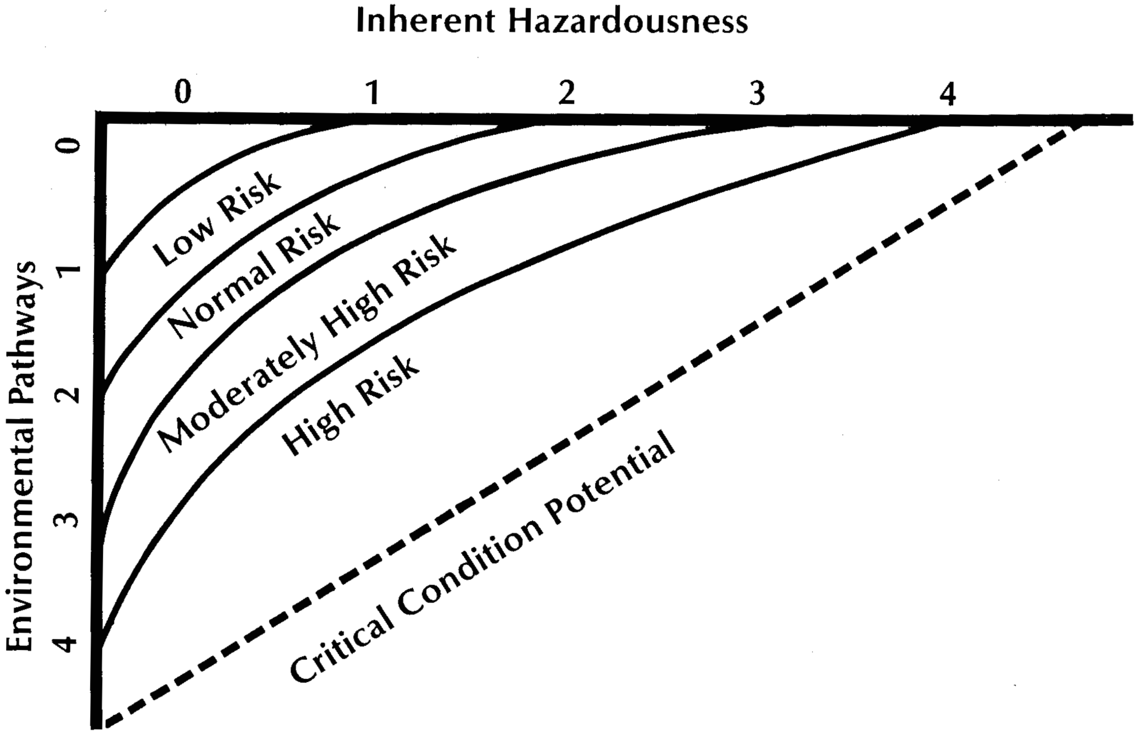


Figure VII-3 Risk Assessment Matrix



Summary of the Risk

Information gathered on inherent hazard potential of materials, environmental pathways, and management factors is used to estimate the likely magnitude of exposure and relative risks to populations and ecological systems. An important part of any risk assessment is a consideration of how exposures can be decreased or minimized.

Reducing Risks

An assessment of health and environmental risks is a valuable tool for underwriters of EIL insurance. This risk assessment is an important first step for risk managers. Once areas of exposure have been identified, management can assess the potential liabilities and financial impact of such exposures, and managers can examine the impact of alternative strategies for decreasing the exposures with the corresponding allocation of resources for risk reduction.

Any risk reduction strategy must be evaluated in the framework of hazardous waste regulatory requirements. For example, if a facility disposes of hazardous waste, it must ensure that its operations are in compliance with RCRA. But risk reduction strategies must go far beyond regulatory requirements; all areas resulting in financial exposure and common law liability must be considered.

A broad range of options could be considered, depending on the nature of the risk, including:

- Alter the process so that less toxic materials are used or less toxic by-products are produced.
- Minimize the source of chemical emission with control equipment.
- Recycle materials that present a risk from disposal.
- Automate the processor; isolate affected populations.
- Alter storage and disposal practices.
- Improve management control practices.
- Provide employee training and education.
- Change facility structures or operations.

Even the most comprehensive program of risk identification and reduction will not ensure that all future exposures will be eliminated. The techniques of assessment are continually being refined, and new control technologies are being developed to handle hazardous substances. Furthermore, a substance that today is believed not to pose a substantial hazard may be considered hazardous in the future. Thus, while risk managers are attempting to recognize the exposures that may result from their operations, examination of EIL insurance as a mechanism to cover areas of excessive risk and uncertain future risks is most prudent.

A Chemical Inventory System

A chemical inventory system is an important aspect of a Hazardous and Infectious Waste Management program because it provides the following information:

a. Complete list of chemicals used
b. Quantity of each chemical used per time interval
c. A means to monitor chemical inventories
d. Complete list of chemical wastes, by-products, or reactants

(A sample **Chemical Inventory** form is provided in this section.)

As a result of initiating a chemical inventory system, a complete list of chemicals located in each department, the type of chemicals, the quantity of each chemical, and its location will be known. This information is useful in assuring an adequate supply of chemicals and in preventing them from becoming misplaced. Forgotten or misplaced chemicals can present safety and waste disposal problems as in the case of time sensitive or organic peroxide forming reagents such as ether.

The maintenance of an up-to-date site storage, and disposal waste inventory will provide a means to anticipate hazardous waste transportation and disposal service requirements. By tracking the waste quantities generated, small amounts often can then be identified, transported and disposed of as exempt quantities.

Purchasing

The department inventory and purchasing report may show that some chemicals are purchased in excessive quantities. Few people realize the potential disposal problem of laboratory reagent chemicals. Depending upon usage rates, storage, and management controls, the cost of chemical disposal may be higher than the original cost of the chemical. When possible, reduce chemical purchases to smaller amounts that are sure to be used rather than obtaining discounts on large quantity purchases.

The purchasing department should request Material Safety Data Sheets (MSDS) or OSHA Form-20 (sample form provided in the appendix) when ordering new chemicals. These sheets include necessary information beneficial for determining proper labeling, storage, usage, disposal, and emergency procedures. These forms should be used in the development of safety policies and procedures as well as in employee education. They should be reviewed annually by an Occupational Health physician.

Chemical Data Sheets providing limited emergency information for many chemicals common to health care facilities have been provided in the appendix of this manual.

Labeling

The requirements for proper labeling exceeds those required for the immediate user. Adequate labels not only keep important information up-to-date and readily accessible, but also provide useful information to employees. Some chemical laboratories are beginning to use a label system which is numbered, color coded, and graphically depicts the hazards. The hazards for health, flammability, and reactivity for each chemical are clearly visible.

Complete labeling requries both a proper identification and storage label for each chemical. The Identification Label, Figure VII-5, identifies the types of hazards according to a color code. Starting from the left: health hazards are blue; in the center, flammability is in red; and on the right, reactivity is shown in yellow. The spatial arrangement is uniform for guiding color blind persons. The severity of the hazards rating system is from "4" to "0", or from severe to no hazard.

Figure VII-4

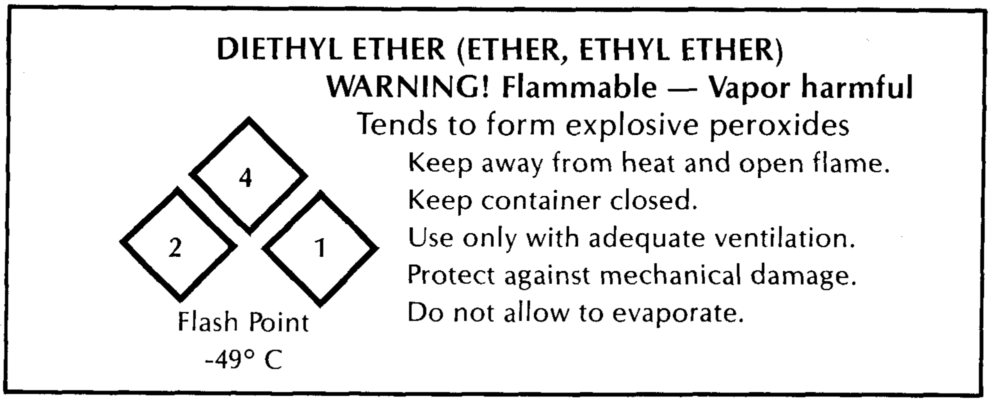
Inventory Label

Date Received: ______________________________
Storage Time Limit: __________________________
Lab or Dept.: ________________________________
Date Opened: ________________________________
Disposal Date: _______________________________

The Inventory label, Figure VII-4, should help insure that chemicals are not stored beyond the recommended time period. This is critical for those chemicals which become unstable such as ethers and pitric acid.

Figure VII-5

Sample: Chemical Identification Label



DIETHYL ETHER (ETHER, ETHYL ETHER)
WARNING! Flammable — Vapor harmful
Tends to form explosive peroxides
Keep away from heat and open flame.
Keep container closed.
Use only with adequate ventilation.
Protect against mechanical damage.
Do not allow to evaporate.

Flash Point
-49° C

Fire Hazard	**Health Hazard**	**Instability Hazard**
4 Extreme	4 Extreme	4 Extreme
3 Severe	3 Severe	3 Severe
2 Moderate	2 Moderate	2 Moderate
1 Minor	1 Minor	1 Minor
0 None	0 None	0 None

Chemical Labeling System

The Chemical Manufacturers' Association (CMA) gives the following recommendations for the identification label. Notice these are included on the example given in Figure VII-5.

a. **Name of the chemical,** preferably the chemical name, or types of chemicals

b. **Signal Word** stating the severity of the hazard, i.e. "Danger", "Warning", or "Caution"

c. **Hazard Statements** listing the most serious hazards first

d. **Precautionary Measures** to avoid injury or damage from the stated hazards

e. **Instructions** if exposure or contact requires immediate first aid or emergency action

f. **Flammable Chemicals** should list the flash point

g. **Highly Flammable Chemicals** or those **Insoluble** or **Slightly Soluble in Water** should be marked "Do Not Dispose of in Building Drains."

Source Separation

The concept of source separation is an important one in reducing the quantity of hazardous wastes. If hazardous waste is allowed to be mixed with nonhazardous waste, the entire amount is considered hazardous. Since hazardous waste transportation and disposal costs are determined primarily by the quantity of the waste, it follows that by preventing hazardous and nonhazardous waste from being mixed, the overall quantity and resulting transportation and disposal costs are minimized. Two general rules concerning source separation are as follows:

1. Do not mix hazardous with nonhazardous waste.
2. Do not mix incompatible wastes, or wastes from different hazard classes.

Containers

Container size and the amount of hazardous material stored within the department should not exceed the amounts needed for two days.

Glass is the standard material for containing a variety of hazardous chemicals, including the many flammable solvents. It is important to note that only limited quantities (1 pint or less) of highly flammable liquids are allowed to be stored in glass. These highly flammable liquids include alcohols, benzene, and ether. Although plastic or metal containers provide better protection than glass from breakage, none of these three types are safe when exposed to a laboratory fire.

However, there are special metal safety cans which are designed according to the NFPA recommendations that will not rupture or release contents suddenly in a fire. They are either Underwriters Laboratories (UL) listed or Factory Mutual (FM) approved.

Storage

To establish a safe storage area, the assistance of a person knowledgeable in the area of chemical compatibility, applicable codes, and standards should be utilized.

The National Fire Safety Protection Association (NFPA) has specific regulations for laboratories in health-related institutions. The following is stated in the 1983 edition of NFPA 56C, Chapter 4 concerning storage:

a. The total capacity of flammable or combustible liquids outside of approved storage cabinets shall not exceed 10 gal. (37.85 L) per 5,000 sq. ft. (464.4 sq.m.).

b. The total capacity of all approved storage cabinets in a laboratory shall not exceed 60 gal. (227.1 L) per 5,000 sq. ft. (464.4 sq. m.).

c. Any facility with a reserve storage capacity greater than 300 gal. (1135.5 L) shall have at least one approved flammable or combustible liquid storage room available within the facility.

d. Flammable or combustible liquids shall not be stored in ordinary refrigerators or in refrigerators approved a Class 1, Division 1, Group C, and D "Explosion-Proof." The outside of the refrigerator door must be labeled to show what liquids can be safely stored or specifically, "Not For Storage Of Flammables."

e. Flammable or combustible liquids must be stored and positioned away from Bunsen burners, ovens, hot pipes, or other sources of heat. These chemicals must not be stored in corridors or in fume hoods.

Wastes stored in tanks and drums generally have created the most significant storage problems. Many of these difficulties can be controlled by implementing the following practices:

a. Storage areas for tanks and/or drums should be diked. The recommended dike capacity should be capable of containing the total stored gallonage plus the maximum amount of rain that could be generated in a 24-hour period (by a once-in-25-year storm), or 150% of the total stored volume, whichever is greatest.

b. Light-colored containers should be used to store volatile liquids, such as flammable solvents, chlorinated solvents, and carbon disulfide. This will minimize absorption of the sun's radiation and help prevent expansion/contraction failure. Allow sufficient "head space," of at least 10% of total volume so that the container has room for expansion caused by a temperature increase.

c. Tanks and drums that must be stored outside should be secured on pallets to protect against moisture damage. This also facilitates handling by lift trucks.

d. Containers that are likely to rupture by expansion from freezing should be stored inside at appropriate temperatures.

e. Proper security should be provided to restrict access to authorized person only.

f. The hazardous waste area and containers should be properly signed and labeled.

g. The nature and amount of the contents should be known and readily available in the event of an emergency.

h. Storage areas should be routinely inspected.

Compatibility

Proper storage of chemicals provides a margin of safety for daily operations by reducing the potential for two or more chemicals to produce a severe chemical reaction upon accidental mixing. By physically separating chemicals based upon their hazard class, the likelihood for these chemicals to accidently interreact during storage is greatly reduced. A hazard class is comprised of chemicals that have a common hazard associated with their use. An example of a hazard class is flammability. Flammable liquids such as acetone, xylene, and benzene are common examples; all exhibit the characteristic of burning vigorously under certain conditions.

Examples of hazard classes are:

Flammable	Toxic	Allergins
Corrosive	Radioactive	Carcinogens
Reactive	Explosive	Mutagens

A few basic principles regarding these hazard classes will provide added safety in a chemical storage area.

a. Store flammable chemicals separately from all other hazard classes.
b. Flammable liquids should be stored separately from flammable gasses.
c. Store corrosive chemicals separately since they tend to corrode everything that is stored with them.
d. Concentrated acids and bases should be stored separately.
e. Toxic chemicals, or chemicals known to produce toxic gases when reacted with other chemicals or produce toxic aerosols when heated to decomposition, should be stored separately from the interractive chemicals and/or flammable liquids.

The topic of chemical incompatibility is a complex one and many excellent chemical references are available to provide assistance with specific problems of chemical incompatibilities.

Waste Management

Classifying Hazardous Waste

As hazardous wastes are collected, specific information is required to be placed on the storage container. Fully regulated, fully managed, or partially managed quantities of hazardous wastes require the following information to be present on the container:

a. Label clearly as a hazardous waste. (See sample labels in this section)
b. Date that the container began accumulating hazardous waste.
c. Marking indicating EPA description paragraph, name and address of generator, etc.
d. Label indicating hazard class of hazardous waste per EPA definition.

Self-adhering labels may be purchased that include the information specified in items A, C, and D above. These markings and labels should be affixed to the container as soon as it begins accumulating waste.

Chemical Inventory Form

Institution: ______________________________

Department: ______________________________

Unit/Location: ______________________________

Date: ______________________________

Verified By: ______________________________

No.	Chemical Product Trade Name	Chemical Name Major Components	Quantity Use/Mo.	Physical State	Hazard Class *				Shelf Life Age	Storage Limit	MSDS Y/N	Storage/Comments Sat. or Unsat.
					H	F	R	C				

* Hazard Class Rating per DOT (H) Health, (F) Flammability, (R) Reactivity, (C) Corrosivity on a 0-4 scale

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JAMES TECHNICAL SERVICE

The May 22, 1980, **Federal Register** provides useful information in determining the necessary hazard class label required for each container. This document will list each chemical name and give the appropriate hazard class and label required. Additionally, approved shipping containers are specified and identification numbers are assigned to each chemical. The identification numbers are required on the manifest. A licensed waste hauler can provide assistance in filling out the forms and providing class numbers.

If a hazardous waste does not consist of a single chemical, then a general hazard class may be assigned to the waste. These general hazards should contain the letters N.O.S., "Not Otherwise Specified." An example of the use of this type of classification would be a container with xylene, toluene, and isopropanol, which would be labeled "Flammable Liquid N.O.S." Be sure not to mix incompatible or different categories of hazardous wastes such as highly toxic metals with solvents, as this may render the reclamation or proper storage impossible and even more costly.

The original EPA Hazard Class Designations lists are provided in Appendix G.

Although small quantities of hazardous waste that are considered exempt are not required to have the above labels and markings, it is prudent to indicate the date the container began accumulating waste and the appropriate hazard class.

Detailed Waste Listing

After an inventory is made of the chemical wastes present at the facility, further work may need to be done to determine the potentially hazardous contents of the materials. For materials in which the chemical constituents are known, the May 22, 1980, **Federal Register** may be used to determine the hazard class, as mentioned above.

For materials that are listed by product name only, the Material Safety Data Sheet (MSDS) or OSHA-20 for these materials should be consulted. The MSDS will usually provide chemical constituents and safety and health data which could be used in determining the proper care needed for the use, storage, and disposal of the product. Table VII-1 indicates treatment and disposal options.

Table VII-1

Treatment & Disposal Options

Item	Description	Disposal Options
1.	Liquid, non-halogenated hydrocarbon compounds, aromatic or aliphatic	I,F
2.	Liquid, halogenated hydrocarbon compounds, aromatic or aliphatic	I
3.	Oxidizers	C,B
4.	Reactive compounds, e.g., cyanides, acids, alkalies	C + LF, B
5.	Solid organic chemicals	I, B, LF
6.	Solid inorganic Chemicals	C+ LF, LF

Key:
I -Incineration
F -Fuel recovery, e.g., distillation
C -Chemical reaction, e.g., oxidation, reduction, neutralization
LF -Secure landfill
B -Biological wastewater treatment

The MSDS should be requested, reviewed, and filed by designated staff for all hazardous materials. A partial listing of common health care hazardous materials is provided in Appendix E, Chemical Data Sheets.

Waste Treatment Methods Defined

Physical Treatments

1. Absorption: The process of separating a waste material from an air stream by mixing with a liquid which dissolves or absorbs the waste. Three types of absorbers are venturi scrubbers, spray towers, and packed towers.
2. Adsorption: The use of a finely divided solid (e.g., carbon) to separate a liquid or gas from an aqueous or air stream. The material which adheres to the solid can be recycled or treated for disposal.
3. Dialysis: The separation of a waste solute from a liquid stream by means of unequal diffusion through membranes.
4. Distillation: The separation of a mixture into two or more fractions that have different normal boiling points.
5. Electrodialysis: The use of an electric driving force instead of a concentration gradient to make separations by means of unequal diffusion through membranes.

6. Evaporation: A basic technique for separation of dissolved solids from liquids by vaporization of the liquid. It is used for treating radiologically contaminated solutions and inorganic chemicals contaminating liquids.
7. Extraction: The transfer of one or more components between two immiscible liquid phases,each component being exclusively soluble in one of the phases.
8. Filtration: The process of separating suspended waste solids from a liquid or gas, usually by forcing a carrier gas or liquid through a porous medium.
9. Flocculation/Settling: The coagulation of fine micron scale particles followed by gravity separation. A chemical agent is usually added to precipitate the flocculate.
10. Freezing/freeze drying: The separation of two materials (usually one liquid) by freezing the mixture and placing it in an area of high vacuum. The more volatile component is then sublimated.
11. Reverse osmosis: The separation of a dissolved material from a solution by the transfer of the solvent across a semipermeable membrane with the application of pressure to one side of the membrane. The solvent passes from a region of higher solute to one of lower concentration.
12. Stripping: The transfer of a volatile component from a liquid mixture to a gas. Also known as absorption.

Chemical Treatments

1. Catalysis: Treatment of waste materials with chemical catalysts and heat or other reactant(s).
2. Incineration: The process of burning a waste in the presence of excess oxygen. It is appropriate for treating materials which are toxic as compounds but can be broken down into non-toxic elements.
3. Ion exchange: The passing of a liquid, usually water, through a resin with an ionic charge. Free ions of opposite charge are displaced from the liquid. The resin is regenerated by a solution with the ions which were initially present in the resin.
4. Neutralization: The treatment of an acid with a base or vice versa to reduce the toxicity of the waste stream. Normally, this is part of an integrated waste treatment system.
5. Oxidation: The reaction of a substance with oxygen or a strong oxidizing agent.
6. Pyrolysis: The heating and decomposition of compounds in the absence of oxygen. It is often used in conjunction with incineration.
7. Reduction: The reverse reaction of oxidation which removes oxygen, sulfur, or other substances from a compound. An example is the removal of nitrogen oxides in emissions from power plants by reducing with ammonia in the presence of oxygen.

Biological Treatments

1. Activated sludges: The process of using microorganisims which thrive on waste materials in liquid waste streams, does not require long residence times.
2. Aerated lagoons: The use of microorganisms to treat wastes where extended residence times are required. The microorganisms require that molecular oxygen must be added to the system.
3. Trickling filters: A vertical bed utilizing organisms to treat aqueous effluent.
4. Waste stabilization ponds: A variation of the activated sludge process which uses two contact steps: biosorption and aerobic degradation.

Disposal and Storage

1. Deep-well injection: The pumping of liquid wastes into deep geologic formations.
2. Engineered storage: The design of an area to handle hazardous materials with adequate precautions against accidents.
3. Land burial: The ultimate means of disposing of solid hazardous wastes. New facilities must meet RCRA requirements.
4. Ocean disposal: The incineration of wastes in ocean going vessels. Also refers to direct dumping of waste materials in corrosion resistant containers.
5. Solidification and encapsulation: The immobilizing of toxic chemicals by incorporating them into the structure of a stable solid compound.

On Site Incineration

Recommended Incinerator Design Criteria

(Individual states may provide specific criteria,
permits, monitoring, etc.)

Minimum Operating Conditions

Waste type	Combustion zone temperature (degrees Celsius)	Retention time (seconds)	Oxygen in exiting combustion gases (%)
Halogenated aromatic hydrocarbons and antineoplastics	1200	2	3
All other combustible toxic components	1000	2	2

Stack emission analysis should include:

a. An analysis of the hazardous waste for concentrations of organohalides and for toxic components specified.

b. An analysis of the ash residues and scrubber effluent for toxic components.

c. An analysis of the exhaust gas for concentrations of toxic components, hydrogen halides, CO, CO_2, and total particulates.

d. A measurement of combustion zone temperatures and computation of residue time.

e. A computation of destruction efficiency for such toxic component specified.

f. A computation of scrubber efficiency in removing halogens.

The incinerator shall be operated with a functioning device to automatically shut off the hazardous waste feed to the incinerator in the event of any of the following:

a. The failure of any parameter critical to thermal destruction of hazardous waste.

b. The failure or partial loss of operating capability of any device for control of halogen emissions to the atmosphere.

c. The failure of monitoring operations critical to thermal destruction of the hazardous waste.

The "Lab Pack" Alternatives

The U.S. Environmental Protection Agency now permits the disposal by secure landfill of "lab packs." The term lab pack is becoming more and more widely used, but many who use the term do not realize that it has a specific meaning in federal waste management and transportation regulations.

A lab pack is a steel drum, usually 55 gallons although other sizes can be used, that is packed with small containers of laboratory wastes. The small containers must be surrounded with enough absorbent material so that if all the containers were to break, their contents could be completely absorbed by the packing in the drum.

All the materials in a particular lab pack must be compatible — that is, they must not react with one another if the individual containers were to break. A lab pack must remain intact during transportation and following disposal; reactions within lab packs could destroy the integrity of the pack, and thus defeat its purpose.

Lab packs need not be used exclusively for landfill disposal. They can also be used solely for safe storage or transportation if the wastes are eventually treated or incinerated. In this case, the drum used for the lab pack can be reused, which is a substantial cost saving.

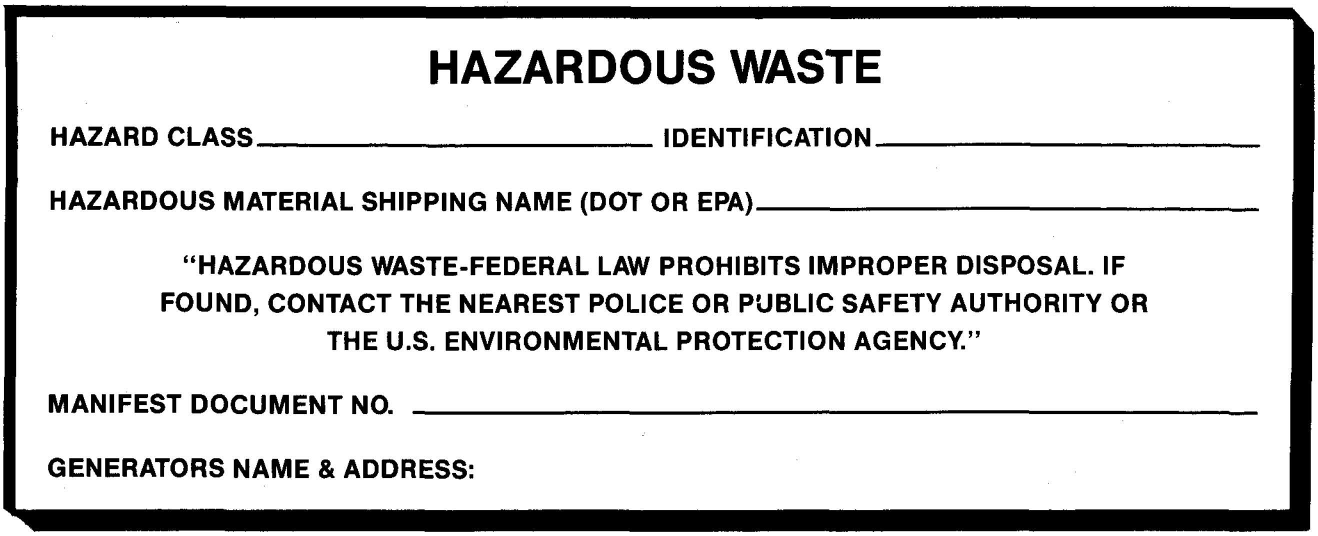
Packaging wastes into a lab pack is an operation that requires a certain degree of skill — more than is usually involved in a normal packaging and shipping department. The lab pack may have to be labeled, manifested, and shipped in accordance with federal and/or state regulations; therefore, the contents must be carefully selected.

An emerging alternative to the lab pack is a new device that acts as its own 4 liter, self-contained disposal, storage, and shipping package, and requires no over-packing in a lab pack.

Finally, the laboratory manager must select the best disposal methods in accordance with applicable laws. Sample labels for hazardous wastes are illustrated in Figure VII-6.

Figure VII-6

Sample Labels for Hazardous Waste



HAZARDOUS WASTE

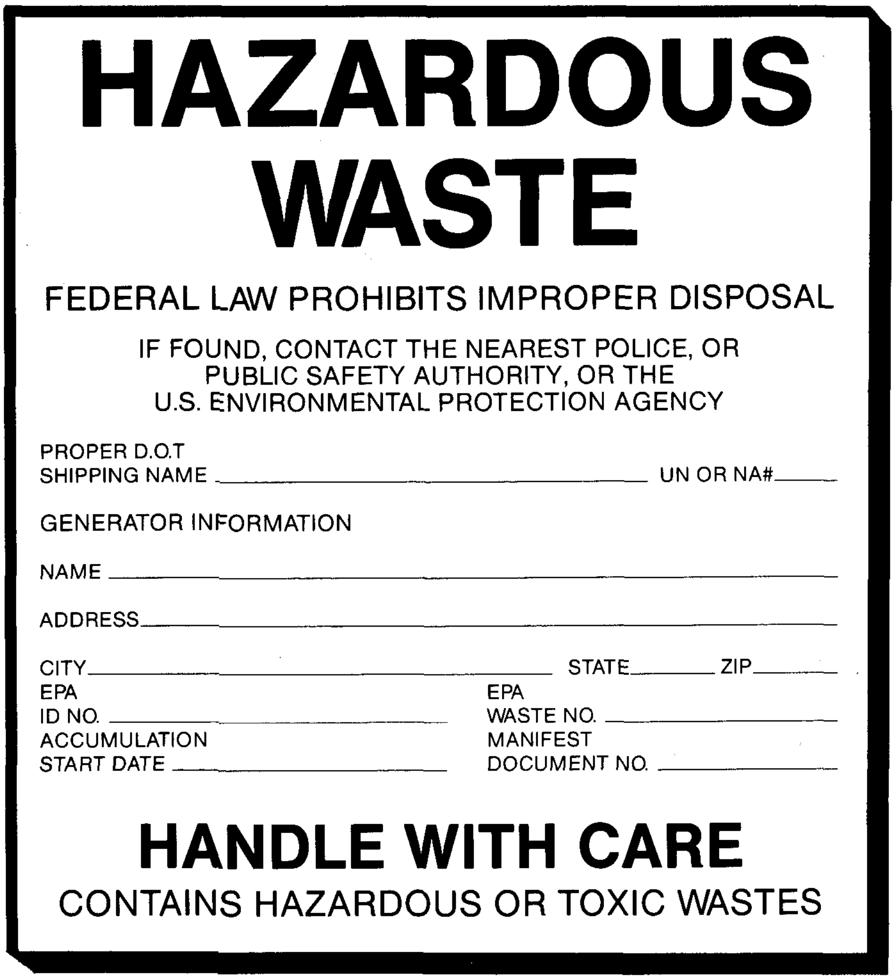
HAZARD CLASS________________ IDENTIFICATION________________

HAZARDOUS MATERIAL SHIPPING NAME (DOT OR EPA)________________

"HAZARDOUS WASTE-FEDERAL LAW PROHIBITS IMPROPER DISPOSAL. IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY."

MANIFEST DOCUMENT NO. ________________

GENERATORS NAME & ADDRESS:



HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL

IF FOUND, CONTACT THE NEAREST POLICE, OR
PUBLIC SAFETY AUTHORITY, OR THE
U.S. ENVIRONMENTAL PROTECTION AGENCY

PROPER D.O.T
SHIPPING NAME ________________ UN OR NA#______

GENERATOR INFORMATION

NAME ________________

ADDRESS________________

CITY________________ STATE______ ZIP______

EPA
ID NO. ________________

EPA
WASTE NO. ________________

ACCUMULATION
START DATE ________________

MANIFEST
DOCUMENT NO. ________________

HANDLE WITH CARE

CONTAINS HAZARDOUS OR TOXIC WASTES

Institution: ______________________

Hazardous/Infectious Waste Inventory

Department: ______________________

Date: ______________________

Unit/Location: ______________________

Verified By: ______________________

No.	Chemical Product Trade Name	Waste Name Major Components	Storage Location	Physical State 1	Hazard Class 2				Quantity Per Month	Disposal Route 3	Off-Site Disposal Yes/No
					H	F	R	C			

1 (S) Solid (L) Liquid (G) Gas

2 Hazardous Class Rating per DOT — Health (H), Flammability (F), Reactivity (R), Corrosivity (C), on a 0-4 scale

3 See specific disposal route classifications on reverse side.

FRED.S.JAMES & CO., INC.

JAMES TECHNICAL SERVICE

Hazardous and Infectious Waste Management

Disposal Routes

(LF)	Secure Landfill
(SS)	Sanitary Sewer, Biological Waste Water Treatment
(RC)	Reclamation/Reprocessed Returned to Supplier
(C)	Chemical Reaction, e.g. Oxidation, Reduction, Neutralization
(I)	Incineration
(L)	On Site Land via Dry Well, Septic Field
(WI)	Well Injection
(LG)	Lagoon, Pond
(HL)	Hazardous/Infectious Waste Landfill
(F)	Fuel Recovery

HAZARDOUS INFECTIOUS WASTE MANAGEMENT JAMES TECHNICAL SERVICES

Annual Departmental Report

Institution:

Department Report Period:

Date of Report: Prepared By:

Description of Waste	Quantity/Mo	Disposal Frequency 1	Transportation & Disposal Costs
TOTALS			

1 X in Times Per Day (D) Month (M) or Year (Y)

Annual Summary Report

— All Departments —

Department	Total Quantity	Internal Disposal Cost	External Disposal Cost
		TOTAL COST	

CHAPTER VIII

Environmental Emergency Preparedness

Preparedness Planning

A sound Environmental Preparedness Plan can often prevent a simple incident from developing into a major disaster or could greatly reduce the damage, disruption and injury caused by environmental situations. These sample guidelines for environmental preparedness outline key steps in the formulation of an appropriate plan.

There are six (6) elements that should be included in developing an effective Plan:

1. Management Responsibility, Support, and Approval
2. Selection of an Environmental Coordinator and an Environmental Preparedness Committee
3. Hazards' Assessment and Probability
4. Development of an Environmental Preparedness Plan
5. Training of Personnel
6. Testing and Revision of the Plan

It is essential that Administration recognize the potential magnitude of environmental problems and concentrate its best effort on developing an effective plan. It should be recognized that any plan will not function on its own and that it takes the people, dedication, and time to effectively implement and maintain the Plan.

Management Support of the Plan

For implementation to be effective, the plan must receive support from the Executive Board and Chief Operating Officer. The actual development and implementation of the plan can best be conducted under the direction of a designated Environmental Coordinator.

Environmental Coordinator

The Environmental Coordinator has a key role in the development, implementation, and maintenance of the plan. This person should have sufficient administrative authority to carry out the duties of this office.

The Coordinator should be responsible for direction and implementation of the plan in the event of an incident. Therefore, it is necessary that the Environmental Coordinator be a person that is normally on the premises or is readily available. The Environmental Coordinator may also be Chairperson of the Disaster Committee.

Disaster Committee

The Disaster Committee should be made up of representatives from the key departments. Their duty should be to assist and advise the Environmental Coordinator in developing, organizing, and implementing the plan. It is suggested that these representatives be department heads. It may be necessary for smaller departments, other committees, service agencies, and consultants to be ex officio members of the committee.

Under guidance of the Environmental Coordinator, the Committee should work to:

a. Identify exposures.

b. Assess risks.

c. Recommend specific policies, procedures, and action plans.

d. Establish a liaison with local government.

e. Establish a liaison with service companies and consultants.

f. Prepare and publish the **Environmental Preparedness Plan.**

g. Assign emergency duties to staff.

h. Develop employee training and education procedures.

i. Test and revise the plan.

j. Review and update the plan as necessary.

Chart VIII-1, Environmental Preparedness Elements and Responsibilities, may be helpful in defining and tracking activities, tasks, and the persons responsible for implementation of the plan.

Chart VIII-1 — Environmental Preparedness Elements and Responsibilities

Functional Group or Agencies / PLAN ELEMENTS	Executive Board	Chief Executive Officer	Director/Coordinator	Functional Committee	Environmental Agencies	Security/Police/Fire	Medical	Local Government	Red Cross/Mutual Aid
Policy									
Purpose									
Authority									
Control Center									
Organization Chart									
Hazardous & Infectious Materials Inventory									
Emergency Description									
Medical Map									
Shelter Map									
Evacuation Map									
Communications									
Shutdown List									
Visitor Control									
Security/Guards									
Transportation									
Training									
Personnel Assignment									
Employee Welfare									
Alarms and Signals									
Protective & Rescue Equipment									
Coordination									
Vital Records/EDP									
Restore, Repair, Salvage									

Control Center

The Control Center should:

a. Be located outside of any high potential emergency area.

b. Be equipped with some means of initiating internal alarm signals, a paging system, a radio base station, site maps, two-way radios, and a National Oceanic and Atmospheric Administration (NOAA) weather radio and external communications.

c. Have at least one (1) copy of the **Hazardous and Infectious Waste Emergency Preparedness Plan.**

d. Have a list of home telephone numbers of managers and other key employees. This list should establish the priority with which they are to be notified, depending on the type and severity of the emergency.

Emergency Telephone System

The telephone system is the key to emergency operations. It is the backbone of verbal communications and a vital line to outside agencies. The telephone system should not be used for non-emergency calls during an incident. All incoming calls should be screened and callers told that the facility is experiencing an emergency (or drill) and that they should call back later. It is important to remember that telephone service during an emergency may not be as reliable as it is normally.

Agency Contact List

A telephone list of possible outside agencies that the Environmental Coordinator may have to contact during an emergency should be established.

The list may include the following:

a. Alarm Service
b. Ambulance Service
c. Attorney
d. City Offices
e. DNR/CHEMTREC
f. Doctors
g. EPA
h. Fire Department
i. Health Department
j. Highway Department
k. Insurance Broker
l. Media
m. Medical Examiner
n. MIOSHA
o. National Response Center
p. Poison Center
q. Police Department
r. Security Service
s. Snow Removal
t. Spill Response Company
u. State Response Center
v. Telephone Company
w. Utility Companies
x. Water Department

PUBLIC FIRE DEPARTMENT

The Environmental Coordinator should invite personnel from all shifts of the first responding public fire department company to visit the property. During this visit a working relationship should be established that will allow cooperation during an emergency.

Fire fighters and Environmental Response Teams should be taken on a tour to familiarize themselves with the facility layout, construction, occupancy, and the unique nature of the chemical hazards. They should also be shown items such as utility shut-offs, fire protection equipment, and should be given a copy of the building layout which is used to develop their response plan.

POLICE DEPARTMENT

The Environmental Coordinator should meet with the police department periodically to ensure close cooperation in the event of an emergency. Among the items to be considered are crowd and traffic control and emergency communications.

National Response Center

Immediate reports to the NRC are mandatory in the following instances (see section 311b) (5) of the Federal Water Pollution Control Act, section 306(a) of the Outer Continental Shelf Lands Act Amendments of 1978, and section 18(b) of the Deepwater Port Act of 1974 :

User Guidance
What to report to the NRC **1-800-424-8802**

- Discharges of oil involving U.S. waters must be reported to the NRC by the person in charge of the vessel, facility, or vehicle from which the discharge occurs.
- Releases of hazardous substances into the environment must be reported to the NRC by the person in charge of the vessel, facility, or vehicle from which the discharge occurs.
- Transportation accidents involving hazardous materials, hazardous wastes, or hazardous substances must be reported to the NRC by the carrier.
- Whenever a hazardous waste treatment, storage, or disposal facility has a release, fire, or explosion which could threaten human health or the environment outside the facility, the emergency coordinator must immediately notify the NRC.
- Transportation accidents involving hazardous materials, hazardous wastes, or hazardous polluting substances must be reported to the NRC by the carrier.
- Hazardous waste discharges from abandoned dump sites should be reported to the NRC by any person witnessing a discharge into the environment.
- It is also desired that threats of discharges or releases be reported.

The National Response Center can provide chemical hazard information, guidance, and warnings when given the name of the chemical or product involved and the nature of the problem. In instances where detailed assistance is required, or where the chemical or product is unknown, attempt to provide as much of the following information as possible:

- Name
- Telephone number where the caller can be reached.
- Location of emergency and/or body of water affected.
- Type of vehicle, facility, or container involved and amount spilled.
- Rail car or truck number and chemical identification number, U.N. code, etc.
- Carrier name.
- Shipper or manufacturer.
- Consignee.
- Local weather conditions.
- Any response/clean up actions presently in progress or planned.
- Extent of injuries, if any.

REMEMBER — Requesting assistance from CHEMTREC does not fulfill the requirements of any statute, regulation, directive, or order which requires reporting discharge incidents or accidents to the Federal Government.

EPA Hotlines

RCRA & Superfund	(800) 424-9346
TSCA & Toxins	(800) 424-9065
Pesticides	(800) 531-7790
NRC	(800) 424-8802

EPA Regional Offices
List of Addresses

Region I - Massachusetts, Maine, Rhode Island, Connecticut, New Hampshire, Vermont Room 2203, John F. Kennedy Federal Building,
Boston, MA 02203 - (617) 223-7210
Administrator: Lester A. Sutton

Region II - New York, New Jersey, Virgin Islands, Puerto Rico
Room 1009, 26 Federal Plaza, New York, NY 10007 -
(212) 264-2525
Acting Administrator: Richard T. Dewling

Region III - Pennsylvania, Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia
Curtis Building, 6th and Walnut Streets, Philadelphia, PA 19106
-(215) 597-9814
Administrator: Peter N. Bibko

Region IV - Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee
345 Courtland Street, N.E., Atlanta, GA 30308 - (404) 881-4727
Administrator: Charles R. Jeter

Region V - Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin
Federal Building, 230 South Dearborn, Chicago, IL 60604 -
(312) 353-2000
Acting Administrator: Valdas Adamkus

Region VI - Arkansas, Louisiana, New Mexico, Oklahoma, Texas
Suite 1100, 1201 Elm Street, Dallas, TX 75201 - (214) 769-2600
Acting Administrator: Frances E. Phillips

Region VII - Iowa, Kansas, Missouri, Nebraska
1735 Baltimore St., Kansas City, MO 64108 - (816) 758-5493
Administrator: Vacant

Region VIII - Montana, North Dakota, South Dakota, Utah, Wyoming
Suite 900, 1860 Lincoln Street, Denver, CO 80203 -
(303) 837-3895
Administrator: Steven J. Durham

Region IX - Arizona, California, Hawaii, Nevada, Guam, American Samoa,
Common-wealth of the Northern Marianas
215 Fremont Street, San Francisco, CA 94111 - (415) 556-2320
Acting Administrator: Sheila Prindiville

Region X - Alaska, Idaho, Oregon, Washington
1200 6th Avenue, Seattle, WA - (206) 442-1220
Administrator: John R. Spencer

Employee Training and Documentation

In order for the Hazardous and Infectious Waste Management Program to operate effectively, employees involved in hazardous and infectious waste management activities need to be properly trained. Both new and current employees need to be trained in waste management procedures. This includes day-to-day operations and emergency response situations.

This manual is designed to be used with other reference materials as a training resource for employees. Because **Hazardous and Infectious Waste Management for Health Care Facilities** includes information on key phases of hazardous and infectious waste management, it can be utilized in training staff with a wide varitey of background involvement in waste management activities. In addition to the general policies, specific waste disposal procedures are outlined for many departments.

A form is provided to properly document training activities.

Training Drills

Environmental Response Team members, following proper training, should participate in periodic performance assessments. Development of monthly drills or simulated emergency conditions should be part of the plan testing. Small, well-monitored groups should implement various Environmental Emergency Preparedness Plan aspects to evaluate the effectiveness of the team in carrying out its assigned duties. Conducting periodic drills and assessments should result in the improvement of skills on the part of the response team as well as in indentifying plan deficiencies. Provisions should be made for realistic training, but drills should not be so realistic as to endanger anyone.

Evacuation

The movement of personnel from an area in response to an evacuation signal should be supervised by designated persons who will make certain that all portions of the area have been successfully evacuated. Particular attention should be paid to such isolated portions, tunnels, locker rooms, etc. Special provisions may be needed to assure that nonambulatory persons receive needed assistance in evacuating.

Once evacuated, personnel should assemble at a prearranged location for a roll call. This will further assure that all persons have been evacuated. Evacuation procedures should be defined for each area and be a training subject. The evacuation process should be a part of the training drills.

Documentation of Instruction

Hazardous/Infectious Waste Management

Institution: ______________________ Department: ______________________

Employee: ____

Title: ______________________ Date: ______________________

Hazardous/Infectious Waste Management Responsibilities:

Include those duties pertaining to the safe and proper handling, use and/or disposal of hazardous or infectious materials for the protection of people, property, and the environment.

Specific Hazardous/Infectious Waste Management Responsibilities. (List in Detail)

____

____

____

The above named individual has received training in the following areas:

☐ Chemical and Infectious Waste Hazards
☐ Proper Waste Handling
☐ Proper Waste Disposal
☐ Inventory and Storage
☐ Manifest Procedures
☐ Emergency Response
☐ Personal Protective Equipment
☐ Legal Requirements and Liability
☐ Other (Specify) ______________

______________________ Trainer Signature

______________________ Employee Signature

Emergency Response Equipment

Careful consideration should be given to the provision of appropriate environmental emergency response equipment. Determination of the nature type, and quality of such equipment will depend on the identified and quantified hazards as well as the capabilities of the staff to respond.

Any response by the staff to an evironmental incident should be limited to the scope of their capabilities which must be predetermined through training and drills. More significant incidents should be handled by professionals with the health care staff serving in a security, communication, and support capacity only.

The following equipment is desirable:

1. Mono Goggles
2. Face Shield
3. Gloves, Light and Heavy Neoprene
4. Apron
5. Disposal Suit - Nomex
6. Boots
7. Fire Extinguisher
8. Fire Hoses
9. Safety Shower
10. Eye Wash
11. Fire Blankets
12. Respirators, Chemical Cartridges
13. Respirators, SCBA
14. Spill Containment Pillows
15. Spill Absorbent Granules
16. Spill Neutralization Chemicals
17. Spill Kit for Ultra Hazardous or Special Materials
18. Hazardous Waste Containers
19. Hazardous Waste Labels
20. Utensils, Shovels, Tongs, etc.
21. Explosimeter
22. Detector Tubes
23. Camera
24. Geiger - Muller
25. Radiation Dosimeter

Hazardous and Infectious Waste Management

Emergency Equipment Inspection

Institution____________________ Inspected by ____________________

Department ____________________ Date____________________

Item/Description	Quantity	Location	Deficiencies

CHEMICAL RESISTANCE CHART *

This Chemical Resistance Chart is offered as a general guide to chemical attack. The ratings are based upon data from laboratory tests and published literature from the various manufacturers of rubber and polymers.

To select the proper glove for your chemical handling application, you must test to determine which liquid-proof type is most suitable. First determine the chemical and physical conditions present, then choose the glove with the highest performance ratings for those conditions.

You are now ready to test your selection under actual use conditions. You must determine suitability based on your own performance requirements.

Special Note: Those chemicals highlighted in bold type are considered known or suspected carcinogens. The chart indicates.only comparative resistance to the degrading effect of these chemicals. Liquid and vapor permeation resistance is not considered in the ratings. The rate of permeation (the time required for a liquid or vapor to pass through the glove) is related to the thickness of the glove (the thicker the glove, the slower the rate) and the concentration of the chemical (the more concentrated the chemical, the quicker the liquid or vapor may pass through the glove). Permeation can occur even if there is no visible damage to the glove in question. Therefore, test for the presence of the liquid or vapor inside the glove to determine suitability.

The information contained in this chart is advisory only. Norton Company assumes no responsibility for the suitability of particular user glove selections.

Key to Chemical Chart:

E. Excellent — Fluid has no effect
G. Good — Fluid has minor effect
F. Fair — Fluid has moderate effect
P. Poor — Fluid has severe effect, ranging from moderate to complete destruction
Blank — No data or insufficient evidence

Physical Performance Chart

PHYSICAL CHARACTERISTICS	NITRILE	BUTYL	NATURAL RUBBER	PVC	VITON
Abrasion Resistance	E	G	G	G	G
Cut Resistance	E	G	E	P	G
Puncture (Snag) Resistance	E	G	E	G	G
Flexibility	E	G	E	G	G
Heat Resistance	G	G	F	P	G
Ozone Resistance	F	G	P	E	E
Tensile Strength	E	G	E	F	G
Low Gas Permeability	P	E	F	P	E

Note: Products in these categories vary in capabilities. Laboratory tests are necessary for specific recommendations.

	UNSUPPORTED				SUPPORTED
CHEMICAL	VITON	NITRILE	BUTYL	NATURAL RUBBER	PVC
A					
Acetaldehyde	P	F	E	F	F
Acetic Acid	P	G	G	G	G
Acetone	P	P	E	G	P
Acrylonitrile	F	P	G	F	P
Aluminum Chloride	E	E	E	E	E
Ammonium Hydroxide	G	F	E	G	E
Amyl Acetate	P	P	E	F	P
Amyl Alcohol	G	G	E	G	—
Aniline	G	P	G	P	G
Animal Fats	E	E	G	P	G
B					
Benzaldehyde	P	P	E	F	F
Benzene	G	F	P	P	P
Benzyl Alcohol	E	P	G	P	—
Benzyl Chloride	E	P	F	P	—
Butane	E	E	P	P	P
Butyl Acetate	P	P	G	P	P
Butyl Alcohol	E	E	G	E	G
Butyraldehyde	P	P	G	P	G
C					
Calcium Hypochlorite	E	G	E	G	—
Carbolic Acid	E	P	G	P	—
Carbon Tetrachloride	E	G	P	P	P
Castor Oil	E	E	G	E	F
Chlorine (Dry)	G	P	F	P	—
Chlorine (Wet)	G	F	F	F	—
Chloroacetone	P	P	G	P	—
Chlorobenzene	E	P	P	P	P
Chloroform	E	P	P	P	P
Chromic Acid	E	P	P	P	G
Citric Acid	E	E	E	E	E
Cottonseed Oil	E	E	F	P	G
Creosote	E	G	P	P	G
Cutting Oil	E	E	F	F	F
Cyclohexane	E	E	P	P	F
Cyclohexanol	E	G	P	P	F
D					
Diacetone Alcohol	P	P	G	P	P
Dibenzyl	P	P	G	P	—
Dibutyl Phthalate	F	P	F	P	—
Diethylamine	P	F	G	F	F
Di-Isobutyl Ketone	—	P	E	G	P
Di-Isocyanate	—	G	—	P	F
Dimethyl Formamide	P	F	E	P	P
Dioxane	P	P	G	P	P
E					
Epoxy Resins	P	E	E	E	E
Ethyl Acetate	P	P	G	P	P
Ethyl Alcohol	G	E	E	E	G
Ethyl Ether	P	F	G	P	P
Ethyl Formate	E	P	G	P	P
Ethylene Dichloride	G	P	F	P	P
Ethylene Glycol	E	E	E	E	E
Ethylene Trichloride	E	P	F	P	—
F					
Fluorine	G	F	F	F	—
Formaldehyde	P	F	E	F	G

---

* Chemical Resistance Chart courtesy of Siebe North, Inc.

	UNSUPPORTED				SUP-PORTED
CHEMICAL	VITON	NITRILE	BUTYL	NATURAL RUBBER	PVC
F					
Formic Acid	F	F	E	E	E
Freon 11-12-21-22					
Freon 11	G	G	P	P	—
Freon 12	E	G	G	G	—
Freon 21	P	P	P	P	—
Freon 22	P	P	E	E	—
Furfural	P	P	G	P	P
G					
Gasoline	E	E	P	P	P
Glycerin	E	E	E	E	F
H.					
Hexane	E	E	P	P	F
Hydraulic Fluid-Petroleum Base	E	E	P	P	G
Hydraulic Fluid-Ester Base	F	P	G	P	P
Hydrobromic Acid	E	P	E	E	—
Hydrochloric Acid 37%	E	G	E	G	G
Hydrofluoric Acid	G	F	G	F	F
Hydrogen Peroxide	E	F	G	F	F
Hydroquinone	G	F	P	G	F
I					
Isobutyl Alcohol	E	G	E	E	G
Iso-Octane	E	E	P	P	P
Isopropyl Alcohol	E	G	E	E	G
K					
Kerosene	E	E	P	P	F
L					
Lactic Acid	E	E	E	E	G
Lard	E	E	F	P	—
Linseed Oil	E	E	G	P	F
Lubricating Oils (Petroleum)	E	E	P	P	—
M					
Maleic Acid	E	P	P	P	G
Methyl Acetate	P	P	G	P	—
Methyl Alcohol	P	E	E	E	F
Methyl Bromide	E	G	F	F	P
Methyl Cellosolve	P	F	G	P	—
Methylene Chloride	G	P	F	P	P
Methyl Ethyl Ketone (M.E.K.)	P	P	E	G	P
Methyl Formate	—	P	G	P	—
Methyl Isobutyl Ketone	P	P	G	F	F
Methylamine	—	F	G	F	F
Methyl Methacrylate	P	P	F	P	F
Mineral Oil	E	E	P	P	F
Monoethanolamine	P	P	G	G	G
Morpholine	—	P	G	F	G
Muriatic Acid	—	G	E	G	G
N					
Naptha	E	E	P	P	P
Nitric Acid — Concentrated	G	P	F	P	F
Nitric Acid — Diluted	G	F	F	F	G

	UNSUPPORTED				SUP-PORTED
CHEMICAL	VITON	NITRILE	BUTYL	NATURAL RUBBER	PVC
N					
Nitric Acid — Red Fuming	F	P	P	P	P
Nitrobenzene	G	F	P	P	P
Nitromethane	P	P	G	G	P
O					
Octyl Alcohol	E	G	G	G	F
Oleic Acid	G	F	P	P	F
Olive Oil	E	E	G	P	F
Oxalic Acid	E	G	E	G	G
P					
Paint Remover	G	G	P	F	P
Pentane	E	E	P	P	P
Perchloric Acid	E	P	G	P	P
Perchloroethylene	E	F	P	P	P
Phenol	E	P	G	P	G
Phosphoric Acid	E	G	E	G	P
Pickling Solution	F	P	F	P	G
Picric Acid	E	G	G	G	G
Pine Oil	E	G	P	P	F
Plating Solutions — Chrome	E	E	E	G	E
Potassium Hydroxide (50%)	F	G	E	G	E
Printing Ink	—	E	—	G	F
Propane	E	E	P	P	F
Propyl Acetate	P	P	G	P	F
Propyl Alcohol	E	E	E	E	G
Propylene	E	P	P	P	—
S					
Skydrol 500	F	P	G	P	P
Sodium Hydroxide (50%)	G	G	E	E	E
Sodium Hypochlorite	E	G	E	G	—
Soybean Oil	E	E	F	P	—
Stearic Acid	—	G	G	G	G
Stoddard Solvent	E	E	P	P	F
Styrene	G	P	P	P	P
Sulfuric Acid (Diluted)	E	G	G	G	G
Sulfuric Acid (Concentrated)	E	P	G	P	F
T					
Tannic Acid	E	E	E	E	E
Tetrahydrofuran	P	P	G	P	P
Toluene	E	F	P	P	P
Toluene Di-Isocyanate	P	P	G	P	P
Trichlorethylene	E	F	P	P	P
Tricresyl Phosphate	G	P	E	P	P
Triethanol Amine	P	F	G	G	G
Trinitrotoluene	G	P	P	P	F
Tung Oil	E	E	F	P	F
Turbine Oil	E	G	P	P	P
Turpentine	E	E	P	P	F
V					
Vegetable Oil	E	E	E	P	F
Vinyl Chloride	G	—	—	—	—
X					
Xylene	E	F	P	P	P

Respiratory Program

As required by OSHA, respirators shall be provided when such equipment is necessary to protect the health of the employee. The employer is responsible for the establishment and maintenance of a respiratory program which shall include at least the following to be considered a minimal acceptable program:

a. Written standard operating procedures governing the selection and use of respirators shall be established.

b. Respirators shall be selected on the basis of hazards to which the worker is exposed.

c. The user shall be instructed and trained in the proper use of respirators and their limitations.

d. Where practical, the respirators should be assigned to individual workers for their exclusive use.

e. Respirators shall be regularly cleaned and disinfected. Those issued for the exclusive use of one worker should be cleaned after each day's use, or more often if necessary. Those used by more than one worker should be thoroughly cleaned and disinfected after each use.

f. Respirators shall be stored in a convenient, clean, and sanitary location.

g. Respirators shall be inspected during cleaning. Worn or deteriorated parts shall be replaced. Respirators for emergency use such as self-contained devices shall be thoroughly inspected at least once a month and after each use.

h. Appropriate surveilance of work area conditions and degree of employee exposure or stress shall be maintained.

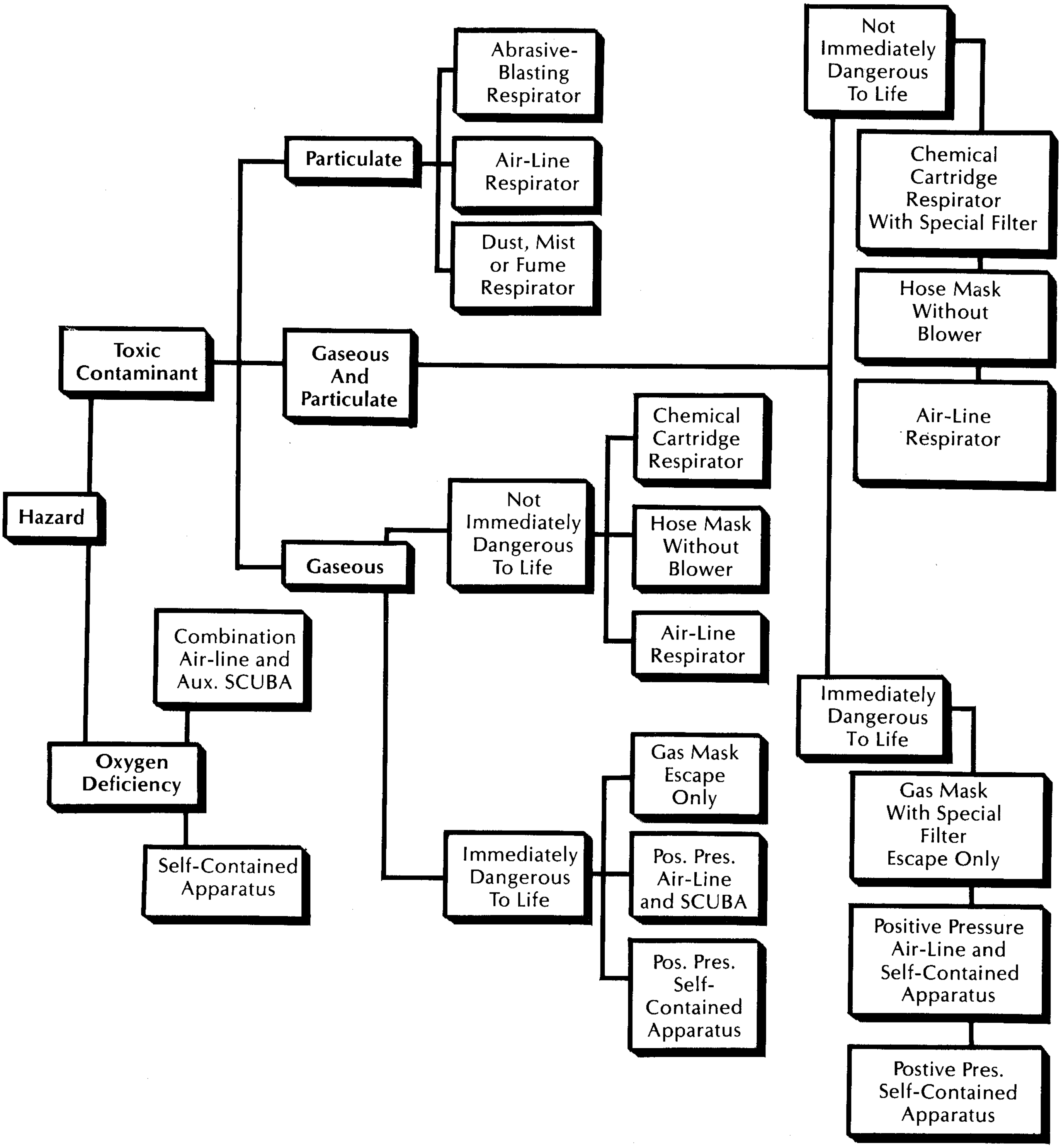
i. There shall be regular inspection and evaluation to determine the continued effectiveness of the program.

j. Persons should not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. The local physican shall determine what health and physical conditions are pertinent. The respirator user's medical status should be reviewed periodically (annually).

k. Only NIOSH (National Institute for Occupational Safety and Health)/ MSHA (Mine Safety Health Administration) approved respirators shall be used. The respirator furnished shall provide adequate respiratory protection against the particular hazard for which it is designed in accordance with standards established by competent authorities.

Figure VIII-1

Selection of Respirators Per NIOSH



Environmental Incidents

Emergency response guidelines should be developed for each waste chemical generated. Emergency Response Chemical Data Sheets are provided in the Appendix for many of the chemicals utilized in a health care institution. Employees involved in hazardous and infectious waste management activities should be familiar with these procedures. Interfacing with existing emergency procedures may also be required when appropriate. Chemical hazard information should be a part of the standard employee training materials.

Hazardous and Infectious Waste Emergency Categories

Emergency planning is an essential consideration in hazardous and infectious waste management. Hazardous and infectious waste incidents will fall into one or more of the following four emergency categories:

1. Fire
2. Explosion
3. Spill
4. Leak

Emergency response to fire and/or explosion involving hazardous wastes may be the same as for the existing Internal Disaster Plan established by the facility for those contingencies. However, the information contained in the institution's Hazardous and Infectious Waste Management Manual can be very useful in assessing the additional potential hazards when hazardous or infectious wastes are involved in fire and/or explosion. This information should be made available in advance to all emergency response personnel. Specific emergency response guidelines should be established for each chemical or waste identified.

General Guidelines for Environmental Incidents

In the case of a release, the organization should exercise caution in allowing employees, public, or government personnel into the affected area until the nature of the release has been ascertained. The Environmental Coordinator or other responsible official must insure conformance to applicable regulatory environmental and occupational safety and health requirements.

General Safety Procedures

Response actions, in general, should address the following requirements:

1. They should be in written form and should be prepared in advance of anticipated use rather than under the stress of an emergency.
2. Must be based on the best available knowledge, operational principles, and technical guidance.

3. Should be field tested, reviewed, and revised, as necessary, by competent safety and health professionals.
4. Should be understandable, practical, feasible, and applicable.
5. All personnel involved in response operations should be briefed on operating procedures, and provided with a written copy.
6. Response personnel should receive thorough and periodic training in operating procedures.
7. Response personnel should be participating in a medical monitoring and respiratory protection program.

Immediate Action for Spills or Leaks

1. Activate proper alarm.
2. Rescue persons in immediate danger and evacuate all nonessential personnel.
3. Limit Access to Area.
4. Extinguish/disconnect all potential sources of ignition.
5. Notify Hazardous/Infectious Waste Coordinator or Emergency Coordinator.
6. Put on appropriate personal protective equipment.
7. Dike or contain the spill or leak to prevent its spreading.
8. Absorb the spilled material with suitable compound (vermiculite, dried clay, baking soda, sand, etc.).
9. Transfer any material in a leaking container or a suitable, nonleaking container.
10. Properly label all waste containers.
11. Contract outside help, if needed, arrange for transportation and disposal of waste material.
12. Thoroughly document the incident.
13. All incident reports should be reviewed by the Safety, Radiation Safety, Infection Control, or other appropriate committees.
14. Special Actions: Where toxic materials will be volitized, spread or cross-contaminate other areas, it will be essential to shut down air handling systems and/or provide alternate means to ventilate contaminants to achieve safe working levels.

Environmental Incident Response

An **Environmental Incident Response** form is provided as a means of identifying the specific response activities for classes of, or individual, hazards. The form provides for various disciplines, agencies, staff input, and responsibility.

Environmental Incident Response

MEDICAL RESPONSE	DOCTOR'S NAME			DOCTOR AFFILIATION			
	EYE WASH METHOD			SKIN-WATER WASH			
	SKIN-SOAP & WATER	CLOTHING WASH	DRY-CLEAN	DESTROY	OTHER		
	INHALATION THERAPY						
	INGESTION THERAPY						
	OTHER						
SPILL CONTROL	EVACUATE	DIKE	ABSORB	RECOVER	NEUTRALIZE		
	LEAKAGE TO SEWERS OR WATER COURSES	PREVENTION	TREATMENT				
PROTECTIVE EQUIP.	CONTAINER	LABEL	OTHER				
	CHEMICAL GOGGLES	RUBBER GLOVES	RUBBER APRON	RUBBER BOOTS	RESPIRATOR		
	OTHER						
FIRE CONTROL	EVACUATE	WATER SPRAY	WATER FOG	DRY CHEMICAL	PROTEIN FOAM	ALCOHOL FOAM	CO_2
	COOL CONTAINERS	OTHER					
DECONTAMINATION	ISOLATE	TREATMENT					
	CONTAINERS			DISPOSAL			
	OTHER						
ESSENTIAL MISC. DATA							
TECH. RESOURCES	ANALYTICAL	INDUSTRIAL HYGIENE	TOXICOLOGY	WASTE CONTROL	TRANSPORTATION		
	MEDICAL	SUPPLIER	OTHER				
NOTIFY AGENCIES	INSURANCE	LEGAL	PUBLIC RELATIONS	SAFETY	ORDER HANDLING		
	ENVIRONMENTAL	FIELD SERVICE REP.	SECURITY	OTHER			
	FEDERAL	DEPT. OF TRANSP.	EPA	COAST GUARD	NRC		
	STATE	DEPT. OF TRANSP.	HEALTH	AIR POLLUTION	WATER POLLUTION		
RESPONSE COMPLETE		DATE	TIME AM PM	SIGNED			

Incident Reporting

As with all health care incidents, prompt and proper documentation is essential. Immediately subsequent to any environmental incident, the Environmental Coordinator should gather all pertinent data, interview involved persons, and write an incident report on the standard hospital form (sample provided) as well as a detailed narrative of the events. Photographs and other support materials should be obtained.

An analysis of the event should then be performed by the Environmental Coordinator and appropriate experts to assess causes and recommend any policy, procedural, or equipment modifications.

A sample **Accident and Incident Investigation Report** is provided as an example of the type of information form useful in documenting incidents.

Hazard Specific Safety Plan

Because response activities associated with each specific incident are unique, standard procedures may have to be adapted or modified. For this reason, a written safety plan must be prepared for each environmental incident anticipated. The plan must cover all phases of incident operations and identify key personnel.

Plan Elements

As a minimum requirement, the plan should address the following:

1. Personnel permitted to enter the contamination zones.
2. Entry and escape routes.
3. Procedures to identify, locate, and alert off site medical personnel.
4. Physical, chemical, and biological properties of known contaminants.
5. Support area, decontamination area, and exclusion area.
6. Decontamination protocol.
7. Levels of protection.
8. Personnel air monitoring protocols.
9. General safety rules and equipment.
10. Hazardous and infectious materials safety meetings.
11. Key agency and emergency contacts.

Reentry Into Contaminated Atmospheres

Reentry should only be attempted after careful determination of a safe atmosphere can be made. This determination can be made by use of a specific, direct reading instrument designed to measure the particular toxic material.

An alternative is to calculate the safe reentry time based on air turnover rates, mixing criteria, quantity of material involved, and toxicity of the material. This calculation should be made only by an Industrial Hygienist or Ventilation Engineer.

Accident and Incident Investigation Report

ACCIDENT LOCATION	DEPARTMENT			
	DATE OF OCCURENCE	TIME ☐ AM ☐ PM	DATE REPORTED	

PERSONAL INJURY		**PROPERTY DAMAGE**	
INJURED'S NAME		PROPERTY DAMAGED	
OCCUPATION	INJURED PART OF BODY	ESTIMATED COSTS $	ACTUAL COSTS
NATURE OF INJURY		NATURE OF DAMAGE	
OBJECT - EQUIPMENT - SUBSTANCE - INFLICTING INJURY		OBJECT - EQUIPMENT - SUBSTANCE - INFLICTING INJURY	
PERSON WITH MOST CONTROL OF OBJECT - EQUIPMENT - SUBSTANCE		PERSON WITH MOST CONTROL OF OBJECT - EQUIPMENT - SUBSTANCE	

DESCRIPTION

DESCRIBE CLEARLY HOW THE ACCIDENT OCCURRED: *ATTACH ACCIDENT DIAGRAM FOR ALL MOTOR VEHICLE ACCIDENTS.*

ANALYSIS

WHAT ACTS, FAILURES TO ACT AND/OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS ACCIDENT?

WHAT ARE THE BASIC OR FUNDAMENTAL REASONS FOR THE EXISTENCE OF THESE ACTS AND/OR CONDITIONS?

LOSS SEVERITY POTENTIAL	**PROBABLE RECURRENCE RATE**
☐ Major ☐ Serious ☐ Minor	☐ Frequent ☐ Occasional ☐ Rare

PREVENTION

WHAT ACTION HAS OR WILL BE TAKEN TO PREVENT RECURRENCE? PLACE X BY ITEMS COMPLETED.

INVESTIGATED BY	DATE	REVIEWED BY	DATE

The dilution formulas for the determination of safe reentry time are as follows:

Assume the concentration is greater than the current American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV). Ventilation rates must be known before an incident, since incorrect assumption of air change rates could result in premature reentry into a dangerous environment.

Where:

G = Generation Rate (in cfm)

C_0 = Initial Concentration (in ppm)

C = Desired Reentry Concentration (TLV in ppm see Appendix D ACGIH TLV's).

Q = Ventilation Rate (in cfm)

P = Room Volume (in cubic feet)

t = Time (in minutes)

K = Safety Factor from 3 to 10 depending on nonuniform dilution ventilation characteristics. (Recommendation: $K \geq 5$)

1. Rate of Accumulation = Rate of Generation - Rate of Removal
   or
   $VdC = Gdt - QCdt$

2. $\log\left(\frac{C}{C_0}\right) = \frac{-1}{2.3} \quad \frac{Q\,(t_2 - t_1)}{P}$

3. $$\text{Cubic Feet of Air per print evaporated} = \frac{403 \times \text{Specific Gravity} \times 1{,}000{,}000 \times K}{\text{Molecular Weight} \times \text{TLV}}$$

4. $$\text{Cubic Feet per pound evaporated} = \frac{387 \times 1{,}000{,}000 \times K}{\text{Molecular Weight} \times \text{TLV}}$$

Specific Waste Response Procedures

Infectious Waste Spills

1. Immediate Actions
   a. Assess the type of spill and degree of hazard involved.
   b. Notify all employees in the same area that a spill has occurred.
   c. Secure the area to prevent the spread of infectious agents and to restrict access to prevent the exposure of additional personnel.

   - d. Determine most effective and least hazardous approach to clean up.
   - e. Decontaminate the area.
   - f. Affected personnel should report to Employee Health for appropriate physical or biological testing.
2. Spills on Bench or Floor
   - a. Use proper personal protective equipment, i.e., lab coat, gloves, surgical mask, etc.
   - b. Flood area with a disinfectant solution.
   - c. Soak up the disinfectant and contaminated materials with an absorbent material (paper towels) and dispose of in a red biohazard plastic bag. Assure that all bags are labeled with the proper hazard identification.
   - d. The spill area should be thoroughly washed after clean up.
   - e. Remove all contaminated clothing. All contaminated material must be contained while inside the restricted area.
   - f. Autoclave contaminated material or dispose of in a biological hazard container. Incinerate all nonusable items.
3. All incidents must be documented and reported in detail on the hospital **Incident Report Form.**
4. All incident reports shall be reviewed by the Safety And Infection Control Committees.

Pathological Infectious Wastes

1. All infectious wastes shall be autoclaved or gas sterilized with ethylene oxide before leaving the lab.
   - a. Autoclave sterilization must be verified with thermal indicator tape for each load and by appropriate recorder graph.
   - b. Stearothermophilius spore assay must be used weekly to verify autoclave sterilization.
   - c. Subtilis must be used weekly to verify ETO sterilization.
2. Nonautoclavable infectious waste able to be incinerated shall be handled in the following manner:
   - a. Use appropriate personal protective equipment.
   - b. Double bag infectious material in red bags.
   - c. Assure proper hazard labeling.
   - d. Promptly deliver to incinerator area, observing established infection control procedures.
   - e. Incinerate in a timely manner. (Once per shift minimum).
   - f. Maintain records of infectious waste incineration. Include estimated quantity and specify type (organism) if known.

3. Nonautoclavable infectious waste not able to be incinerated shall be handled in the following manner:
    a. Use appropriate personal protective equipment.
    b. Red double bag infectious material.
    c. Assure proper hazard labeling.
    d. Observing established infection control procedures, deliver waste to a secure, temporary, holding area to be transported off-site to an approved location, in a timely manner.

Toxic Wastes

Small quantities of toxic wastes (see definitions of exempt quantities) can be handled as in corrosive procedures. It is recommended that all solid toxic wastes be placed in an approved container. Liquid toxic waste can be absorbed with vermiculite and placed in an approved container for disposal

Highly Toxic Wastes (Including Mutagens/Carcinogens/Teratogens)

These wastes should be handled with appropriate personal protective equipment in accordance with the procedure for hazardous solid wastes.

This waste must not be disposed of via drain systems including sanitary sewers and/or into ordinary solid waste landfills.

Reactive Hazardous Wastes

These wastes shall be handled according to procedures for solid hazardous waste. Incompatible reactive wastes should be placed in separate drums or containers.

Flammable Liquids (Miscible With Water)

1. Use the procedures for corrosives giving special attention to fire safety.
2. Limit this disposal method to small quantities (<500 ml).
3. Follow procedures for nonmiscible flammables for quantities >500 ml.
4. Maintain a record of the name, quantity, and concentration of the chemical disposed.

Flammable Liquids (Not Miscible With Water)

1. These liquids should be containerized in an approved DOT container.
2. The containers should be properly labled.
3. The chemical should be properly stored.
4. The chemical should be transported to an approved facility for disposal.
5. Maintain a record of the name, quantity, and approximate qualitative analysis.

Corrosives

1. Run cold tap water in laboratory sink (allow serveral liters of water to rinse sink and flush plumbing of residues).
2. Use appropriate personal protective equipment and slowly pour liquid waste down the drain with copious quantities of water.
3. Allow water to flush drain thoroughly after disposal to clear pipes.
4. Flush with copious amounts of water between the disposal of chemicals from different categories.
5. Flush with copious amounts of water between acids and bases.
6. Maintain and record the name and quantitiy of chemical disposed and approximate pH or concentration.

   NOTE: Disposal of specific, exempt quantities of waste via drains and sanitary sewers may be permitted by EPA and state regulatory authorities, but may not be in the best interest of the facility if there is a potential for environmental harm resulting from this practice.

Hazardous Solid Waste

1. Small quantities may be placed in appropriate individual containers and placed in a DOT approved container packed with vermiculite.
2. Maintain a record of individual container contents and the date it was placed in the container.
3. Maintain a packing list for container contents.
4. Label and store properly.
5. Transport and dispose of in an approved manner.

Mercury Waste

1. This waste should be collected in plastic containers having a positively sealed cap. Other contained mercury wastes as in mercury batteries should be segregated and placed in a closed plastic container.
2. This waste should be properly labeled.
3. Transport and dispose, recycle, or resell in an approved manner.

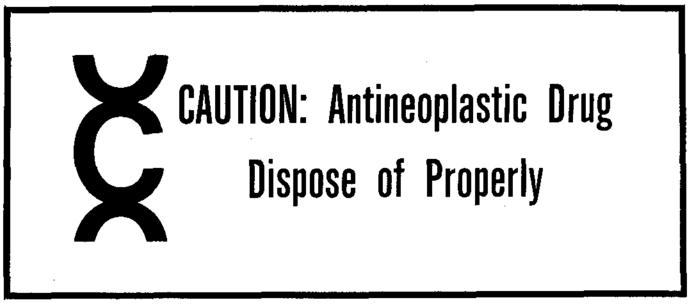
Antineoplastics (Chemotherapy) Drugs and Supplies

1. A vertical laminar flow containment hood equiped with a HEPA filter and exhaust ducted to the exterior should be employed for the reconstitution, drawing up, and further dilution of all antineoplastic products.
2. Use protective garments including appropriate disposable gloves, long-sleeved gowns, and eye protection.

3. Personnel preparing or disposing of antineoplastic drugs should use proper aseptic technique to avoid spillage or exposure of these agents onto themselves, other personnel, and equipment.
4. All products/equipment coming in contact with the antineoplastic drug during preparation or administration (including cleanup materials) should be properly disposed.
5. All spillage on counters, equipment, floor, etc. should be cleaned up immediately using a hypochlocite solution. If Housekeeping is needed, alert them as to the nature of the spill so that appropriate measures are followed.
6. Dispose in a specially marked box lined with a heavy plastic red isolation bag. All needles and sharp objects should be sheathed and deposited in the container in a manner to prevent the liner from being punctured.
7. Remaining drug and waste should be incinerated and a new box made available at least once a day.
8. To avoid the possibility of antineoplastic drugs entering the general water supply, excess or leftover materials must never be poured down the sink drain or commode.
9. Labeling:
    a. All surfaces, equipment, apparatus in contact with antineoplastic drugs should be labeled as follows:

       CAUTION: ANTINEOPLASTIC DRUG
       HANDLE SAFELY

    b. Wastes should be labeled as follows:



CAUTION: Antineoplastic Drug
Dispose of Properly

Departmental Waste Response Procedures

Pharmacy

Hazardous wastes generated by the Pharmacy Department shall be handled in the following manner:

1. Pharmacological waste agents shall be returned to the manufacturer, when possible.
2. Cytotoxic or Antineoplastic Drugs shall be handled according to special procedures for carcinogens.
3. Contaminated substances should be disposed of in accordance with Federal Regulations. All other medications should be ground and incinerated, and appropriate records kept.
4. Some medications may be ground and disposed of with ordinary solid waste.
5. Phenol generated or accumulated in a one-month period in quantities exceeding 1 kilogram (2.2 lbs.) are "fully regulated." These wastes must be collected, put in a container, labeled, marked, manifested, transported, and disposed of in an approved manner. Refer to applicable sections of this manual. For small phenol quantities (less than 0.1 kg) the following disposal method may be used:
    a. Use appropriate personal protective equipment.
    b. For phenol in the solid form, small packages of paper may be prepared containing phenol to facilitate combustion in an incinerator approved for pathological waste. Larger quantities should be safely stored and disposed of off site in an approved manner.
    c. Liquid phenol should be stored until it can be properly transported for disposal in approved container of absorbent vermiculite.

Laboratory

1. Chemical purchasing practices shall reflect:
    a. The immediate needs of lab operations.
    b. Adherence to lab chemical inventory and storage requirements.
    c. An effort to purchase in reduced quantities where practicable.
    d. An attempt to substitute a less hazardous chemical where practicable.
    e. Obtain material safety data sheets (MSDS) on all materials.
2. Chemical containment and collection:
    a. Waste chemicals shall be collected, stored, and disposed of in a manner which is consistent with hospital procedures.
    b. Compressed gases should be returned to the supplier or transported to a proper landfill.

c. Isotopes should be handled as outlined in this section, and whenever possible, materials returned to the vendor.

d. The Lab Pack System for small quantities is preferential to disposal via drain systems.

e. Return of xylene, alcohol, etc. to a waste and recycler is the best disposal option.

f. Infectious wastes should be treated as specified by CDC and RCRA.

Radiology

Radioactive liquid chemical wastes produced from photographic film development, Nuclear Medicine, and other processes may be handled as follows:

1. Run cold tap water down designated "hot sink".
2. Slowly pour waste down drain.
3. Allow water to flush drain thoroughly after disposal to clear pipes.
4. Do not permit mixing of interacting chemicals.
5. Maintain records of the name and type of radioactive waste disposed.

Radioisotope storage and disposal must follow specified provisions of the Nuclear Regulatory Commission (NRC) in conformance with the Atomic Energy Act. The radiation safety officer must supervise activities and approve of all such handling and disposal practices. Limited quantities of liquid radioisotopes from RIA and other procedures can be disposed of as in prescribed practices for Corrosives in designated "hot sinks" by appropriately trained staff.

Radioactive contaminated solid materials including paper, linens, and disposable items can be kept in lead lined containers and isolated from contact with employees for the appropriate number of half-lives (usually 10) if the following parameters are provided:

1. Safe and secure storage area is provided.
2. Storage areas should be appropriately labeled.
3. Background radiation is measured and documented.
4. Proper half-life decay is allowed and documented.
5. Incineration may be utilized.
6. Personnel handling radioactive materials should wear appropriate dosimeters and/or film badges. Radioisotope generators, implants, etc. should be handled in accordance with NRC guidelines and manufacturer or supplier safety precautions. Wherever possible, the manufacturer or supplier should pick up contaminated material, generators, and unused material.

Special procedures should be developed to protect nursing staff, dietary staff, housekeepers, maintenance staff, etc. for such personnel may be inadvertently and infrequently exposed to radioisotopes utilized in diagnostic or therapeutic treatment which may take place within Nuclear Medicine, X-ray, or in the patients' room. Personnel should be aware of special handling practices necessary for removing the contaminated items and for safe disposal.

Housekeeping/Nursing

Infectious wastes generated by direct or indirect contact with known or suspected patient carriers of etiologic agents should be properly handled as dictated in the **Center For Disease Control Procedure Isolation Techniques For Use In Hospitals.**

1. Hazardous/Infectious wastes should be segregated from nonhazardous waste.
2. Sharps must be placed in a puncture proof container.
3. Wastes must be double red bagged. (puncture resistant bags)
4. Bags must be labeled as either Biohazard or Infectious Waste.
5. Handling must be minimized.
6. Grinding or compacting of wastes should not be permitted.
7. Disposal chutes should not be used.
8. A secure storage area should be provided for temporary disposal.
9. Ultimate disposal techniques may include sterilizing, incinerating, landfilling, etc. as prescribed by code.

APPENDIX

The following charts, lists, and references, are provided to assist in the hazard assessment and management process and include the following:

A. Hazard Assessment Criteria
  1. Toxic Materials
  2. Flammability or Combustibility Rating
  3. Reactivity Rating
  4. DOT Hazardous Materials Warning Placards

B. Chemical Incompatibilities

C. OSHA Carcinogen Listing

D. Work Exposure Standards
  1. OSHA PEL's
  2. ACGIH TLV's 1983 - 1984

E. Chemical Data Sheets
  1. MSDS
  2. Chemical Data Sheets

F. EPA National Priorities List
  1. Current NPL in Order of Ranking
  2. NPL & Proposed Update Sites by State

G. EPA Hazardous Materials List

H. References & Scientific Literature

APPENDIX A

HAZARD ASSESSMENT CRITERIA
TOXIC MATERIALS

RATING	KEY WORDS	HUMAN EXPOSURE OR CONTACT TO TOXIC MATERIALS		TEST ANIMAL EXPOSURE OR CONTACT RELATIVE ACUTE TOXICITY CRITERIA[3]		
		ACUTE EXPOSURE (Single exposure causing immediate or delayed effect)	**CHRONIC EXPOSURE** (Repeated exposure)	**LD_{50} Single Oral Dose RATS mg/kg**	**LC_{50} 4 Hr. Inhalation Exposure RATS mg/kg**	**LD_{50} Skin Rabbits mg/kg**
		POSSIBLE EFFECT OR RESULT:		**LESS THAN OR EQUAL TO:**		
4	**EXTREME HEALTH HAZARD**	Death	Death[1]	1	10	5
3	**HIGH HEALTH HAZARD**	Major temporary or permanent injury. May threaten life.	Major permanent injury. (Includes mutagens & teratogens).	50	100	43
2	**MODERATE HEALTH HAZARD**	Minor temporary or permanent injury.[2] (Includes nonlife threatening substances which sensitize the majority of exposed workers).	Minor temporary or permanent injury. (Includes skin carcinogens)	500	1,000	340
1	**SLIGHT HEALTH HAZARD**	Minor injury. Readily reversible[2]	Minor injury. Readily reversible	5,000	10,000	2,800
0	**NO SIGNIFICANT HEALTH HAZARD**	Materials which produce toxic affects only under the most unusual conditions or by overwhelming dosage.		5,000 or greater	10,000 or greater	2,800 or greater

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

[2] 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.

[3] In the interest of standardization, NIOSH recommends the animal testing procedures of the National Academy of Sciences, or of The Food & Drug Administration as published by The Association of Food & Drug officials of the U.S.

CONDENSED 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 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.
LC_{50}	The air concentration which is required to produce death in 50% of the exposed animals.
LD_{50}	The dose which is required to produce death in 50% of the exposed animals.
SENSITIZER	A substance which can cause an allergic-like response.

APPENDIX A

HAZARD ASSESSMENT CRITERIA
FLAMMABILITY OR COMBUSTIBILITY RATING

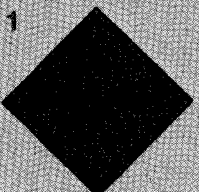
RATING	KEY WORDING OR TERM	PROPERTIES OR CONDITIONS OF MATERIAL
4	**EXTREMELY FLAMMABLE**	Any liquid or gaseous material which is a liquid under pressure having a flash point below 73° F (22.8° C). Materials which can form explosive mixtures with air & which are readily dispersed in air, such as dusts of combustible solids, & mists of flammable or combustible liquid droplets.
3	**HIGHLY FLAMMABLE**	Liquids & solids that can be ignited under almost all ambient temperature conditions. Liquids having a flash point at or above 73° F (22.8° C) but below 100° F (37.8° C).
2	**MODERATELY COMBUSTIBLE**	Materials that must be moderately heated or exposed to high ambient temperatures before ignition can occur. Rating would apply to liquids having a flash point above 100° F (37.8° C) but below 200° F (93.4° C).
1	**SLIGHTLY COMBUSTIBLE**	Materials that must be preheated before igniton can occur. Rating includes 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 & semi-solids having a flash point at or above 200° F (93.4° C).
0	**NONCOMBUSTIBLE**	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.

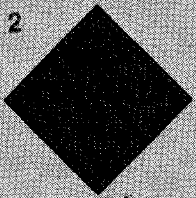
APPENDIX A

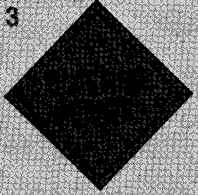
HAZARDOUS ASSESSMENT CRITERIA
REACTIVITY RATING

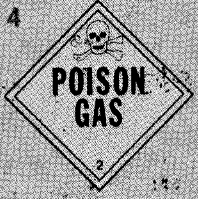
RATING	KEY WORDING OR TERM	PROPERTIES OR CONDITIONS OF MATERIAL
4	**EXTREMELY REACTIVE**	Materials readily capable of detonation, explosive decomposition, or explosive reaction at normal temperatures & pressures. Includes material sensitive to mechanical or localized thermal shock.
3	**HIGHLY REACTIVE**	Materials capable of detonation or of explosive decomposition or explosive reaction if subjected to a strong initiating source, or which must be heated under confinement before initiation. Also includes materials sensitive to thermal or mechanical shock at elevated temperatures and pressures. Materials which react explosively with water without requiring heat or confinement.
2	**MODERATELY REACTIVE**	Materials which in themselves are normally unstable & readily undergo rapid chemical changes but do not detonate. They may cause a rapid release of energy at normal temperatures and pressures. Also may react violently with water.
1	**SLIGHTLY REACTIVE**	Normally stable materials which can become unstable at elevated temperatures and pressures. Also may react violently with water with some release of energy.
0	**NONREACTIVE**	Materials that remain stable even under fire exposure and do not react with water.

DOT Hazardous Materials Warning Placards

1


2


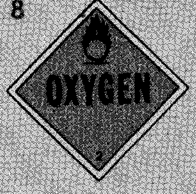
3


4


5


6


7


8


9


10


11


12


13


14


15


16


17


18


★ Numbers in each square (illustration numbers) refer to TABLES 1 and 2.

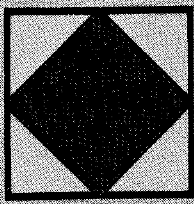
HIGHWAY TRANSPORT

Use a square background on *"large quantity"* shipments requiring special routing.

Cargo and Portable Tanks

May be substituted for Flammable and/or Combustible placard. See Sec. 172.542 and 172.544

RAIL TRANSPORT



Use a square background for the above placards.

TABLE 1

Hazard Classes	★ No.
Class A explosives	1
Class B explosives	2
Poison A	4
Flammable solid (DANGEROUS WHEN WET label only)	12
Radioactive material (YELLOW III label)	16
Radioactive material:	
Uranium hexafluoride, fissile (containing more than 0.7% U^{235}	16 & 17
Uranium hexafluoride, low-specific activity (containing 0.7% or less U^{235}	16 & 17

Guidelines

- Placard motor vehicles, freight containers, and rail cars containing *any quantity* of hazardous materials listed in TABLE 1.
- Placard motor vehicles and freight containers containing 1,000 pounds or more gross weight of hazardous materials classes listed in TABLE 2.
- Placard freight containers 640 cubic feet or more containing any quantity of hazardous materials classes listed in TABLES 1 and/or 2 when offered for transportation by air or water. Under 640 cubic feet, see Sec. 172.512(b).
- Placard rail cars containing *any quantity* of hazardous materials classes listed in TABLE 2 except when less than 1,000 pounds gross weight of hazardous materials are transported in TOFC (Trailer on Flat Car) or COFC (Container on Flat Car) service.

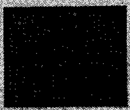
TABLE 2

Hazard Classes	★ No.
Class C explosives	18
Blasting agent	3
Nonflammable gas	6
Nonflammable gas (Chlorine)	7
Nonflammable gas (Fluorine)	15
Nonflammable gas (Oxygen, pressurized liquid)	8
Flammable gas	5
Combustible liquid	10
Flammable liquid	9
Flammable solid	11
Oxidizer	13
Organic peroxide	14
Poison B	15
Corrosive material	17
Irritating material	18

UN and NA Identification Numbers

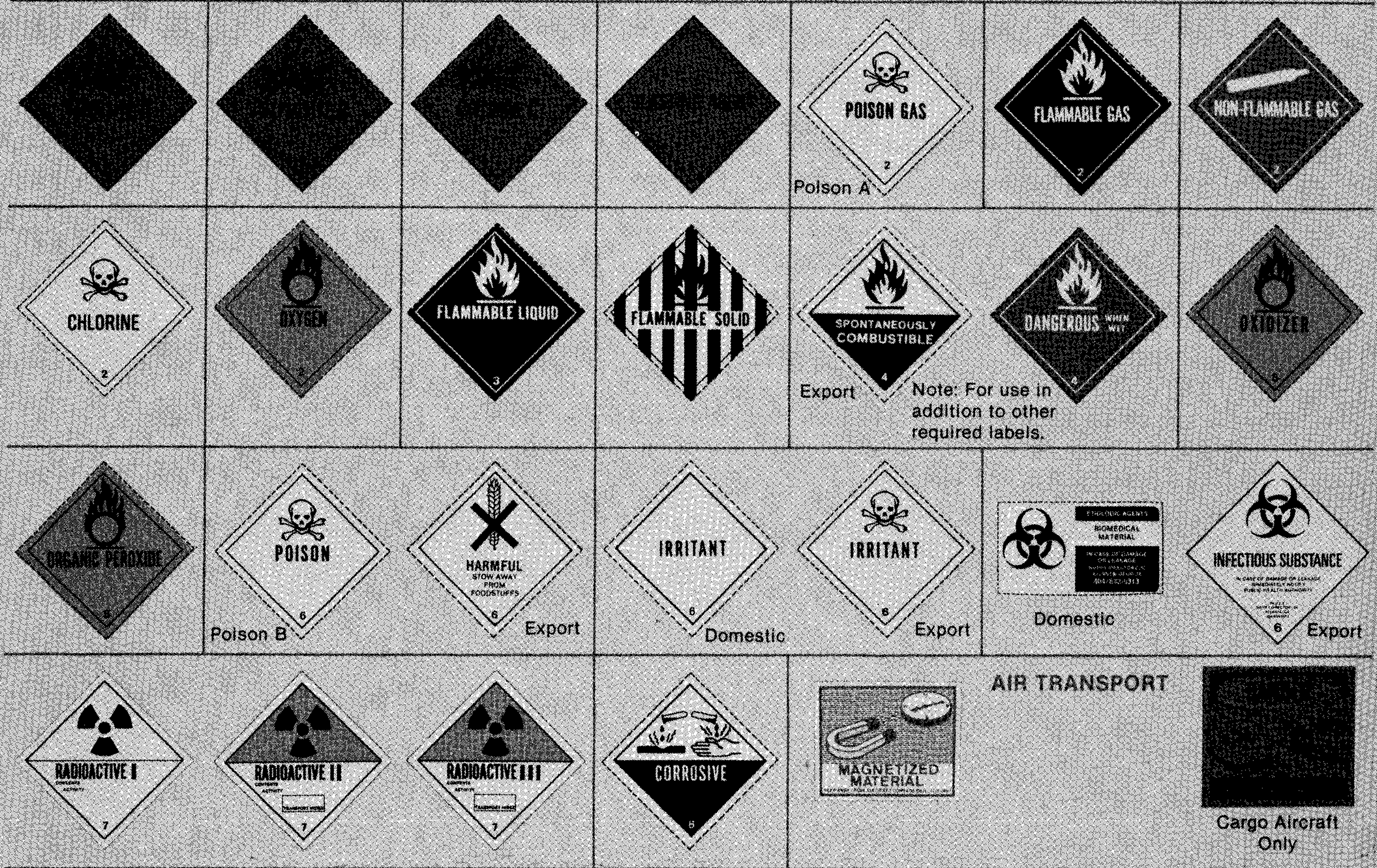
1. UN (United Nations) or NA (North American) numbers are found in Sec. 172.101, 172.102 and the Emergency Response Guidebook.
2. The four-digit UN or NA numbers are used to identify the hazardous materials involved.
3. NA numbers are used only in the USA and Canada.
4. UN or NA numbers must be displayed on Tank Cars, Cargo Tanks and Portable Tanks.
5. When ID numbers are displayed on placards, ORANGE PANELS are not required.
6. When ID numbers are displayed on ORANGE PANELS, appropriate placards are also required.

7. EUROPEAN NUMBERING SYSTEM-Top numbers represent the Hazard Index. The bottom numbers are the required UN identification numbers.



For more compete details on Identification Numbers see Sec. 172.300 through 172.338

DOT Hazardous Materials Warning Labels



General Guidelines on Use of Labels

1. The Hazardous Materials Tables, Sec. 172.101 and 172.102, identify the proper label(s) for the hazardous materials listed.
2. Any person who offers a hazardous material for shipment *must label* the package, if required. [Sec. 172.400(a)]
3. Labels *may* be affixed to packages (even though not required by the regulations) provided *each* label represents a hazard of the material in the package. [Sec. 172.401]
4. Label(s), when required, *must* be printed on or affixed to the surface of the package near the proper shipping name. [Sec. 172.406(a)]
5. When two or more different labels are required, display them next to each other. [Sec. 172.406(c)]
6. When two or more packages containing compatible hazardous materials are packaged within the same overpack, the outside container *must* be labeled as required for each class of material contained therein. [Sec. 172.404(b)]
7. Material classed as an **Explosive A, Poison A,** or **Radioactive Material** also meeting the definition of another hazard class *must* be labeled for *each* class. [Sec. 172.402(a)]
8. Material classed as an **Oxidizer, Corrosive, Flammable Solid,** or **Flammable Liquid** that also meets the definition of a Poison B *must* be labeled POISON, in addition to the hazard class label. [Sec. 172.402(a)(3) and (5)]
9. Material classed as a **Flammable Solid** that also meets the definition of a water-reactive material *must* be labeled with FLAMMABLE SOLID and DANGEROUS WHEN WET labels. [Sec. 172.402(a)(4)]
10. Material classed as a **Poison B, Flammable Liquid, Flammable Solid,** or **Oxidizer** that also meets the definition of a Corrosive material *must* be labeled CORROSIVE in addition to the class label. [Sec. 172.402(a)(6) through (9)]

This chart is designed as a reference. For more complete details, refer to the *Code of Federal Regulations*, Title 49, Parts 100-177

Hazardous Materials Class Numbers

Hazardous materials class numbers associated with the hazard classes.

Class 1- Explosives
Class 2- Gases (Compressed, liquefied or dissolved under pressure)
Class 3- Flammable liquids
Class 4- Flammable solids or Substances
Class 5- Oxidizing Substances
Class 6- Poisonous and Infectious Substances
Class 7- Radioactive Substances
Class 8- Corrosives
Class 9- Miscellaneous dangerous Substances

NOTE: For requirements, see Sec. 172.102(h), 172.332(c)(3) and 172.407(g).

U.S. Department of Transportation
Research and Special Programs Administration
Materials Transportation Bureau
Washington, D.C. 20590

Chart 7 September 1982
Revised

APPENDIX B
CHEMICAL INCOMPATIBILITIES

CHEMICAL	IS INCOMPATIBLE WITH
Acetic Acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates.
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury.
Acetone	Concentrated nitric and sulfuric acid mixtures.
Alkali and Alkaline Earth Metals (such as powdered aluminum or magnesium, calcium, lithium, sodium, potassium.)	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens.
Ammonia (Anhydrous)	Mercury (in manometers, for example), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous).
Ammonium Nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials.
Aniline	Nitric acid, hydrogen peroxide.
Arsenical Materials	Any reducing agent.
Azides	Acids.
Bromine	See Chlorine.
Calcium Oxide	Water.
Carbon (activated)	Calcium hypochlorite, all oxidizing agents.
Carbon Tetrachloride	Sodium.
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials.
Chromic Acid & Chromium Trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general.
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine.

Chlorine Dioxide	Ammonia, methane, phosphine, hydrogen sulfide.
Copper	Acetylene, hydrogen peroxide.
Cumene Hydroperoxide	Acids (organic or inorganic).
Cyanides	Acids.
Flammable Liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens.
Fluorine	Everything.
Hydrocarbons (such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide.
Hydrocyanic Acid	Nitric acid, alkali.
Hydrofluoric Acid (Anhydrous)	Ammonia (aqueous or anhydrous).
Hydrogen Peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials.
Hydrogen Sulfide	Fuming nitric acid, oxidizing gases.
Hypochlorites	Acids, activated carbon.
Iodine	Acetylene, ammonia (aqueous or anhydrous, hydrogen.
Mercury	Acetylene, fulminic acid, ammonia.
Nitrates	Sulfuric acid.
Nitric Acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals.
Nitrites	Acids.
Nitroparaffins	Inorganic bases, amines.
Oxalic Acid	Silver, mercury.
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, or gases.
Perchloric Acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wocd, grease, oils.
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold.

Phosphorus (white)	Air, oxygen, alkalis, reducing agents.
Potassium	Carbon tetrachloride, carbon dioxide, water.
Potassium Chlorate	Sulfuric and other acids.
Potassium Perchlorate (see also chlorates)	Sulfuric and other acids.
Potassium Permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid.
Selenides	Reducing agents.
Silver	Acetylene, oxalic acid, tartartic acid, ammonium compounds, fulminic acid.
Sodium	Carbon tetrachloride, carbon dioxide, water.
Sodium Nitrite	Ammonium nitrate & other ammonium salts.
Sodium Peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural.
Sulfides	Acids.
Sulfuric Acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium).

APPENDIX C

OSHA CARCINOGEN LISTING

The Occupational Safety & Health Administration has identified as Category I Carcinogens, those substances listed in Appendix C. Category I Carcinogens have been confirmed in the workplace plus positive evidence on the basis of human data or through tests on two mammalian species or on one species where the tests have been replicated.

The current NIOSH *Registry of Toxic Effects of Chemical Substances* is a comprehensive source for the identification of carcinogic, teratogenic, and mutagenic substances.

OSHA CATEGORY I CARCINOGENS

.Acenaphthene, 5-nitro- Syn: 1,2-Dihydro-5-nitro-acenaphthylene
.Acetamide Syn: Methanecarboxamide
.Acetanilide, 4'-phenyl- Syn: 4-Acetylaminobiphenyl
.Acetic acid, bromo-, ethyl ester Syn: Antol
.p-Acetophenetidide, 3'-amino- Syn: 3-Amino-4-ethoxyacetanilide
.p-Acetophenetidide, 3'-nitro- Syn: 3-Nitro-p-acetophenetide
.Aniline Syn: Benzeneamine
.Aniline, N,N-dimethyl-p-nitroso- Syn: 4-Nitrosodimethylaniline
.Aniline, N,N-dimethyl-p-(m-tolylazo)- Syn: N,N-Dimethyl-4-((3-methylphenyl)azo) benzeneamine
.Aniline hydrochloride Syn: Benzeneamine hydrochloride
.Aniline, N-methyl-N-nitroso- Syn: N-Methyl-N-nitrosobenzeneamine
.Aniline, 4,4'-methylenebis(N,N-dimethyl- Syn: Michler's Base
.Aniline, 4,4'-sulfonyldi- Syn: Dapsone
.Aniline, 4,4'-thiodi- Syn: p,p'-Diaminodiphenyl sulfide
.Aniline, 2,4,6-trichloro- Syn: 2,4,6-Trichloroaniline
.Aniline, 2,4,6-trimethyl Syn: Aminomesitylene
.o-Anisidine, 5-methyl- Syn: p-Cresidine
.o-Anisidine, 5-nitro- Syn: 2-Amino-4-nitroanisole
.Anthraquinone, 2-amino- Syn: 2-Amino-9,10-anthracenedione
.Asphalt Syn: Petroleum pitch
.Azobenzene Syn: Benzeneazobenzene
.1,3-Benzenediamine, 4-methoxy-, sulfate (1:1) Syn: 2,4-Diaminoanisole sulfate
.Benzidine dihydrochloride Syn: (1,1'-Bephenyl)-4,4'-diamine dihydrochloride
.Benzimidazole, 5-nitro- Syn: 6-Nitro-benzimidazole
.Benzoic acid, 3-amino-2,5-dichloro- Syn: Amiben
.Benzoic acid, hydrazide Syn: Benzoyl hydrazide
.Benzophenone, 4,4'-bis(dimethylamino)- Syn: Michler's Ketone
.p-Benzoquinone dioxime Syn: Quinone dioxime
.4'4'''-Biacetanilide Syn: Diacetylbenzidine
.3,3',4,4'-Biphenyl-tetramine tetrahydrochloride Syn: 3,3'-Diaminobenzidine tetrahydrochloride

.Butyric acid, 2-amino-4-(ethylthio)-, DL- Syn: DL Ethionine
.Butyric acid, 2-amino-4-(ethylthio)-, L- Syn: Ethionine
.Carbamic acid, bis(2-hydroxyethyl)dithio-,monopotassium salt Syn: Potassium bis(2-hydroxyethyl)dithiocarbamate
.Carbazole, 3-amino-0-ethyl Syn: 3-Amino-N-ethylcarbazole
.C.I. Azoicdiazo component 11 Syn: o-Toluidine, 4-chloro-, hydrochloride
.C.I. Direct Black 38, disodium salt Syn: 2,7-Naphthalenedisulfonic acid, 1-amino-3-((4'-((2,4-diaminophenyl)azo) (1,1'-biphenyl)-4-yl)azo) 5-hydroxy-5-(phenylazo), disodium salt
.C.I. Direct Blue 5, tetrasodium salt Syn: 2,7-Naphthalenedisulfonic acid, 3,3'-((4,4'-biphenylene)bis(azo)) bis (5-amino-4-hydroxy-,tetrasodium salt
.C.I. Direct Brown 95 Syn: Copper, (5-((4'-((2,5-dihydroxy-4-((2-hydroxy-5-sulfophenyl)azo) phenyl)azo)(1,1'-biphenyl)-4yl)azo) 2-hydroxybenzoato (2-))-,disodium salt
.C.I. Disperse Balck 5, dihydrochloride Syn: Benzidine, 3,3'-dimethoxy, dihydrochloride
.C.I. Disperse Orange 11 Syn: Anthraquinone 1-amino-2-methyl-
.C.I. Solvent Orange 2 Syn: 1-(o-Tolylazo)-beta-naphthol
.C.I. Solvent Yellow 1 Syn: Aniline, o-(phenylazo)-
.C.I. Solvent Yellow 3 Syn: o-toluidine, 4-(o-tolylazo)-
.C.I. Solvent Yellow 34 Syn: Aniline, 4,4'-(imidocarbonyl)bis(N,N-dimethyl-
.Cyclohexane, 1,2,3,4,5,6-hexachloro- Syn: Benzene hexachloride
.Diethylamine, 2,2'-dichloro-N-methyl-, hydrochloride Syn: Mechlorethamine hydrochloride
.m-Dioxan-4-ol, 2,6-dimethyl-,acetate Syn: Acetomethoxan
.Diphenylamine, 4-nitroso- Syn: p-Nitroso-N-phenylaniline
.Diphenylamine, N-nitroso- Syn: Diphenylnitrosamine
.Ethane, 1,2-bis (chloromethoxy)- Syn: Ethylene glycol bis (chloromethyl) ether
.Ethane, 1,1-dichloro-2,2-bis(p-chlorophenyl)- Syn: TDE
.Ethane, 1,1-dichloro-2,2-bis(p-ethylphenyl)- Syn: p,p'-Ethyl-DDD
.Ethanol, 2-hydrazino- Syn: beta-Hydroxyethylhydrazine
.Ether, 2,4-dichlorophenyl p-nitrophenyl Syn: 2,4-Dichloro-1-(4-nitrophenoxy) benzene
.Ethylene, bromo- Syn: Vinyl bromide
.Ethylene, 1,1-dichloro-2,2-bis(p-chlorophenyl)- Syn: p,p'-DDE
.Fluoren-9-one, 2,4,7-trinitro- Syn: 2,4,7-Trinitro-9H-fluoren-9-one
.Fluorene, 2-nitro- Syn: 2-Nitro-9H-fluorene
.2-Furaldehyde, 5-nitro-, semicarbazone Syn: Nitrofurazone
.Hydrazine, 1,2-dimethyl-, dihydrochloride Syn: sym-Dimethylhydrazine dihydrochloride
.Hydrazine, methyl- Syn: Hydrazomethane
.Hydrazine methyl-, sulfate(1:1) Syn: Methylhydrazine monosulfate
.Hydrazine, monohydrate Syn: Hydrazine hydrate
.Hydrazine, phenyl-, monohydrochloride Syn: Phenylhydrazine hydrochloride
.Hydrazine, sulfate (1:1) Syn: Hydrazine hydrogen sulfate
.Hydroxylamine, N-nitroso-N-phenyl-, ammonium salt Syn: Cupferron
.Imidazole-4-carboxamide, 5-(3,3'-dimethyl-1-triazeno)- Syn: Dacarbazine
.Isophthalonitrile, tetrachloro- Syn: m-Tetrachlorophthalonitrile
.1,3,4-Metheno-1H-cyclobuta(cd)pentalene, 1,1a,2,2,3,3a,4,5,5a,5b,6-dodecachlorooctahydro- Syn: Mirex
.2-Naphthylamine, N,N-bis(2-chloromethyl) Syn: Naphthylamine mustard
.Peroxyacetic acid Syn: Peracetic acid
.Phenol, 4-amino-2-nitro- Syn: C.I. 76555

.m-Phenylenediamine, 4-chloro-   Syn: 4-Chlorophene-1,3-diamine
.o-Phenylenediamine, 4-chloro-   Syn: 4-Chloro-1,2-benzenediamine
.o-Phenylenediamine dihydrochloride   Syn: 1,2-Benzenediamine dihydrochloride
.p-Phenylenediamine, 2-nitro-   Syn: C.I. 76070
.Phosphoric acid, 2-chloro- 1-(2,4,5-trichlorophenyl)vinyl dimethy ester   Syn: Tetrachlorvinphos
.Phosphoric acid, trimethyl ester   Syn: Methyl phosphate
.Phosphoric triamide, hexamethyl-   Syn: HMPA
.Picolinic acid, 4-amino-3,5,6-trichloro-   Syn: Picloram
.Piperazine, 1,4-dinitroso-   Syn: N-N'-Dinitrosopiperazine
.Propane,2,2-bis(o-(2,3-epoxypropoxy)phenyl)-   Syn: Bisphenol A diglycidyl ether
.Propane, 2-nitro-   Syn: Isonitropropane
.Pyridine, 2,6-diamino-3-(phenylazo)-, monohydrochloride   Syn: Phenazopyridine hydrochloride
.Quinoline   Syn: 1-Azanaphthalene
.Quinoline, 8-nitro-   Syn: No synonym
.Semicarbazide   Syn: Carbamylhydrazine
.Semicarbazide monohydrochloride   Syn: Carbamylhydrazine hydrochloride
.Semicarbazide, 1-phenyl-   Syn: Cryogenenine
.4,4'-Stilbenediol, alpha, alpha'-diethyl-, dipropionate, (E)-   Syn: Diethylstilbestrol dipropionate
.Strobane   Syn: Terpene polychlorinate
.Succinic acid, mono (2,2-dimethylhydrazide)   Syn: Daminozide
.Sulfanilamide, N'-(5-methyl-3-isoxazolyl)-   Syn: Sulfamethoxazole
.Fulfuric acid, diethyl ester   Syn: Ethyl sulfate
.Tellurium, tetrakis(diethyldithiocarbamato)-   Syn: Ethyl tellurac
.Terphenyl, chlorinated   Syn: PCT
.Thiazole, 2-amino-5-nitro-   Syn: Entramin
.p-Toluamide,N-isopropyl-alpha-(2-methyl-hydrazino)-monohydrochloride   Syn: Procarbazine hydrochloride
.Toluene-2,4-diamine   Syn: m-Toluenediamine
.o-Toluidine   Syn: 1-Amino-2-methylbenzene
.o-Toluidine, 5-chloro-   Syn: 1-Amino-3-chloro-6-methylbenzene
.p-Toluidine, alpha, alpha, alpha-trifluoro-2,6-dinitro-N,N-dipropyl-   Syn: Trifluralin
.Uracil, 2-thio-   Syn: 2-Mercapto-4-hydroxypyrimidine
.Urea, 3-(p-Chlorophenyl)-1,1-dimethyl-   Syn: Monuron
.Urea, 1,3-diethyl-2-thio-   Syn: N,N'-Diethylthiourea
.Urea, 1,1,3,3-tetramethyl-2-thio-   Syn: TMTU
.Urea, 1,1,3-trimethyl-2-thio-   Syn: N,N,N'-Trimethylthiourea

APPENDIX D
WORK EXPOSURE STANDARDS

Table Z-1 was extracted from OSHA General Industry Standards (29 CFR 1910.1000) U.S. Department of Labor Occupational Safety and Health Administration.

Care should be exercised when using the eight hour Time Weighted Average (TWA) Permissible Exposure Levels (PEL's). The most current American Conference of Governmental Industrial Hygienists (ACGIH) TLV Booklet, TLV's should be utilized wherever recommended exposure levels are lower than Table Z-1.

The author extends his appreciation to ACGIH for permission to represent the 1983 - 1984 ACGIH TLV Booklet.

SUBPART Z—TOXIC AND HAZARDOUS SUBSTANCES

1910.1000—AIR CONTAMINANTS

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

(a) Table Z-1:

(1) Materials with names preceded by "C"—ceiling values. An employee's exposure to any material in table Z-1, the name of which is preceded by a "C" (e.g., C Boron triflouride), shall at no time exceed the ceiling value given for that material in the table.

(2) Other materials—8-hour time weighted averages. An employee's exposure to any material in table Z-1, the name of which is not preceded by "C", in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average given for that material in the table.

TABLE Z-1

Substance	p.p.m.[a]	mg./M^3 [b]
Acetaldehyde	200	360
Acetic acid	10	25
Acetic anhydride	5	20
Acetone	1,000	2,400
Acetonitrile	40	70
Acetylene dichloride, see 1, 2-Dichloroethylene		
Acetylene tetrabromide	1	14
Acrolein	0.1	0.25
Acrylamide—Skin		0.3
Aldrin—Skin		0.25
Allyl alcohol—Skin	2	5
Allyl chloride	1	3
C Allyl glycidyl ether (AGE)	10	45
Allyl propyl disulfide	2	12
2-Aminoethanol, see Ethanolamine		
2-Aminopyridine	0.5	2
Ammonia	50	35
Ammonium sulfamate (Ammate)		15
n-Amyl acetate	100	525
sec-Amyl acetate	125	650
Aniline—Skin	5	19
Anisidine (o, p-isomers)—Skin		0.5
Antimony and compounds (as Sb)		0.5
ANTU (alpha naphthyl thiourea)		0.3
Arsine	0.05	0.2
Azinphos-methyl—Skin		0.2
Barium (soluble compounds)		0.5
p-Benzoquinone, see Quinone		
Benzoyl peroxide		5
Benzyl chloride	1	5
Biphenyl, see Diphenyl		
Boron oxide		15
C Boron trifluoride	1	3
Bromine	0.1	0.7
Bromoform—Skin	0.5	5
Butadiene (1, 3-butadiene)	1,000	2,200
Butanethiol, see Butyl mercaptan		
2-Butanone	200	590
2-Butoxy ethanol (Butyl Cellosolve)—Skin	50	240
Butyl acetate (n-butyl acetate)	150	710
sec-Butyl acetate	200	950
tert-Butyl acetate	200	950
Butyl alcohol	100	300
sec-Butyl alcohol	150	450
tert-Butyl alcohol	100	300
C Butylamine—Skin	5	15
C tert-Butyl chromate (as CrO_3)—Skin		0.1
n-Butyl glycidyl ether (BGE)	50	270
Butyl mercaptan	10	35
p-tert-Butyltoluene	10	60
Calcium oxide		5
Camphor		2
Carbaryl (Sevin ®)		5
Carbon black		3.5
Carbon dioxide	5,000	9,000
Carbon monoxide	50	55
Chlordane—Skin		0.5
Chlorinated camphene—Skin		0.5
Chlorinated diphenyl oxide		0.5
C Chlorine	1	3
Chlorine dioxide	0.1	0.3
C Chlorine trifluoride	0.1	0.4
C Chloroacetaldehyde	1	3
α-Chloroacetophenone (phenacylchloride)	0.05	0.3
Chlorobenzene (monochlorobenzene)	75	350
o-Chlorobenzylidene malononitrile (OCBM)	0.05	0.4
Chlorobromomethane	200	1,050
2-Chloro-1,3-butadiene, see Chloroprene		
Chlorodiphenyl (42 percent Chlorine)—Skin		1
Chlorodiphenyl (54 percent Chlorine)—Skin		0.5
1-Chloro,2,3-epoxypropane, see Epichlorhydrin		
2-Chloroethanol, see Ethylene chlorohydrin		

See footnotes at end of table.

TABLE Z-1—Continued

Substance	p.p.m.[a]	mg./M^3 [b]
Chloroethylene, see Vinyl chloride		
C Chloroform (trichloromethane)	50	240
1-Chloro-1-nitropropane	20	100
Chloropicrin	0.1	0.7
Chloroprene (2-chloro-1,3-butadiene)—Skin	25	90
Chromium, sol. chromic, chromous salts as Cr		0.5
Metal and insol. salts		1
Coal tar pitch volatiles (benzene soluble fraction) anthracene, BaP, phenanthrene, acridine, chrysene, pyrene		0.2
Cobalt, metal fume and dust		0.1
Copper fume		0.1
Dusts and Mists		1
Cotton dust (raw)		1
Crag® herbicide		15
Cresol (all isomers)—Skin	5	22
Crotonaldehyde	2	6
Cumene—Skin	50	245
Cyanide (as CN)—Skin		5
Cyclohexane	300	1,050
Cyclohexanol	50	200
Cyclohexanone	50	200
Cyclohexene	300	1,015
Cyclopentadiene	75	200
2, 4-D		10
DDT—Skin		1
DDVP, Skin		1
Decaborane—Skin	0.05	0.3
Demeton®—Skin		0.1
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	50	240
1,2-diaminoethane, see Ethylenediamine		
Diazomethane	0.2	0.4
Diborane	0.1	0.1
Dibutyl Phosphate	1	5
Dibutylphthalate		5
C o-Dichlorobenzene	50	300
p-Dichlorobenzene	75	450
Dichlorodifluoromethane	1,000	4,950
1,3-Dichloro-5,5-dimethyl hydantoin		0.2
1,1-Dichloroethane	100	400
1,2-Dichloroethylene	200	790
C Dichloroethyl ether—Skin	15	90
Dichloromethane, see Methylenechloride		
Dichloromonofluoromethane	1,000	4,200
C 1,1-Dichloro-1-nitroethane	10	60
1,2-Dichloropropane, see Propylenedichloride		
Dichlorotetrafluoroethane	1,000	7,000
Dieldrin—Skin		0.25
Diethylamine	25	75
Diethylamino ethanol—Skin	10	50
Diethylether, see Ethyl ether		
Difluorodibromomethane	100	860
C Diglycidyl ether (DGE)	0.5	2.8
Dihydroxybenzene, see Hydroquinone		
Diisobutyl ketone	50	290
Diisopropylamine—Skin	5	20

See footnotes at end of table.

TABLE Z-1—Continued

Substance	p.p.m.[a]	mg./M^3 [b]
Dimethoxymethane, see Methylal		
Dimethyl acetamide—Skin	10	35
Dimethylamine	10	18
Dimethylaminobenzene, see Xylidene		
Dimethylaniline(N-dimethylaniline)—Skin	5	25
Dimethylbenzene, see Xylene		
Dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate, (Dibrom)		3
Dimethylformamide—Skin	10	30
2,6-Dimethylheptanone, see Diisobutyl ketone		
1,1-Dimethylhydrazine—Skin	0.5	1
Dimethylphthalate		5
Dimethylsulfate—Skin	1	5
Dinitrobenzene (all isomers)—Skin		1
Dinitro-o-cresol—Skin		0.2
Dinitrotoluene—Skin		1.5
Dioxane (Diethylene dioxide)—Skin	100	360
Diphenyl	0.2	1
Diphenylmethane diisocyanate (see Methylene bisphenyl isocyanate (MDI)		
Dipropylene glycol methyl ether—Skin	100	600
Di-sec, octyl phthalate (Di-2-ethylhexylphthalate)		5
Endrin—Skin		0.1
Epichlorhydrin—Skin	5	19
EPN—Skin		0.5
1,2-Epoxypropane, see Propyleneoxide		
2,3-Epoxy-1-propanol, see Glycidol		
Ethanethiol, see Ethylmercaptan		
Ethanolamine	3	6
2-Ethoxyethanol—Skin	200	740
2-Ethoxyethylacetate (Cellosolve acetate)—Skin	100	540
Ethyl acetate	400	1,400
Ethyl acrylate—Skin	25	100
Ethyl alcohol (ethanol)	1,000	1,900
Ethylamine	10	18
Ethyl sec-amyl ketone (5-methyl-3-heptanone)	25	130
Ethyl benzene	100	435
Ethyl bromide	200	890
Ethyl butyl ketone (3-Heptanone)	50	230
Ethyl chloride	1,000	2,600
Ethyl ether	400	1,200
Ethyl formate	100	300
C Ethyl mercaptan	10	25
Ethyl silicate	100	850
Ethylene chlorohydrin—Skin	5	16
Ethylenediamine	10	25
C Ethylene glycol dinitrate and/or Nitroglycerin—Skin	[d] 0.2	1
Ethylene glycol monomethyl ether acetate, see Methyl cellosolve acetate		
Ethylene imine—Skin	0.5	1

See footnotes at end of table.

TABLE Z-1—Continued

Substance	p.p.m.[a]	mg./M^3 [b]
Ethylene oxide	50	90
Ethylidine chloride, see 1,1-Dichloroethane		
N-Ethylmorpholine—Skin	20	94
Ferbam		15
Ferrovanadium dust		1
Fluoride (as F)		2.5
Fluorine	0.1	0.2
Fluorotrichloromethane	1,000	5,600
Formic acid	5	9
Furfural—Skin	5	20
Furfuryl alcohol	50	200
Glycidol (2,3-Epoxy-1-propanol)	50	150
Glycol monoethyl ether, see 2-Ethoxyethanol		
Guthion ®, see Azinphos-methyl		
Hafnium		0.5
Heptachlor—Skin		0.5
Heptane (n-heptane)	500	2,000
Hexachloroethane—Skin	1	10
Hexachloronaphthalene—Skin		0.2
Hexane (n-hexane)	500	1,800
2-Hexanone	100	410
Hexone (Methyl isobutyl ketone)	100	410
sec-Hexyl acetate	50	300
Hydrazine—Skin	1	1.3
Hydrogen bromide	3	10
C Hydrogen chloride	5	7
Hydrogen cyanide—Skin	10	11
Hydrogen peroxide (90%)	1	1.4
Hydrogen selenide	0.05	0.2
Hydroquinone		2
C Iodine	0.1	1
Iron oxide fume		10
Isoamyl acetate	100	525
Isoamyl alcohol	100	360
Isobutyl acetate	150	700
Isobutyl alcohol	100	300
Isophorone	25	140
Isopropyl acetate	250	950
Isopropyl alcohol	400	980
Isopropylamine	5	12
Isopropylether	500	2,100
Isopropyl glycidyl ether (IGE)	50	240
Ketene	0.5	0.9
Lindane—Skin		0.5
Lithium hydride		0.025
L.P.G. (liquified petroleum gas)	1,000	1,800
Magnesium oxide fume		15
Malathion—Skin		15
Maleic anhydride	0.25	1
C Manganese		5
Mesityl oxide	25	100
Methanethiol, see Methyl mercaptan		
Methoxychlor		15
2-Methoxyethanol, see Methyl cellosolve		
Methyl acetate	200	610
Methyl acetylene (propyne)	1,000	1,650
Methyl acetylene-propadiene mixture (MAPP)	1,000	1,800
Methyl acrylate—Skin	10	35
Methylal (dimethoxymethane)	1,000	3,100
Methyl alcohol (methanol)	200	260
Methylamine	10	12
Methyl amyl alcohol, see Methyl isobutyl carbinol		
Methyl (n-amyl) ketone (2-Heptanone)	100	465
C Methyl bromide—Skin	20	80
Methyl butyl ketone, see 2-Hexanone		
Methyl cellosolve—Skin	25	80
Methyl cellosolve acetate—Skin	25	120
Methyl chloroform	350	1,900
Methylcyclohexane	500	2,000
Methylcyclohexanol	100	470
o-Methylcyclohexanone—Skin	100	460
Methyl ethyl ketone (MEK), see 2-Butanone		
Methyl formate	100	250
Methyl iodide—Skin	5	28
Methyl isobutyl carbinol—Skin	25	100
Methyl isobutyl ketone, see Hexone		
Methyl isocyanate—Skin	0.02	0.05
C Methyl mercaptan	10	20
Methyl methacrylate	100	410
Methyl propyl ketone, see 2-Pentanone		
C α Methyl styrene	100	480
C Methylene bisphenyl isocyanate (MDI)	0.02	0.2
Molybdenum:		
Soluble compounds		5
Insoluble compounds		15
Monomethyl aniline—Skin	2	9
C Monomethyl hydrazine—Skin	0.2	0.35
Morpholine—Skin	20	70
Naphtha (coaltar)	100	400
Naphthalene	10	50
Nickel carbonyl	0.001	0.007
Nickel, metal and soluble cmpds, as Ni		1
Nicotine—Skin		0.5
Nitric acid	2	5
Nitric oxide	25	30
p-Nitroaniline—Skin	1	6
Nitrobenzene—Skin	1	5
p-Nitrochlorobenzene—Skin		1
Nitroethane	100	310
C Nitrogen dioxide	5	9
Nitrogen trifluoride	10	29
C Nitroglycerin—Skin	0.2	2
Nitromethane	100	250
1-Nitropropane	25	90
2-Nitropropane	25	90
Nitrotoluene—Skin	5	30
Nitrotrichloromethane, see Chloropicrin		
Octachloronaphthalene—Skin		0.1
Octane	500	2,350
Oil mist, mineral		5
Organic Arsenic compounds (as As)		0.5
Osmium tetroxide		0.002
Oxalic acid		1
Oxygen difluoride	0.05	0.1
Ozone	0.1	0.2
Paraquat—Skin		0.5
Parathion—Skin		0.1
Pentaborane	0.005	0.01

See footnotes at end of table.

TABLE Z-1—Continued

Substance	p.p.m.[a]	mg./M^3 [b]
Pentachloronaphthalene—Skin		0.5
Pentachlorophenol—Skin		0.5
Pentane	1,000	2,950
2-Pentanone	200	700
Perchloromethyl mercaptan	0.1	0.8
Perchloryl fluoride	3	13.5
Petroleum distillates (naphtha)	500	2,000
Phenol—Skin	5	19
p-Phenylene diamine—Skin		0.1
Phenyl ether (vapor)	1	7
Phenyl ether-biphenyl mixture (vapor)	1	7
Phenylethylene, see Styrene		
Phenyl glycidyl ether (PGE)	10	60
Phenylhydrazine—Skin	5	22
Phosdrin (Mevinphos ®)—Skin		0.1
Phosgene (carbonyl chloride)	0.1	0.4
Phosphine	0.3	0.4
Phosphoric acid		1
Phosphorus (yellow)		0.1
Phosphorus pentachloride		1
Phosphorus pentasulfide		1
Phosphorus trichloride	0.5	3
Phthalic anhydride	2	12
Picric acid—Skin		0.1
Pival ® (2-Pivalyl-1,3-indandione)		0.1
Platinum (Soluble Salts) as Pt		0.002
Propane	1,000	1,800
n-Propyl acetate	200	840
Propyl alcohol	200	500
n-Propyl nitrate	25	110
Propylene dichloride	75	350
Propylene imine—Skin	2	5
Propylene oxide	100	240
Propyne, see Methylacetylene		
Pyrethrum		5
Pyridine	5	15
Quinone	0.1	0.4
Rhodium, Metal fume and dusts, as Rh		0.1
Soluble salts		0.001
Ronnel		15
Rotenone (commercial)		5
Selenium compounds (as Se)		0.2
Selenium hexafluoride	0.05	0.4
Silver, metal and soluble compounds		0.01
Sodium fluoroacetate (1080)—Skin		0.05
Sodium hydroxide		2
Stibine	0.1	0.5
Stoddard solvent	500	2,900
Strychnine		0.15
Sulfur dioxide	5	13
Sulfur hexafluoride	1,000	6,000
Sulfuric acid		1
Sulfur monochloride	1	6
Sulfur pentafluoride	0.025	0.25
Sulfuryl fluoride	5	20
Systox, see Demeton ®		
2,4,5T		10
Tantalum		5
TEDP—Skin		0.2
Tellurium		0.1
Tellurium hexafluoride	0.02	0.2
TEPP—Skin		0.05
C Terphenyls	1	9
1,1,1,2-Tetrachloro-2,2-difluoroethane	500	4,170
1,1,2,2-Tetrachloro-1,2-difluoroethane	500	4,170
1,1,2,2-Tetrachloroethane—Skin	5	35
Tetrachloromethane, see Carbon tetrachloride		
Tetrachloronaphthalene—Skin		2
Tetraethyl lead (as Pb)—Skin		0.075
Tetrahydrofuran	200	590
Tetramethyl lead (as Pb)—Skin		0.075
Tetramethyl succinonitrile—Skin	0.5	3
Tetranitromethane	1	8
Tetryl (2,4,6-trinitrophenylmethylnitramine)—Skin		1.5
Thallium (soluble compounds)—Skin as Tl		0.1
Thiram		5
Tin (inorganic cmpds, except oxides		2
Tin (organic cmpds)		0.1
C Toluene-2,4-diisocyanate	0.02	0.14
o-Toluidine—Skin	5	22
Toxaphene, see Chlorinated camphene		
Tributyl phosphate		5
1,1,1-Trichloroethane see Methyl chloroform		
1,1,2-Trichloroethane—Skin	10	45
Titaniumdioxide		15
Trichloromethane, see Chloroform		
Trichloronaphthalene—Skin		5
1,2,3-Trichloropropane	50	300
1,1,2-Trichloro 1,2,2-trifluoroethane	1,000	7,600
Triethylamine	25	100
Trifluoromonobromomethane	1,000	6,100
2,4,6-Trinitrophenol, see Picric acid		
2,4,6-Trinitrophenylmethylnitramine, see Tetryl		
Trinitrotoluene—Skin		1.5
Triorthocresyl phosphate		0.1
Triphenyl phosphate		3
Turpentine	100	560
Uranium (soluble compounds)		0.05
Uranium (insoluble compounds)		0.25
C Vanadium:		
V_2O_5 dust		0.5
V_2O_5 fume		0.1
Vinyl benzene, see Styrene		
Vinylcyanide, see Acrylonitrile		
Vinyl toluene	100	480
Warfarin		0.1
Xylene (xylol)	100	435
Xylidine—Skin	5	25
Yttrium		1
Zinc chloride fume		1
Zinc oxide fume		5
Zirconium compounds (as Zr)		5

See footnotes at end of table.

*“This standard applies in cotton yarn manufacturing until compliance with § 1910.1043 (c) and (e) is achieved.

[a] Parts of vapor or gas per million parts of contaminated air by volume at 25° C. and 760 mm. Hg pressure.

[b] Approximate milligrams of particulate per cubic meter of air.

(No footnote “c” is used to avoid confusion with ceiling value notations.)

[d] An atmospheric concentration of not more than 0.02 p.p.m., or personal protection may be necessary to avoid headache.

(b) Table Z–2:

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

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

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

TABLE Z–2

Material	8-hour time weighted average	Acceptable ceiling concentration	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift.	
			Concentration	Maximum
Benzene (Z37.40-1969)	10 p.p.m	25 p.p.m	50 p.p.m	10 minutes.
Beryllium and beryllium compounds (Z37.29–1970).	2 μg./M^3	5 μg./M^3	25 μg./M^3	30 minutes.
Cadmium dust (Z37.5–1970)	0.2 mg./M^3	0.6 mg./M^3		
Cadmium fume (Z37.5–1970)	0.1 mg./M^3	0.3 mg./M^3		
Carbon disulfide (Z37.3–1968)	20 p.p.m	30 p.p.m	100 p.p.m	30 minutes
Carbon tetrachloride (Z37.17–1967)	10 p.p.m	25 p.p.m	200 p.p.m	5 minutes in any 4 hours.
Ethylene dibromide (Z37.31–1970)	20 p.p.m	30 p.p.m	50 p.p.m	5 minutes.
Ethylene dichloride (Z37.21–1969)	50 p.p.m	100 p.p.m	200 p.p.m	5 minutes in any 3 hours.
Fluoride as dust (Z37.28–1969)	2.5 mg./M^3			
Formaldehyde (Z37.16–1967)	3 p.p.m	5 p.p.m	10 p.p.m	30 minutes.
Hydrogen fluoride (Z37.28–1969)	do			
Hydrogen sulfide (Z37.2–1966)		20 p.p.m	50 p.p.m	10 minutes once only if no other measurable exposure occurs.
Methyl chloride (Z37.18–1969)	100 p.p.m	200 p.p.m	300 p.p.m	5 minutes in any 3 hours.
Methylene Chloride (Z37.3–1969)	500 p.p.m	1,000 p.p.m	2,000 p.p.m	5 minutes in any 2 hours.
Organo (alkyl) mercury (Z37.30–1969)	0.01 mg./M^3	0.04 mg./M^3		
Styrene (Z37.15–1969)	100 p.p.m	200 p.p.m	600 p.p.m	5 minutes in any 3 hours.
Tetrachloroethylene (Z37.22–1967)	100 p.p.m	200 p.p.m	300 p.p.m	5 minutes in any 3 hours.
Toluene (Z37.12–1967)	200 p.p.m	300 p.p.m	500 p.p.m	10 minutes.
Trichloroethylene (Z37.19–1967)	100 p.p.m	200 p.p.m	300 p.p.m	5 minutes in any 2 hours.
Mercury (Z37.8–1971)		1 mg./10M^3		
Chromic acid and chromates (Z37.7–1971)		do^3		

[46 F.R. 32022, June 19, 1981]

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

TABLE Z–3—MINERAL DUSTS

Substance	Mppcf [e]	Mg/M³
Silica:		
Crystalline:		
Quartz (respirable)	$\frac{250}{\%SiO_2+5}$ [f]	$\frac{10mg/M^3}{\%SiO_2+2}$ [m]
Quartz (total dust)		$\frac{30mg/M^3}{\%S_2O_2+2}$
Cristobalite: Use ½ the value calculated from the count or mass formulae for quartz.		
Tridymite: Use ½ the value calculated from the formulae for quartz.		
Amorphous, including natural diatomaceous earth	20	$\frac{80mg/M^3}{\%SiO_2}$
Silicates (less than 1% crystalline silica):		
Mica	20	
Soapstone	20	
Talc (non-asbestos-form)	20[n]	
Talc (fibrous). Use asbestos limit		
Tremolite (see talc, fibrous)		
Portland cement	50	
Graphite (natural)	15	
Coal dust (respirable fraction less than 5% SiO_2)		2.4mg/M³ or
For more than 5% SiO_2		$\frac{10mg/M^3}{\%SiO_2+2}$
Inert or Nuisance Dust:		
Respirable fraction	15	5mg/M³
Total dust	50	15mg/M³

NOTE: Conversion factors—
mppcf×35.3=million particles per cubic meter
=particles per c.c.

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[e] Millions of particles per cubic foot of air, based on impinger samples counted by light-field technics.

[f] The percentage of crystalline silica in the formula is the amount determined from air-borne samples, except in those instances in which other methods have been shown to be applicable.

[m] Both concentration and percent quartz for the application of this limit are to be determined from the fraction passing a size-selector with the following characteristics:

[n] Containing < 1% quartz; if > 1% quartz, use quartz limit.

(d) Computation formulae:

(1)

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

$$E = \frac{C_aT_a + C_bT_b + \ldots C_nT_n}{8}$$

where:

E is the equivalent exposure for the working shift.

C is the concentration during any period of time T where the concentration remains constant.

T is the duration in hours of the exposure at the concentration C.

The value of E shall not exceed the 8-hour time weighted average limit in table Z–1, Z–2, or Z–3 for the material involved.

(ii) To illustrate the formula prescribed in subdivision (i) of this subparagraph, note that isoamyl acetate has an 8-hour time weighted average limit of 100 p.p.m. (table Z–1). Assume that an employee is subject to the following exposure:

Two hours exposure at 150 p.p.m.
Two hours exposure at 75 p.p.m.
Four hours exposure at 50 p.p.m.

Substituting this information in the formula, we have

$$\frac{2 \times 150 + 2 \times 75 + 4 \times 50}{8} = 81.25 \text{ p.p.m.}$$

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

(2)

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

$$E_m = \frac{C_1}{L_1} + \frac{C_2}{L_2} + \ldots \frac{C_n}{L_n}$$

where:

E_m is the equivalent exposure for the mixture.

C is the concentration of a particular contaminant.

L is the exposure limit for that contaminant, from table Z–1, Z–2, or Z–3.

The value of E_m shall not exceed unity (1).

(ii) To illustrate the formula prescribed in subdivision (i) of this subparagraph, consider the following exposures:

Material	Actual concentration of 8-hour exposure	8-hour time weighted average exposure limit
Acetone (Table Z–1)	500 p.p.m.	1,000 p.p.m.
2-Butanone (Table Z–1)	45 p.p.m.	200 p.p.m.
Toluene (Table Z–2)	40 p.p.m.	200 p.p.m.

Substituting in the formula, we have:

$$E_m = \frac{500}{1,000} + \frac{45}{200} + \frac{40}{200}$$
$$E_m = 0.500 + 0.225 + 0.200$$
$$E_m = 0.925$$

Since E_m is less than unity (1), the exposure combination is within acceptable limits.

(e) To achieve compliance with paragraph (a) through (d) of this section, administrative or engineering controls must first be determined and implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this section. Any equipment and/or technical measures used for this purpose must be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used, their use shall comply with § 1910.134.

Threshold Limit Values
for Chemical Substances and Physical Agents
in the Work Environment
with Intended Changes for
1983-84

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PREFACE
CHEMICAL SUBSTANCES

Threshold limit values refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Because of wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or below the threshold limit; a smaller percentage may be affected more seriously by aggravation of a pre-existing condition or by development of an occupational illness.

Threshold limits are based on the best available information from industrial experience, from experimental human and animal studies, and, when possible, from a combination of the three. The basis on which the values are established may differ from substance to substance; protection against impairment of health may be a guiding factor for some, whereas reasonable freedom from irritation, narcosis, nuisance or other forms of stress may form the basis for others.

The amount and nature of the information available for establishing a TLV varies from substance to substance; consequently, the precision of the estimated TLV is also subject to variation and the latest *Documentation* should be consulted in order to assess the extent of the data available for a given substance.

These limits are intended for use in the practice of industrial hygiene and should be interpreted and applied only by a person trained in this discipline. They are not intended for use, or for modification for use, (1) as a relative index of hazard or toxicity, (2) in the evaluation or control of community air pollution nuisances, (3) in estimating the toxic potential of continuous, uninterrupted exposures or other extended work periods, (4) as proof or disproof of an existing disease or physical condition, or (5) for adoption by countries whose working conditions differ from those in the United States of America and where substances and processes differ.

The TLV-TWA should be used as guides in the control of health hazards and should not be used as fine lines between safe and dangerous concentrations.

In spite of the fact that serious injury is not believed likely as a result of exposure to the threshold limit concentrations, the best practice is to maintain concentrations of all atmospheric contaminants as low as is practical.

Legal Status. The Threshold Limit Values, as issued by ACGIH, are recommendations and should be used as guidelines for good practices. Wherever these values (of whatever year) have been used or included by reference in Federal and/or State statutes and registers, the TLVs do have the force and effects of law.

"Notice of Intent." At the beginning of each year, proposed actions of the Committee for the forthcoming year are issued in the form of a "Notice of Intended Changes." This Notice provides not only an opportunity for comment, *but solicits suggestions of substances to be added to the list*. The suggestions *should be accompanied by substantiating evidence.* The list of Intended Changes follows the Adopted Values in the TLV booklet. Values listed in parenthesis in the "Adopted" list are to be used during the period in which a proposed change for that Value is listed in the Notice of Intended Changes.

Definitions. Three categories of Threshold Limit Values (TLVs) are specified herein, as follows:

a) The Threshold Limit Value-Time Weighted Average (TLV-TWA) — the time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

b) Threshold Limit Value-Short Term Exposure Limit (TLV-STEL) — the concentration to which workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible tissue damage, or 3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded. It is not a separate independent exposure limit, rather it supplements the time-weighted average (TWA) limit where there are recognized acute effects from a substance whose toxic effects are primarily of a chronic nature. STELs are recommended only where toxic effects have been reported from high short-term exposures in either humans or animals.

A STEL is defined as a 15-minute time-weighted average exposure which should not be exceeded at any time during a work day even if the eight-hour time-weighted average is within the TLV. Exposures at the STEL should not be longer than 15 minutes and should not be repeated more than four times per day. There should be at least 60 minutes between successive exposures at the STEL. An averaging period other than 15 minutes may be recommended when this is warranted by observed biological effects.

c) Threshold Limit Value-Ceiling (TLV-C) — the concentration that should not be exceeded even instantaneously.

For some substances, e.g., irritant gases, only one category, the TLV-Ceiling, may be relevant. For other substances, either two or three categories may be relevant, depending upon their physiologic action. It is important to observe that if any one of these three TLVs is exceeded, a potential hazard from that substance is presumed to exist.

The committee holds to the opinion that limits based on physical irritation should be considered no less binding than those based on physical impairment. There is increasing evidence that physical irritation may initiate, promote or accelerate physical impairment through interaction with other chemical or biologic agents.

Time-Weighted Average vs Ceiling Limits. Time-weighted averages permit excursions above the limit provided they are compensated by equivalent excursions below the limit during the workday. In some instances it may be permissible to calculate the average concentration for a workweek rather than for a workday. The relationship between threshold limit and permissible excursion is a rule of thumb and in certain cases may not apply. The amount by which threshold limits may be exceeded for short periods without injury to health depends upon a number of factors such as the nature of the contaminant, whether very high concentrations — even for short periods — produce acute poisoning, whether the effects are cumulative, the frequency with which high concentrations occur, and the duration of such periods. All-factors must be taken into consideration in arriving at a decision as to whether a hazardous condition exists.

Although the time-weighted average concentration provides the most satisfactory, practical way of monitoring airborne agents for compliance with the limits, there are certain substances for which it is inappropriate. In the latter group are substances which are predominantly fast acting and whose threshold limit is more appropriately based on this particular response. Substances with this type of response are best controlled by a ceiling "C" limit that should not be exceeded. It is implicit in these definitions that the manner of sampling to determine noncompliance with the limits for each group must differ; a single brief sample, that is applicable to a "C" limit, is not appropriate to the time-weighted limit; here, a sufficient number of samples are needed to permit a time-weighted average concentration throughout a complete cycle of operations or throughout the work shift.

Whereas the ceiling limit places a definite boundary which concentrations should not be permitted to exceed, the time-weighted average limit requires an explicit limit to the excursions that are permissible above the listed values. It should be noted that the same factors are used by the Committee in determining the magnitude of the value of the STELs, or whether to include or exclude a substance for a "C" listing.

Excursion Limits. For the vast majority of substances with a TLV, there is not enough toxicological data available to warrent a STEL. Nevertheless, excursions above the TWA-TLV should be controlled even where the eight-hour TWA is within recommended limits. Earlier editions of the TLV list included such limits whose values depended on the TWA-TLVs of the substance in question.

While no rigorous rationale was provided for these particular values, the basic concept was intuitive: in a well controlled process exposure, excursions should be held within some reasonable limits. Unfortunately, neither toxicology nor collective industrial hygiene experience provide a solid basis for quantifying what those limits should be. The approach here is that the maximum recommended excursion should be related to the variability generally observed in actual industriall processes. Leidel, Busch and Crouse,* in reviewing large numbers of industrial hygiene surveys conducted by NIOSH, found that short-term exposure measurements were generally log normally distributed with geometric standard deviations mostly in the range of 1.5 to 2.0.

While a complete discussion of the theory and properties of the log normal distribution is beyond the scope of this section, a brief description of some important terms is presented. The measure of central tendency in a log normal distribution is the antilog of the mean logarithm of the sample values. The distribution is skewed and the geometric mean is always smaller than the arithmetic mean by an amount which depends on the geometric standard deviation. In the log normal distribution, the geometric standard deviation (sd_g) is the antilog of the standard deviation of the sample value logarithms and 68.26% of all values lie between m_g/sd_g and $m_g \times sd_g$.

If the short-term exposure values in a given situation have a geometric standard deviation of 2.0, 5% of all values exceed 3.13 times the geometric mean. If a process displays a variability greater than this, it is not under good control and efforts should be made to restore control. This concept is the basis for the new excursion limit recommendations which are as follows:

> *Short-term exposures should exceed three times the TLV-TWA for no more than a total of 30 minutes during a work day and under no circumstances should they exceed five times the TLV, provided that the TLV-TWA is not exceeded.*

The approach is a considerable simplification of the idea of the log normal concentration distribution but is considered more convenient to use by the practicing industrial hygienist. If exposure excursions are maintained within the recommended limits, the geometric standard deviation of the concentration measurements will be near two and the goal of the recommendation will be accomplished.

When the toxicologic data for a specific substance are available to establish a STEL, this value takes precedence over the excursion limit regardless of whether it is more or less stringent.

"Skin" Notation. Listed substances followed by the designation "Skin" refer to the potential contribution to the overall exposure by the cutaneous route including mucous membranes and eye, either by air borne, or more particularly, by direct contact with the substance. Vehicles can alter skin absorption.

Little quantitative data are available describing absorption of vapors and gases through the skin. The rate of absorption is a function of the concentration to which the skin is exposed.

Substances having a skin notation and a low TLV may present a problem at high airborne concentrations, particularly if a significant area of the skin is exposed for a long period of time. Protection of the respiratory tract, while the rest of the body surface is exposed to a high concentration, may present such a situation.

Biological monitoring should be considered to determine the relative contribution of dermal exposure to the total dose.

This attention-calling designation is intended to suggest appropriate measures for the prevention of cutaneous absorption so that the threshold limit is not invalidated.

Mixtures. Special consideration should be given also to the application of the TLVs in assessing the health hazards which may be associated with exposure to mixtures of two or more substances. A brief discussion of basic considerations involved in developing threshold limit values for mixtures, and methods for their development, amplified by specific examples are given in Appendix C.

Nuisance Particulates. In contrast to fibrogenic dusts which cause scar tissue to be formed in lungs when inhaled in excessive amounts, so-called "nuisance" dusts have a long history of little adverse effect on lungs and do not produce significant organic disease or toxic effect when exposures are kept under reasonable control. The nuisance dusts have also been called (biologically) "inert" dusts, but the latter term is inappropriate to the extent that there is no dust which does not evoke some cellular response in the lung when inhaled in sufficient amount. However, the lung-tissue reaction caused by inhalation of nuisance dusts has the following characteristics: (1) The architecture of the air spaces remains intact. (2)

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*Leidel, N.A., K.A. Busch and W.E. Crouse: *Exposure Measurement, Action Level and Occupational Environmental Variability*. NIOSH Pub. No. 76-131 (December 1975).

Collagen (scar tissue) is not formed to a significant extent. (3) The tissue reaction is potentially reversible.

Excessive concentrations of nuisance dusts in the workroom air may seriously reduce visibility, may cause unpleasant deposits in the eyes, ears and nasal passages (Portland Cement dust), or cause injury to the skin or mucous membranes by chemical or mechanical action per se or by the rigorous skin cleansing procedures necessary for their removal.

A threshold limit of 10 mg/m^3, or 30 mppcf, of total dust $<$ 1% quartz, or, 5 mg/m^3 respirable dust is recommended for substances in these categories and for which no specific threshold limits have been assigned. This limit, for a normal workday, does not apply to brief exposures at higher concentrations. Neither does it apply to those substances which may cause physiologic impairment at lower concentrations but for which a threshold limit has not yet been adopted. Some nuisance particulates are given in Appendix D.

Simple Asphyxiants — "Inert" Gases or Vapors. A number of gases and vapors, when present in high concentrations in air, act primarily as simple asphyxiants without other significant physiologic effects. A TLV may not be recommended for each simple asphyxiant because the limiting factor is the available oxygen. The minimal oxygen content should be 18 percent by volume under normal atmospheric pressure (equivalent to a partial pressure, pO_2 of 135 mm Hg). Atmospheres deficient in O_2 do not provide adequate warning and most simple asphyxiants are odorless. Several simple asphyxiants present an explosion hazard. Account should be taken of this factor in limiting the concentration of the asphyxiant. Specific examples are listed in Appendix E.

Physical Factors. It is recognized that such physical factors as heat, ultraviolet and ionizing radiation, humidity, abnormal pressure (altitude) and the like may place added stress on the body so that the effects from exposure at a threshold limit may be altered. Most of these stresses act adversely to increase the toxic response of a substance. *Although most threshold limits have built-in safety factors to guard against adverse effects to moderate deviations* from normal environments, the safety factors of most substances are not of such a magnitude as to take care of gross deviations. For example, continuous work at temperatures above 90°F, or overtime extending the workweek more than 25%, might be considered gross deviations. In such instances judgment must be exercised in the proper adjustments of the Threshold Limit Values.

Biologic Limit Values (BLVs). Other means exist and may be necessary for monitoring worker exposure other than reliance on the Threshold Limit Values for industrial air, namely, the Biologic Limit Values. These values represent limiting amounts of substances (or their effects) to which the worker may be exposed without hazard to health or well-being as determined in *his* tissues and fluids or in *his* exhaled breath. The biologic measurements on which the BLVs are based can furnish two kinds of information useful in the control of worker exposure: (1) measure of the individual worker's over-all exposure; (2) measure of the worker's individual and characteristic response. Measurements of response furnish a superior estimate of the physiologic status of the worker, and may be made of (a) changes in amount of some critical biochemical constituent, (b) changes in activity of a critical enzyme, (c) changes in some physiologic function. Measurement of exposure may be made by (1) determining in blood, urine, hair, nails, in body tissues and fluids, the amount of substance to which the worker was exposed; (2) determination of the amount of the metabolite(s) of the substance in tissues and fluids; (3) determination of the amount of the substance in the exhaled breath. The biologic limits may be used as an adjunct to the TLVs for air, *or in place of them*. The BLVs, and their associated procedures for determining compliance with them, should thus be regarded as an effective means of providing health surveillance of the worker.

Tests are available (*J. Occup. Med. 15*:564, 1973; *Ann. N.Y. Acad. Sci. 151, Art. 2*:968, 1968) that may be used to detect those individuals hypersusceptible to a variety of industrial chemicals (respiratory irritants, hemolytic chemicals, organic isocyanates, carbon disulfide).

Unlisted Substances. Many substances present or handled in industrial processes do not appear on the TLV list. In a number of instances the material is rarely present as a particulate, vapor or other airborne contaminant, and a TLV is not necessary. In other cases sufficient information to warrant development of a TLV, even on a tentative basis, is not available to the Committee. Other substances, of low toxicity, could be included in Appendix D pertaining to nuisance particulates. This list (as well as Appendix E) is not meant to be all inclusive; the substances serve only as examples.

In addition there are some substances of not in considerable toxicity, which have been omitted primarily because only a limited number of workers (e.g., employees of a single plant) are known to have potential exposure to possibly harmful concentrations.

Trade names. Because many chemical substances are marketed under several trade names, the trade names have been replaced with their generic equivalent in the alphabetical listing. Appendix H was created to ease this transition and the CAS number appears with the generic name to aid identification.

Operational Guidelines: The ACGIH Board of Directors has adopted operational guidelines for the Chemical Substances TLV Committee. These guidelines prescribe: charge, authority, policies, membership, organization, and operating procedures. The policies include the appeals procedures. Copies of the guidelines document are available from the Publications Office at a cost of $5 per copy.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
Acetaldehyde [75-07-0].....	100	180	150	270
Acetic acid [64-19-7]	10	25	15	37
Acetic anhydride [108-24-7]................	C 5	C 20	—	—
Acetone [67-64-1]...........	750	1,780	1,000	2,375
Acetonitrile [75-05-8] — Skin	40	70	60	105
Acetylene [74-86-2].........	E	—	—	—
Acetylene dichloride, see 1, 2-Dichloroethylene				
Acetylene tetrabromide [79-27-6]	1	15	1.5	20
Acetylsalicylic acid (Asprin) [50-78-2]	—	5	—	—
Acrolein [107-02-8].........	0.1	0.25	0.3	0.8
Acrylamide [79-06-1] — Skin	—	0.3	—	0.6
Acrylic acid [79-10-7].......	10	30	—	—
‡Acrylonitrile [107-13-1] — Skin	(2, A1a)	(4.5, A1a)	—	—
Aldrin [309-00-2] — Skin ..	—	0.25	—	0.75
Allyl alcohol [107-18-6] — Skin	2	5	4	10
Allyl chloride [107-05-1] ...	1	3	2	6
Allyl glycidyl ether (AGE) [106-92-3] — Skin.......	5	22	10	44
Allyl propyl disulfide [2179-59-1]...............	2	12	3	18
α-Alumina [1344-28-1].....	—	D	—	20
Aluminum [7429-90-5]				
Metal & oxide	—	10	—	20
Pyro powders	—	5	—	—
Welding fumes...........	—	5	—	—
Soluble salts	—	2	—	—
Alkyls (NOC†)	—	2	—	—
4-Aminodiphenyl [92-67-1] — Skin....................	—	A1b	—	A1b
2-Aminoethanol, see Ethanolamine				
2-Aminopyridine [504-29-0]................	0.5	2	2	4
3-Amino 1, 2, 4-triazole, see Amitrol				
Amitrol [61-82-5]...........	A2	A2	—	—
Ammonia [7664-41-7]......	25	18	35	27
Ammonium chloride fume [12125-02-9].............	—	10	—	20
Ammonium sulfamate [7773-06-0]	—	10	—	20
n-Amyl acetate [628-63-7] .	100	530	150	800
sec-Amyl acetate [626-38-0]................	125	670	150	800
Aniline [62-53-3] & homologues — Skin	2	10	5	20
Anisidine [29191-52-4] (o-, p-isomers) — Skin.......	0.1	0.5	—	—
Antimony [7440-36-0] & compounds, as Sb	—	0.5	—	—
Antimony trioxide [1309-64-4]				
Handling and use, as Sb	—	0.5	—	—
Production................	—	A2	—	—
ANTU [86-88-4]	—	0.3	—	0.9

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f)
‡See Notices of Intended Changes.
†NOC = Not otherwise classified.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
Argon [7440-37-1]..........	E	—	—	—
Arsenic [7440-38-2] & soluble compounds, as As..........................	—	0.2	—	—
Arsenic trioxide production [1327-53-3]..............	—	A2	—	—
Arsine [7784-42-1]..........	0.05	0.2	—	—
Asbestos [1332-21-4], see MINERAL DUSTS.........	—	A1a	—	A1a
Asphalt (petroleum) fumes [8052-42-4]..............	—	5	—	10
*Atrazine [1912-24-9]........	—	5	—	—
Azinphos-methyl [86-50-0] — Skin	—	0.2	—	0.6
Barium [7440-39-3], soluble compounds, as Ba..........................	—	0.5	—	—
Benomyl [17804-35-2]	0.8	10	1.3	15
Benzene [71-43-2]	10, A2	30, A2	25, A2	75, A2
Benzidine [92-87-5] — Skin	—	A1b	—	A1b
p-Benzoquinone, see Quinone				
Benzoyl peroxide [94-36-0]	—	5	—	—
Benzo(a)pyrene [50-32-8]..	—	A2	—	A2
Benzvl chloride [100-44-7].	1	5	—	—
Beryllium [7440-41-7]......	—	0.002, A2	—	—
Biphenyl [92-52-4]..........	0.2	1.5	0.6	4
Bismuth telluride [1304-82-1]..............	—	10	—	20
Se-doped	—	5	—	10
Borates, tetra, sodium salts [1303-96-4],				
Anhydrous................	—	1	—	—
Decahydrate..............	—	5	—	—
Pentahydrate.............	—	1	—	—
Boron oxide [1303-86-2]...	—	10	—	20
Boron tribromide [10294-33-4].............	1	10	3	30
Boron trifluoride [7637-07-2]..............	C 1	C 3	—	—
Bromacil [314-40-9]	1	10	2	20
Bromine [7726-95-6]	0.1	0.7	0.3	2
Bromine pentafluoride [7789-30-2]	0.1	0.7	0.3	2
Bromochloromethane, see Chlorobromomethane				
Bromoform [75-25-2] — Skin	0.5	5	—	—
‡ 1, 3-Butadiene [106-99-0] .	(1,000)	(2,200)	(1,250)	(2,750)
Butane [106-97-8]...........	800	1,900	—	—
Butanethiol, see Butyl mercaptan				
2-Butanone, see Methyl ethyl ketone (MEK)				
2-Butoxyethanol [111-76-2] — Skin.......	25	120	75	360
n-Butyl acetate [123-86-4] .	150	710	200	950
sec-Butyl acetate [105-46-4]................	200	950	250	1,190
tert-Butyl acetate [540-88-5]................	200	950	250	1,190
Butyl acrylate [141-32-2]...	10	55	—	—
n-Butyl alcohol [71-36-3] — Skin....................	C 50	C 150	—	—

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Footnotes (a thru f)
*1983 Addition
‡See Notice of Intended Changes.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	**ppm$^{a)}$**	**mg/m$^{3\,b)}$**	**ppm$^{a)}$**	**mg/m$^{3\,b)}$**
sec-Butyl alcohol [78-92-2]	100	305	150	455
tert-Butyl alcohol [75-65-0]	100	300	150	450
Butylamine [109-73-9] — Skin	C 5	C 15	—	—
tert-Butyl chromate, as CrO$_3$ [1189-85-1] — Skin	—	C 0.1	—	—
n-Butyl glycidyl ether (BGE) [2426-08-6]	25	135	—	—
n-Butyl lactate [138-22-7]	5	25	—	—
Butyl mercaptan [109-79-5]	0.5	1.5	—	—
o-sec-Butylphenol [89-72-5] — Skin	5	30	—	—
p-tert-Butyltoluene [98-51-1]	10	60	20	120
Cadmium [7440-43-9]				
Dust & salts, as Cd	—	0.05	—	0.2
Cadmium oxide [1306-19-0]				
Fume, as Cd	—	C 0.05	—	—
* Production	—	0.05	—	—
Calcium carbonate/ marble [1317-65-3]	—	D	—	20
Calcium cyanamide [156-62-7]	—	0.5	—	1
Calcium hydroxide [1305-62-0]	—	5	—	—
Calcium oxide [1305-78-8]	—	2	—	—
Calcium silicate [1344-95-2]	—	D	—	—
Camphor, synthetic [76-22-2]	2	12	3	18
Caprolactam [105-60-2]				
Dust	—	1	—	3
Vapor	5	20	10	40
Captafol [2425-06-1] — Skin	—	0.1	—	—
Captan [133-06-2]	—	5	—	15
Carbaryl [63-25-2]	—	5	—	10
Carbofuran [1563-66-2]	—	0.1	—	—
Carbon black [1333-86-4]	—	3.5	—	7
Carbon dioxide [124-38-9]	5,000	9,000	15,000	27,000
Carbon disulfide [75-15-0] — Skin	10	30	—	—
Carbon monoxide [630-08-0]	50	55	400	440
Carbon tetrabromide [558-13-4]	0.1	1.4	0.3	4
Carbon tetrachloride [56-23-5] — Skin	5, A2	30, A2	20, A2	125, A2
Carbonyl chloride, see Phosgene				
Carbonyl fluoride [353-50-4]	2	5	5	15
Catechol (Pyrocatechol) [120-80-9]	5	20	—	—
Cellulose (paper fiber) [9004-34-6]	—	D	—	20
Cesium hydroxide [21351-79-1]	—	2	—	—
Chlordane [57-74-9] — Skin	—	0.5	—	2

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Footnotes (a thru f)
*1983 Addition.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	**ppm$^{a)}$**	**mg/m$^{3\,b)}$**	**ppm$^{a)}$**	**mg/m$^{3\,b)}$**
Chlorinated camphene [8001-35-2] — Skin	—	0.5	—	1
Chlorinated diphenyl oxide [55720-99-5]	—	0.5	—	2
Chlorine [7782-50-5]	1	3	3	9
Chlorine dioxide [10049-04-4]	0.1	0.3	0.3	0.9
Chlorine trifluoride [7790-91-2]	C 0.1	C 0.4	—	—
Chloroacetaldehyde [107-20-0]	C 1	C 3	—	—
α-Chloroacetophenone [532-27-4] (Phenacyl chloride)	0.05	0.3	—	—
Chloroacetyl chloride [79-04-9]	0.05	0.2	—	—
Chlorobenzene [108-90-7] (Monochlorobenzene)	75	350	—	—
*o-Chlorobenzylidene malononitrile [2698-41-1] — Skin	C 0.05	C 0.4	—	—
Chlorobromomethane [74-97-5]	200	1,050	250	1,300
2-Chloro-1, 3-butadiene, see β Chloroprene				
Chlorodifluoromethane [75-45-6]	1,000	3,500	1,250	4,375
Chlorodiphenyl (42% Chlorine) [53449-21-9] — Skin	—	1	—	2
Chlorodiphenyl (54% Chlorine) [11097-69-1] — Skin	—	0.5	—	1
1-Chloro, 2, 3-epoxy-propane, see Epichlorohydrin				
2-Chloroethanol, see Ethylene chlorohydrin				
Chloroethylene, see Vinyl chloride				
Chloroform [67-66-3]	10, A2	50, A2	50, A2	225, A2
bis-Chloromethyl ether [542-88-1]	0.001, A1a	0.005, A1a	—	—
*Chloromethyl methyl ether [107-30-2]	A2	A2	—	—
1-Chloro-1-nitropropane [600-25-9]	2	10	—	—
Chloropentafluoroethane [76-15-3]	1,000	6,320	—	—
Chloropicrin [76-06-2]	0.1	0.7	0.3	2
β-Chloroprene [126-99-8] — Skin	10	45	—	—
o-Chlorostyrene [1331-28-8]	50	285	75	430
o-Chlorotoluene [95-49-8] — Skin	50	250	75	375
2-Chloro- 6-(trichloromethyl) pyridine, see Nitrapyrin				
Chlorpyrifos [2921-88-2] — Skin	—	0.2	—	0.6
Chromite ore processing (Chromate), as Cr.	—	0.05, A1a	—	—
Chromium [7440-47-3]				
Metal	—	0.5	—	—
Chromium (II) compounds, as Cr	—	0.5	—	—

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Footnotes (a thru f)
*1983 Addition.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm$^{a)}$	mg/m$^{3\,b)}$	ppm$^{a)}$	mg/m$^{3\,b)}$
Chromium (III) compounds, as Cr	—	0.5	—	—
Chromium (VI) compounds, as Cr				
Water soluble	—	0.05	—	—
Certain water insoluble	—	0.05, Ala	—	—
Chromyl chloride [14977-61-8]	0.025	0.15	—	—
Chrysene [218-01-9]	A2	A2	—	—
Clopidol [2971-90-6]	—	10	—	20
Coal tar pitch volatiles *[8007-45-2], as benzene* solubles	—	0.2, A1a	—	—
‡Cobalt [7440-48-4], as Co metal, dust & fume	—	(0.1)	—	—
**Cobalt carbonyl* [00000-00-0], as Co	—	0.1	—	—
*Cobalt hydrocarbonyl [16842-03-8], as Co	—	0.1	—	—
Copper [7440-50-8]				
Fume	—	0.2	—	—
Dusts & mists, as Cu	—	1	—	2
Cotton dust, raw	—	0.2$^{k)}$	—	0.6
Cresol [1319-77-3], all isomeres — Skin	5	22	—	—
Crotonaldehyde [123-73-9]	2	6	6	18
Crufomate [299-86-5]	—	5	—	20
Cumene [98-82-8] — Skin	50	245	75	365
Cyanamide [420-04-2]	—	2	—	—
Cyanides [151-50-8; 143-33-9], as CN — Skin	—	5	—	—
Cyanogen [460-19-5]	10	20	—	—
Cyanogen chloride [506-77-4]	C 0.3	C 0.6	—	—
Cyclohexane [110-82-7]	300	1,050	375	1,300
Cyclohexanol [108-93-0]	50	200	—	—
Cyclohexanone [108-94-1]	25	100	100	400
Cyclohexene [110-83-8]	300	1,015	—	—
Cyclohexylamine [108-91-8] — Skin	10	40	—	—
Cyclonite [121-82-4] — Skin	—	1.5	—	3
Cyclopentadiene [542-92-7]	75	200	150	400
Cyclopentane [287-92-3]	600	1,720	900	2,580
Cyhexatin [13121-70-5]	—	5	—	10
2, 4-D [94-75-7]	—	10	—	20
DDT (Dichlorodiphenyl-trichloroethane) [50-29-3]	—	1	—	3
Decaborane [17702-41-9] — Skin	0.05	0.3	0.15	0.9
Demeton [8065-48-3] — Skin	0.01	0.1	0.03	0.3
Diacetone alcohol [123-42-2]	50	240	75	360
1, 2-Diaminoethane, see Ethylenediamine				
Diazinon [333-41-5] — Skin	—	0.1	—	0.3

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Footnotes (a thru f)
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	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm$^{a)}$	mg/m$^{3\,b)}$	ppm$^{a)}$	mg/m$^{3\,b)}$
Diazomethane [334-88-3]	0.2	0.4	—	—
Diborane [19287-45-7]	0.1	0.1	—	—
1, 2-Dibromoethane, see Ethylene dibromide				
2-N-Dibutylaminoethanol [102-81-8] — Skin	2	14	4	28
Dibutyl phosphate	1	5	2	10
Dibutyl phthalate [84-74-2]	—	5	—	10
Dichloroacetylene [7572-29-4]	C 0.1	C 0.4	—	—
o-Dichlorobenzene [95-50-1]	C 50	C 300	—	—
p-Dichlorobenzene [106-46-7]	75	450	110	675
3, 3'-Dichlorobenzidine [91-94-11] — Skin	—	A2	—	A2
Dichlorodifluoromethane [75-71-8]	1,000	4,950	1,250	6,200
1, 3-Dichloro-5, 5-dimethyl hydantoin [118-52-5]	—	0.2	—	0.4
1, 1-Dichloroethane [75-34-3]	200	810	250	1,010
1, 2-Dichloroethane, see Ethylene dichloride				
1, 1-Dichloroethylene, see Vinylidene chloride				
1, 2-Dichloroethylene [540-59-0]	200	790	250	1,000
Dichloroethyl ether [111-44-4] — Skin	5	30	10	60
Dichlorofluoromethane [75-43-4]	10	40	—	—
Dichloromethane, see Methylene chloride				
1, 1-Dichloro-1-nitroethane [594-72-9]	2	10	10	60
1, 2-Dichloropropane, see Propylene dichloride				
Dichloropropene [542-75-6] — Skin	1	5	10	50
2, 2-Dichloropropionic acid [75-99-0]	1	6	—	—
Dichlorotetrafluoroethane [76-14-2]	1,000	7,000	1,250	8,750
Dichlorvos [62-73-7] — Skin	0.1	1	0.3	3
Dicrotophos [141-66-2] — Skin	—	0.25	—	—
Dicyclopentadiene [77-73-6]	5	30	—	—
Dicyclopentadienyl iron [102-54-5]	—	10	—	20
Dieldrin [60-57-1] — Skin	—	*0.25*	—	*0.75*
Diethanolamine [111-42-2]	3	15	—	—
Diethylamine [109-89-7]	10	30	25	75
Diethylaminoethanol *[100-37-8] — Skin*	*10*	50	—	—
Diethylene triamine [111-40-0] — Skin	1	4	—	—
Diethyl ether, see Ethyl ether				
Diethyl ketone [96-22-0]	200	705	—	—
Diethyl phthalate [84-66-2]	—	5	—	10
Difluorodibromomethane [75-61-6]	100	860	150	1,290
Diglycidyl ether (DGE) [2238-07-5]	0.1	0.5	—	—

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Footnotes (a thru f)

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
Dihydroxybenzene, see Hydroquinone				
Diisobutyl ketone [108-83-8]	25	150	—	—
Diisopropylamine [108-18-9] — Skin	5	20	—	—
Dimethoxymethane, see Methylal				
Dimethyl acetamide [127-19-5] — Skin	10	35	15	50
Dimethylamine [124-40-3]	10	18	—	—
Dimethylaminobenzene, see Xylidene				
Dimethylaniline [121-69-7] (N, N-Dimethylaniline) — Skin	5	25	10	50
Dimethylbenzene, see Xylene				
Dimethyl carbamyl chloride [79-44-7]	A2	A2	—	—
Dimethyl-1, 2-dibromo-2-dichloroethyl phosphate, see Naled				
Dimethylformamide [68-12-2] — Skin	10	30	20	60
2, 6-Dimethyl-4-heptanone, see Diisobutyl ketone				
1, 1-Dimethylhydrazine [57-14-7] — Skin	0.5, A2	1, A2	1, A2	2, A2
Dimethylphthalate [131-11-3]	—	5	—	10
Dimethyl sulfate [77-78-1] — Skin	0.1, A2	0.5, A2	—	—
Dinitolmide [148-01-6]	—	5	—	10
Dinitrobenzene [528-29-0] (all isomers) — Skin	0.15	1	0.5	3
Dinitro-o-cresol [534-52-1] — Skin	—	0.2	—	0.6
3, 5-Dinitro-o-toluamide, see Dinitolmide				
Dinitrotoluene [121-14-2] — Skin	—	1.5	—	5
Dioxane, tech. grade [123-91-1] — Skin	25	90	100	360
Dioxathion [78-34-2] — Skin	—	0.2	—	—
Diphenyl, see Biphenyl				
Diphenylamine [122-39-4]	—	10	—	20
Diphenylmethane diisocyanate, see Methylene bisphenyl isocyanate				
Dipropylene glycol methyl ether [34590-94-8]	100	600	150	900
Dipropyl ketone [123-19-3]	50	235	—	—
Diquat [85-00-7]	—	0.5	—	1
Di-sec, octyl phthalate [117-81-7] (Di-2-ethylhexylphthalate)	—	5	—	10
Disulfiram [97-77-8]	—	2	—	5
Disulfoton [298-04-4]	—	0.1	—	0.3
2, 6-Ditert. butyl-p-cresol [128-37-0]	—	10	—	20
Diuron [330-54-1]	—	10	—	—
Divinyl benzene [108-57-6]	10	50	—	—
Emery [112-62-9]	—	D	—	20
Endosulfan [115-29-7] — Skin	—	0.1	—	0.3
Endrin [72-20-8] — Skin	—	0.1	—	0.3
Epichlorohydrin [106-89-8] — Skin	2	10	5	20
EPN [2104-64-5] — Skin	—	0.5	—	2
1, 2-Epoxypropane, see Propylene oxide				
2, 3-Epoxy-1-propanol, see Glycidol				
Ethane [74-84-0]	E	—	—	—

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Footnotes (a thru f)

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
Ethanethiol, see Ethyl mercaptan				
Ethanolamine [141-43-5]	3	8	6	15
Ethion [563-12-2] — Skin	—	0.4	—	—
‡2-Ethoxyethanol [110-80-5] — Skin	(50)	(185)	(100)	(370)
‡2-Ethoxyethyl acetate [111-15-9] — Skin	(50)	(270)	(100)	(540)
Ethyl acetate [141-78-6]	400	1,400	—	—
Ethyl acrylate [140-88-5] — Skin	5	20	25	100
Ethyl alcohol (Ethanol) [64-17-5]	1,000	1,900	—	—
Ethylamine [75-04-7]	10	18	—	—
Ethyl amyl ketone [41-85-5]	25	130	—	—
Ethyl benzene [100-41-4]	100	435	125	545
Ethyl bromide [74-96-4]	200	890	250	1,110
Ethyl butyl ketone [106-35-4]	50	230	75	345
Ethyl chloride [75-00-3]	1,000	2,600	1,250	3,250
Ethylene [74-85-1]	E	—	—	—
Ethylene chlorohydrin [107-07-3] — Skin	C 1	C 3	—	—
Ethylenediamine [107-15-3]	10	25	—	—
Ethylene dibromide [106-93-4] — Skin	A2	A2	—	—
Ethylene dichloride [107-06-2]	10	40	15	60
Ethylene glycol [107-21-1]				
‡ Particulate	—	(10)	—	(20)
Vapor	C 50	C 125	—	—
*‡Ethylene glycol dinitrate [628-96-6] — Skin	0.05	0.3	(0.1)	(0.6)
Ethylene glycol methyl ether acetate, see 2-Methoxyethyl acetate				
‡ Ethylene oxide [75-21-8]	(10)	(20)	—	—
Ethyleneimine [151-56-4] — Skin	0.5	1	—	—
Ethyl ether [60-29-7]	400	1,200	500	1,500
Ethyl formate [109-94-4]	100	300	150	450
Ethylidene chloride, see 1, 1-Dichloroethane				
Ethylidene norbornene [16219-75-3]	C 5	C 25	—	—
Ethyl mercaptan [75-08-1]	0.5	1	2	3
N-Ethylmorpholine [100-74-3] — Skin	5	23	20	95
Ethyl silicate [78-10-4]	10	85	30	255
Fensulfothion [115-90-2]	—	0.1	—	—
*Fenthion [55-38-9] — Skin	—	0.2	—	—
Ferbam [14484-64-1]	—	10	—	20
Ferrovanadium dust [12604-58-9]	—	1	—	3
Fibrous[d)] glass dust	—	10	—	—
Fluorides, as F	—	2.5	—	—
Fluorine [7782-41-4]	1	2	2	4
Fluorotrichloromethane, see Trichlorofluoromethane				
Fonofos [944-22-9] — Skin	—	0.1	—	—
‡Formaldehyde [50-00-0]	(C 2)	(C 3)	—	—
Formamide [75-12-7]	20	30	30	45
Formic acid [64-18-6]	5	9	—	—
Furfural [98-01-1] — Skin	2	8	10	40

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Footnotes (a thru f)
*1983 Addition.
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	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
Furfuryl alcohol [98-00-0] — Skin	10	40	15	60
Gasoline [8006-61-9]	300	900	500	1,500
Germanium tetrahydride [7782-65-2]	0.2	0.6	0.6	1.8
Glass, fibrous or dust, see Fibrous glass dust				
Glutaraldehyde [111-30-8]	C 0.2	C 0.7	—	—
Glycerin mist [56-81-5]	—	D	—	—
Glycidol [556-52-5]	25	75	100	300
Glycol monoethyl ether, see 2-Ethoxyethanol				
Graphite (Natural) [7782-42-5], see MINERAL DUSTS				
Graphite (Synthetic)	—	D	—	—
Gypsum [10101-4-4]	—	D	—	20
Hafnium [7440-58-6]	—	0.5	—	1.5
Helium [7440-59-7]	E	—	—	—
Heptachlor [76-44-8] — Skin	—	0.5	—	2
Heptane [142-82-5] (n-Heptane)	400	1,600	500	2,000
2-Heptanone, see Methyl n-amyl ketone				
3-Heptanone, see Ethyl butyl ketone				
Hexachlorobutadiene [76-68-3]	0.02, A2	0.24, A2	—	—
Hexachlorocyclopentadiene [77-47-4]	0.01	0.1	0.03	0.3
Hexachloroethane [67-72-1]	10	100	—	—
Hexachloronaphthalene [1335-87-1] — Skin	—	0.2	—	0.6
Hexafluoroacetone [684-16-2] — Skin	0.1	0.7	0.3	2
Hexamethyl phosphoramide [680-31-9] — Skin	A2	A2	—	—
Hexane (n-Hexane) [110-54-3]	50	180	—	—
Other isomers	500	1,800	1,000	3,600
2-Hexanone, see Methyl n-butyl ketone				
Hexone, see Methyl isobutyl ketone				
sec-Hexyl acetate [142-92-7]	50	300	—	—
Hexylene glycol [107-41-5]	C 25	C 125	—	—
Hydrazine [302-01-2] — Skin	0.1, A2	0.1, A2	—	—
Hydrogen [1333-74-0]	E	—	—	—
Hydrogenated terphenyls [92-94-4]	0.5	5	—	—
Hydrogen bromide [10035-10-6]	3	10	—	—
Hydrogen chloride [7647-01-0]	C 5	C 7	—	—
Hydrogen cyanide [74-90-8] — Skin	C 10	C 10	—	—
Hydrogen fluoride [7664-39-3], as F	3	2.5	6	5
Hydrogen peroxide [7722-84-1]	1	1.5	2	3
Hydrogen selenide [7783-07-5], as Se	0.05	0.2	—	—
Hydrogen sulfide [7783-06-4]	10	14	15	21
Hydroquinone [123-31-9]	—	2	—	4
4-Hydroxy-4-methyl-2-pentanone, see Diacetone alcohol				
2-Hydroxypropyl acrylate [999-61-1] — Skin	0.5	3	—	—

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Footnotes (a thru f)

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
Indene [95-13-6]	10	45	15	70
Indium [7440-74-6] & compounds, as In	—	0.1	—	0.3
Iodine [7553-56-2]	C 0.1	C 1	—	—
Iodoform [75-47-8]	0.6	10	1	20
Iron oxide fume (Fe_2O_3) [1309-37-1], as Fe	B2	5	—	10
Iron pentacarbonyl [13463-40-6], as Fe	0.1	0.8	0.2	1.6
Iron salts, soluble, as Fe	—	1	—	2
Isoamyl acetate [123-92-2]	100	525	125	655
Isoamyl alcohol [123-51-3]	100	360	125	450
Isobutyl acetate [110-19-0]	150	700	187	875
Isobutyl alcohol [78-83-1]	50	150	75	225
Isooctyl alcohol [26952-21-6]	50	270	—	—
Isophorone [78-59-1]	C 5	C 25	—	—
Isophorone diisocyanate — Skin	0.01	0.09	—	—
Isopropoxyethanol [109-59-1]	25	105	75	320
Isopropyl acetate [108-21-4]	250	950	310	1,185
Isopropyl alcohol [67-63-0]	400	980	500	1,225
Isopropylamine [75-31-0]	5	12	10	24
N-Isopropylaniline [643-28-7] — Skin	2	10	5	20
Isopropyl ether [108-20-3]	250	1,050	310	1,320
Isopropyl glycidyl ether [4016-14-2] (IGE)	50	240	75	360
Kaolin	—	D	—	20
Ketene [463-51-4]	0.5	0.9	1.5	3
Lead [7439-92-1], inorg., dusts & fumes, as Pb	—	0.15	—	0.45
*‡Lead arsenate [10102-48-4], as $Pb_3(AsO_4)_2$	—	0.15	—	(0.45)
Lead chromate [18454-12-1], as Cr	—	0.05, A2	—	—
Limestone [1317-65-3]	—	D	—	20
Lindane [58-89-9] — Skin	—	0.5	—	1.5
Lithium hydride [7580-67-8]	—	0.025	—	—
L.P.G. (Liquified petroleum gas)	1,000	1,800	1,250	2,250
Magnesite [546-90-0]	—	D	—	20
Magnesium oxide fume [1309-48-4]	—	10	—	—
Malathion [121-75-5] — Skin	—	10	—	—
Maleic anhydride [108-31-6]	0.25	1	—	—
Manganese [7439-96-5], as Mn				
Dust & compounds	—	C 5	—	—
Fume	—	1	—	3
Manganese cyclopentadienyl tricarbonyl [12079-65-1], as, Mn — Skin	—	0.1	—	0.3
Manganese tetroxide	—	1	—	—
Marble/calcium carbonate [1317-65-3]	—	D	—	20

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	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
Mercury [7439-97-6], as Hg — Skin				
Alkyl compounds	—	0.01	—	0.03
All forms except alkyl				
Vapor	—	0.05	—	—
Aryl & inorganic compounds	—	0.1	—	—
Mesityl oxide [141-79-7]	15	60	25	100
Methacrylic acid [79-41-4]	20	70	—	—
Methane [74-82-8]	E	—	—	—
Methanethiol, see Methyl mercaptan				
Methomyl [16752-77-5] — Skin	—	2.5	—	—
Methoxychlor [72-43-5]	—	10	—	—
‡2-Methoxyethanol [109-86-4]— Skin	(25)	(80)	(35)	(120)
‡2-Methoxyethyl acetate [110-49-6] — Skin	(25)	(120)	(35)	(170)
4-Methoxyphenol [150-76-5]	—	5	—	—
Methyl acetate [79-20-9]	200	610	250	760
Methyl acetylene [74-99-7]	1,000	1,650	1,250	2,040
Methyl acetylene-propadiene mixture (MAPP)	1,000	1,800	1,250	2,250
Methyl acrylate [96-33-3] — Skin	10	35	—	—
Methylacrylonitrile [126-98-7] — Skin	1	3	2	6
Methylal [109-87-5]	1,000	3,100	1,250	3,875
Methyl alcohol [67-56-1] (methanol) — Skin	200	260	250	310
Methylamine [74-89-5]	10	12	—	—
Methyl amyl alcohol, see Methyl isobutyl carbinol				
Methyl n-amyl ketone [110-43-0]	50	235	100	465
N-Methyl aniline [100-61-8] — Skin	0.5	2	1	5
Methyl bromide [74-83-9] — Skin	5	20	15	60
Methyl n-butyl ketone [591-78-6]	5	20	—	—
Methyl chloride [74-87-3]	50	105	100	205
Methyl chloroform [71-55-6]	350	1,900	450	2,450
Methyl 2-cyanoacrylate [137-05-3]	2	8	4	16
Methylcyclohexane [108-87-2]	400	1,600	500	2,000
Methylcyclohexanol [25639-42-3]	50	235	75	350
o-Methylcyclohexanone [583-60-8] — Skin	50	230	75	345
Methylcyclopentadienyl manganese tricarbonyl, [12108-13-3] — Skin, as Mn	—	0.2	—	0.6
Methyl demeton [8022-00-2] — Skin	—	0.5	—	1.5
Methylene bisphenyl isocyanate (MDI) [101-68-8]	C 0.02	C 0.2	—	—
Methylene chlr [75-09-2]	100	350	500	1,740

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	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
4, 4′-Methylene bis (2-chloroaniline) [101-14-4] - - Skin	0.02, A2	0.22, A2	—	—
Methylene bis(4-cyclohexylisocyanate) [5124-30-1]	C 0.01	C 0.11	—	—
4, 4-Methylene dianiline [101-77-9] — Skin	0.1	0.8	0.5	4
Methyl ethyl ketone (MEK) [78-93-3]	200	590	300	885
Methyl ethyl ketone peroxide [1338-23-4]	C 0.2	C 1.5	—	—
Methyl formate [107-31-3]	100	250	150	375
5-Methyl-3-heptanone, see Ethyl amyl ketone				
Methyl hydrazine [60-34-4] — Skin	C 0.2, A2	C 0.35, A2	—	—
Methyl iodide [74-88-4] — Skin	2, A2	10, A2	5, A2	30, A2
Methyl isoamyl ketone [110-12-3]	50	240	—	—
Methyl isobutyl carbinol [105-30-6] — Skin	25	100	40	165
Methyl isobutyl ketone [108-10-1]	50	205	75	300
Methyl isocyanate [624-83-9] — Skin	0.02	0.05	—	—
Methyl isopropyl ketone [563-80-4]	200	705	—	—
Methyl mercaptan [74-93-1]	0.5	1	—	—
Methyl methacrylate [80-62-6]	100	410	125	510
Methyl parathion [298-00-0] — Skin	—	0.2	—	0.6
Methyl propyl ketone [107-87-9]	200	700	250	875
Methyl silicate [681-84-5]	1	6	5	30
α-Methyl styrene [98-83-9]	50	240	100	485
Mevinphos [7786-34-7] — Skin	0.01	0.1	0.03	0.3
Molybdenum [7439-98-7], as Mo				
Soluble compounds	—	5	—	10
Insoluble compounds	—	10	—	20
Monocrotophos [6923-22-4]	—	0.25	—	—
Morpholine [110-91-8] — Skin	20	70	30	105
Naled [300-76-5]	—	3	—	6
Naphthalene [91-20-3]	10	50	15	75
β-Naphthylamine [91-59-8]	—	A1b	—	A1b
Neon [7440-01-9]	E	—	—	—
Nickel carbonyl, as Ni	0.05	0.35	—	—
Nickel [7440-02-0]				
Metal	—	1	—	—
Soluble compounds, as Ni	—	0.1	—	0.3
Nickel carbonyl [13463-39-3], as Ni	0.05	0.35	—	—
Nickel sulfide roasting, fume & dust, as Ni	—	1, A1a	—	—
Nicotine [54-11-5] — Skin	—	0.5	—	1.5

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Substance [CAS #]	ADOPTED VALUES			
	TWA		STEL	
	ppm[a)]	mg/m³[b)]	ppm[a)]	mg/m³[b)]
Nitrapyrin [1929-82-4]	—	10	—	20
Nitric acid [7697-37-2]	2	5	4	10
Nitric oxide [10102-43-9]	25	30	35	45
p-Nitroaniline [100-01-6] — Skin	—	3	—	—
Nitrobenzene — Skin	1	5	2	10
‡p-Nitrochlorobenzene [100-00-5] — Skin	—	(1)	—	(2)
4-Nitrodiphenyl [92-93-3]	—	A1b	—	A1b
Nitroethane [79-24-3]	100	310	150	465
Nitrogen dioxide [10102-44-0]	3	6	5	10
Nitrogen trifluoride [7783-54-2]	10	30	15	45
*‡Nitroglycerin (NG) [55-63-0] — Skin	0.05	0.5	(0.1)	(1)
Nitromethane [75-52-5]	100	250	150	375
1-Nitropropane [108-03-2]	25	90	35	135
‡2-Nitropropane [79-46-9]	(C 25, A2)	(C 90, A2)	—	—
N-Nitrosodimethylamine [62-75-9] (dimethylnitrosoamine) — Skin	—	A2	—	A2
Nitrotoluene [99-08-1] — Skin	2	11	—	—
Nitrotrichloromethane, see Chloropicrin				
Nonane [111-84-2]	200	1,050	250	1,300
Octachloronaphthalene [2234-13-1] — Skin	—	0.1	—	0.3
Octane [111-65-9]	300	1,450	375	1,800
Oil mist, mineral	—	5[e)]	—	10
Osmium tetroxide [20816-12-0], as Os	0.0002	0.002	0.0006	0.006
Oxalic acid [144-62-7]	—	1	—	2
Oxygen difluoride [7783-41-7]	0.05	0.1	0.15	0.3
Ozone [10028-15-6]	0.1	0.2	0.3	0.6
Paraffin wax fume [8002-74-2]	—	2	—	6
Paraquat [1910-42-5], respirable sizes	—	0.1	—	—
Parathion [56-38-2] — Skin	—	0.1	—	0.3
Particulate polycyclic aromatic hydro-carbons (PPAH), see Coal tar pitch volatiles				
Pentaborane [19624-22-7]	0.005	0.01	0.015	0.03
Pentachloronaphthalene [1321-64-8]	—	0.5	—	2
Pentachlorophenol [87-86-5] — Skin	—	0.5	—	1.5
Pentaerythritol [115-77-5]	—	D	—	20
Pentane [109-66-0]	600	1,800	750	2,250
2-Pentanone, see Methyl propyl ketone				
‡Perchloroethylene [127-18-4]	50	335	(—)	(—)
Perchloromethyl mercaptan [594-42-3]	0.1	0.8	—	—
Perchloryl fluoride [7616-94-6]	3	14	6	28
Phenol [108-95-2] — Skin	5	19	10	38

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Substance [CAS #]	ADOPTED VALUES			
	TWA		STEL	
	ppm[a)]	mg/m³[b)]	ppm[a)]	mg/m³[b)]
Phenothiazine [92-84-2] — Skin	—	5	—	10
N-Phenyl-beta-naphthylamine [135-88-6]	A2	A2	—	—
p-Phenylene diamine [106-50-3] — Skin	—	0.1	—	—
Phenyl ether [101-84-8], vapor	1	7	2	14
Phenylethylene, see Styrene, monomer				
Phenyl glycidyl ether (PGE) [122-60-1]	1	6	—	—
‡Phenylhydrazine [100-63-0] — Skin	(5)	(20)	(10)	(45)
Phenyl mercaptan [108-98-5]	0.5	2	—	—
Phenylphosphine [638-21-1]	C 0.05	C 0.25	—	—
Phorate [298-02-2] — Skin	—	0.05	—	0.2
Phosdrin, see Mevinphos				
Phosgene [75-44-5]	0.1	0.4	—	—
Phosphine [3803-51-2]	0.3	0.4	1	1
Phosphoric acid [7664-38-2]	—	1	—	3
Phosphorus [7723-14-0] (yellow)	—	0.1	—	0.3
Phosphorus oxychloride [10026-13-8]	0.1	0.6	0.5	3
Phosphorus pentachloride [10026-13-8]	0.1	1	—	—
Phosphorus pentasulfide [1314-80-3]	—	1	—	3
Phosphorus trichloride [7719-12-2]	0.2	1.5	0.5	3
Phthalic anhydride [85-44-9]	1	6	4	24
m-Phthalodinitrile [626-17-5]	—	5	—	—
Picloram [1918-02-1]	—	10	—	20
Picric acid [88-89-1] — Skin	—	0.1	—	0.3
Pindone [83-26-1]	—	0.1	—	0.3
Piperazine dihydrochloride [142-64-3]	—	5	—	—
2-Pivalyl-1, 3-indandione, see Pindone				
Plaster of Paris	—	D	—	20
Platinum [7440-06-4]				
Metal	—	1	—	—
Soluble salts, as Pt	—	0.002	—	—
Polychlorobiphenyls, see Chlorodiphenyls				
Polytetrafluoroethylene decomposition products	—	B1	—	B1
Potassium hydroxide [1310-58-3]	—	C 2	—	—
Propane [74-98-6]	E	—	—	—
Propane sultone [1120-71-4]	A2	A2	—	—
Propargyl alcohol [107-19-7] — Skin	1	2	3	6
β-Propiolactone [57-57-8]	0.5, A2	1.5, A2	1, A2	3, A2
Propionic acid [79-09-4]	10	30	15	45
Propoxur [114-26-1]	—	0.5	—	2

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f)
‡See Notice of Intended Changes.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
n-Propyl acetate [109-60-4]	200	840	250	1,050
Propyl alcohol [71-23-8] — Skin	200	500	250	625
n-Propyl nitrate [627-13-4]	25	105	40	170
Propylene [115-07-1]	E	—	—	—
Propylene dichloride [78-87-5]	75	350	110	510
*‡Propylene glycol dinitrate [6423-43-4] — Skin	0.05	0.3	(0.1)	(0.6)
Propylene glycol monomethyl ether [107-98-2]	100	360	150	540
*Propyleneimine [75-55-8] — Skin	2, A2	5, A2	—	—
Propylene oxide [75-56-9]	20	50	—	—
Propyne, see Methyl acetylene				
Pyrethrum [8003-34-7]	—	5	—	10
Pyridine [110-86-1]	5	15	10	30
Quinone [106-51-4]	0.1	0.4	0.3	1
RDX, see Cyclonite				
Resorcinol [108-46-3]	10	45	20	90
Rhodium [7440-16-6]				
Metal	—	1	—	—
‡ Soluble salts, as Rh	—	(0.001)	—	(0.003)
Ronnel [299-84-3]	—	10	—	—
Rosin core solder pyrolysis products, as formaldehyde	—	0.1	—	0.3
Rotenone (commercial) [83-79-4]	—	5	—	10
Rouge	—	D	—	20
Rubber solvent (Naphtha)	400	1,600	—	—
Selenium compounds [7782-49-2], as Se	—	0.2	—	—
Selenium hexafluoride [7783-79-1], as Se	0.05	0.2	—	—
Sesone [136-78-7]	—	10	—	20
Silane, see Silicon tetrahydride				
Silicon [7440-21-3]	—	D	—	20
Silicon carbide [409-21-2]	—	D	—	20
*Silicon tetrahydride (Silane) [7803-62-5]	5	7	—	—
Silver [7440-22-4], as Ag				
Metal	—	0.1	—	—
Soluble compounds	—	0.01	—	—
Sodium azide [26628-22-8]	C 0.1	C 0.3	—	—
Sodium bisulfite [7631-90-5]	—	5	—	—
Sodium 2, 4-dichloro-phenoxyethyl sulfate, see Sesone				
Sodium fluoroacetate [62-74-8] — Skin	—	0.05	—	0.15
Sodium hydroxide [1310-73-2]	—	C 2	—	—
Sodium metabisulfite [7681-57-4]	—	5	—	—
Starch [9005-84-9]	—	D	—	20
Stibine [7803-52-3]	0.1	0.5	0.3	1.5
Stoddard solvent [8052-41-3]	100	525	200	1,050
Strychnine [57-24-9]	—	0.15	—	0.45

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f)
*1983 Addition.
‡See Notice of Intended Changes.

	ADOPTED VALUES			
	TWA		STEL	
Substance [CAS #]	ppm[a)]	mg/m^3[b)]	ppm[a)]	mg/m^3[b)]
Styrene, monomer [100-42-5]	50	215	100	425
Subtilisins [1395-21-7] (Proteolytic enzymes as 100% pure crystalline enzyme)	—	C0.00006[m)]	—	—
Sucrose [57-50-1]	—	D	—	20
Sulfotep [3689-24-5] — Skin	—	0.2	—	0.6
Sulfur dioxide [7446-09-5]	2	5	5	10
Sulfur hexafluoride [2551-62-4]	1,000	6,000	1,250	7,500
Sulfuric acid [7664-93-9]	—	1	—	—
Sulfur monochloride [10025-67-9]	1	6	3	18
Sulfur pentafluoride [5714-22-7]	0.025	0.25	0.075	0.75
Sulfur tetrafluoride [7783-60-0]	0.1	0.4	0.3	1
Sulfuryl fluoride [2699-79-8]	5	20	10	40
Systox, see Demeton				
2, 4, 5-T [93-76-5]	—	10	—	20
Tantalum [7440-25-7]	—	5	—	10
TEDP, see Sulfotep				
Tellurium & compounds [13494-80-9], as Te	—	0.1	—	—
Tellurium hexafluoride [7783-80-4], as Te	0.02	0.2	—	—
Temephos [3383-96-8]	—	10	—	20
TEPP [107-49-3] — Skin	0.004	0.05	0.01	0.2
Terphenyls [92-94-4]	C 0.5	C 5	—	—
1, 1, 1, 2-Tetrachloro-2, 2-difluoroethane [76-11-9]	500	4,170	625	5,210
1, 1, 2, 2-Tetrachloro-1, 2-difluoroethane [76-12-0]	500	4,170	625	5,210
1, 1, 2, 2-Tetrachloroethane [79-34-5] — Skin	1	7	5	35
Tetrachloroethylene, see Perchloroethylene				
Tetrachloromethane, see Carbon tetrachloride				
Tetrachloronaphthalene [1335-88-2]	—	2	—	4
Tetraethyl lead [78-00-2], as Pb — Skin	—	0.100[f)]	—	0.3
Tetrahydrofuran [109-99-9]	200	590	250	735
Tetramethyl lead [75-74-1], as Pb — Skin	—	0.150[f)]	—	0.5
Tetramethyl succinonitrile [3333-52-6] — Skin	0.5	3	2	9
Tetranitromethane [509-14-8]	1	8	—	—
Tetrasodium pyrophosphate [7722-88-5]	—	5	—	—
Tetryl [479-45-8] (2, 4, 6-trinitrophenylmethylnitramine) — Skin	—	1.5	—	3.0
Thallium [7440-28-0]				
Soluble compounds, as Tl — Skin	—	0.1	—	—

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f)
*1983 Addition.

Substance [CAS #]	ADOPTED VALUES TWA ppm[a)]	TWA mg/m^3[b)]	STEL ppm[a)]	STEL mg/m^3[b)]
4, 4′-Thiobis(6-tert. butyl-m-cresol) [96-69-5]	—	10	—	20
Thioglycolic acid [68-11-1]	1	5	—	—
Thiram [137-26-8]	—	5	—	10
Tin [7440-31-5]				
Metal	—	2	—	4
Oxide & inorganic compounds, except SnO_4, as Sn	—	2	—	4
Organic compounds, as Sn — Skin	—	0.1	—	0.2
Titanium dioxide [13463-67-7], as Ti	—	D	—	20
o-Tolidine [119-93-7] — Skin	A2	A2	—	—
Toluene [108-88-3] (toluol)	*100*	*375*	*150*	*560*
* Toluene-2, 4-diisocyanate (TDI) [584-84-9]	0.005	0.04	0.02	0.15
‡o-Toluidine [95-53-4] — Skin	(2)	(9)	—	—
Toxaphene, see Chlorinated camphene				
Tributyl phosphate [126-73-8]	0.2	2.5	0.4	5
Trichloroacetic acid [76-03-9]	1	5	—	—
1, 2, 4-Trichlorobenzene [120-82-1]	C 5	C 40	—	—
1, 1, 1-Trichloroethane, see Methyl chloroform				
1, 1, 2-Trichloroethane [79-00-5] — Skin	10	45	20	90
‡Trichloroethylene [79-01-6]	50	270	(150)	(805)
Trichlorofluoromethane [75-69-4]	C 1,000	C 5,600	—	—
Trichloromethane, see Chloroform				
Trichloronaphthalene [1321-65-9]	—	5	—	10
Trichloronitromethane, see Chloropicrin				
1, 2, 3-Trichloropropane [96-18-4]	50	300	75	450
1, 1, 2-Trichloro-1, 2, 2-trifluoroethane [76-13-1]	1,000	7,600	1,250	9,500
Tricyclohexyltin hydroxide, see Cyhexatin				
*Triethylamine [121-44-8]	10	40	15	60
Trifluorobromomethane [75-63-8]	1,000	6,100	1,200	7,300
Trimellitic anhydride [552-30-7]	0.005	0.04	—	—
*Trimethylamine [75-50-3]	10	24	15	36
Trimethyl benzene [25551-13-7]	25	125	35	170
Trimethyl phosphite [121-45-9]	2	10	5	25
2, 4, 6-Trinitrophenol, see Picric acid				
2, 4, 6-Trinitrophenyl-methylnitramine, see Tetryl				
2, 4, 6-Trinitrotoluene (TNT) [118-96-7] — Skin	—	0.5	—	3
Triorthocresyl phosphate [78-30-8]	—	0.1	—	0.3

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f)
*1983 Addition.
‡See Notice of Intended Changes.

Substance [CAS #]	ADOPTED VALUES TWA ppm[a)]	TWA mg/m^3[b)]	STEL ppm[a)]	STEL mg/m^3[b)]
Triphenyl amine [603-34-9]	—	5	—	—
Triphenyl phosphate [115-86-6]	—	3	—	6
Tungsten [7440-33-7], as W				
Insoluble compounds	—	5	—	10
Soluble compounds	—	1	—	3
Turpentine [8006-64-2]	*100*	*560*	*150*	*840*
Uranium (natural) [7440-61-1], Soluble & Insoluble compounds, as U	—	0.2	—	0.6
Valeraldehyde [110-62-3]	50	175	—	—
Vanadium, as V_2O_5 [1314-62-1], respirable dust & fume	—	0.05	—	—
Vegetable oil mists	—	*D*	—	—
Vinyl acetate [108-05-4]	10	30	20	60
Vinyl benzene, see Styrene				
Vinyl bromide [593-60-2]	5, A2	20, A2	—	—
Vinyl chloride [75-01-4]	5, A1a	10, A1a	—	—
Vinyl cyanide, see Acrylonitrile				
Vinyl cyclohexene dioxide [106-87-6]	10, A2	60, A2	—	—
‡Vinylidene chloride [75-35-4]	(10)	(40)	(20)	(80)
Vinyl toluene [25013-15-4]	50	240	100	485
VM & P Naphtha [8030-30-6]	300	1,350	400	1,800
Warfarin [81-81-2]	—	0.1	—	0.3
Welding fumes (NOC†)	—	5, B2	—	—
Wood dust (certain hard woods as beech & oak)	—	1	—	—
Soft wood	—	5	—	10
Xylene [1330-20-7] (o-, m-, p-isomers)	100	435	150	655
m-Xylene α, α'-diamine [1477-55-0] — Skin	—	C 0.1	—	—
Xylidine [1300-73-8] — Skin	2	10	—	—
Yttrium [7440-65-5]	—	1	—	3
Zinc chloride fume [7646-85-7]	—	1	—	2
Zinc chromate [13530-65-9], as Cr	—	0.05, A2	—	—
Zinc oxide [1314-13-2]				
Fume	—	5	—	10
Dust	—	D	—	—
Zinc stearate [557-05-1]	—	D	—	20
Zirconium compounds [7440-67-2], as Zr	—	5	—	10

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
Footnotes (a thru f)
†NOC = Not otherwise classified.

a) Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 mm Hg pressure.
b) Approximate milligrams of substance per cubic meter of air.
d) $< 7\ \mu m$ in diameter.
e) As sampled by method that does not collect vapor.
f) For control of general room air, biologic monitoring is essential for personnel control.

Radioactivity: The Committee accepts the philosophy and recommendations of the National Council on Radiation Protection and Measurements (NCRP) for the ionizing radiation TLV. The NCRP is charted by Congress to, in part, collect, analyze, develop and disseminate information and recommendations about protection against radiation and about radiation measurements, quantities and units, including development of basic concepts in these areas. NCRP Report No. 39 (reference 1) provides basic philosophy and concepts leading to protection criteria established in the same report. Other NCRP reports address specific areas of radiation protection and, collectively, provide an excellent basis for establishing a sound program for radiation control. The Committee recommends the listed references as substantative documentation of a sound basis for ionizing radiation protection. The Committee also strongly recommends that all exposures to ionizing radiations be kept low as reasonably achievable within the stated guidance.

References:

1. *Basic Radiation Protection Criteria.* NCRP Report No. 39, issued January 15, 1971.
2. *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure.* US Department of Commerce, National Bureau of Standards Handbook 69, issued June 5, 1959, with Addendum 1 issued August 1963. Available as NCRP Report No. 22.

The above documents, as well as information on numerous other NCRP Reports addressing specific subjects in ionizing radiation protection are available from: NCRP Publications, PO Box 30175, Washington, DC 20014.

DUSTS

Substance	**TLV**
SILICA, SiO₂	
Crystalline	
‡Quartz [14808-60-7]	TLV in mppcf[g]: $\dfrac{300}{\%\ \text{quartz} + 10}$[h] TLV for respirable dust in mg/m³: $\dfrac{10\ \text{mg/m}^3}{\%\ \text{Respirable quartz} + 2}$[i] TLV for "total dust," respirable and nonrespirable: $\dfrac{30\ \text{mg/m}^3}{\%\ \text{quartz} + 3}$
‡Cristobalite [14464-46-1]	Use one-half the value calculated from the count or mass formulae for quartz.
‡Tridymite [15468-32-3]	Use one-half the value calculated from formulae for quartz.
‡*Amorphous* [7631-86-9]	(20 mppcf[g])
‡Silica, fused [60676-86-0]	Use quartz formulae.
‡Tripoli [1317-95-9]	Use respirable[n] mass quartz formula

SILICATES and OTHER DUSTS (< *1*% quartz)

Asbestos[l]	
Amosite [12172-73-5]	0.5 fiber/cc > 5 μm in length, A1a
Chrysotile [12001-29-5]	2 fibers/cc > 5 μm in length, A1a
Crocidolite [12001-28-4]	0.2 fiber/cc > 5 μm in length, A1a
Other forms	2 fibers/cc > 5 μm in length, A1a
‡Graphite (natural) [7782-42-5]	15 mppcf
‡Mica [12001-26-2]	20 mppcf
Mineral wool fiber	10 mg/m³
‡Perlite	30 mppcf
‡Portland Cement	30 mppcf
‡Soapstone	20 mppcf
*Talc (containing no asbestos fibers) [14807-96-6]	2 mg/m³, Respirable dust
‡Talc (fibrous), (use Asbestos limit.)	
Nuisance particulates (see Appendix D)	‡(30 mppcf) or 10 mg/m³[j] of total dust < 1% quartz, or, 5 mg/m³ respirable dust.

Conversion factors:

mppcf × 35.3 = Million particles per cubic meter
= particles per cc

COAL DUST

2 mg/m³ (respirable dust fraction < 5% quartz).
‡(If > 5% quartz, use respirable mass formula.)

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g) Millions of particles per cubic foot of air, based on impinger samples counted by light-field technics.

h) The percentage of quartz in the formula is the amount determined from airborne samples, except in those instances in which other methods have been shown to be applicable.

i) Both concentration and percent quartz for the application of this limit are to be determined from the fraction passing a size-selector with the following characteristics:

Aerodynamic Diameter (μm) (unit density sphere)	% passing selector
≤ 2	90
2.5	75
3.5	50
5.0	25
10	0

‡j) containing < 1% quartz; (if quartz content > 1%, use formulae for quartz.)

k) Lint-free dust as measured by the vertical elutriator, cotton-dust sampler described in the *Transactions of the National Conference on Cotton Dust*, p. 33 by J. R. Lynch, (May 2, 1970).

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‡See Notice of Intended Changes.

‡See Notice of Intended Changes.
*1983 Addition.

l) As determined by the membrane filter method at 400–450X magnification (4 mm objective) phase contrast illumination.
m) Based on "high volume" sampling.
n) "Respirable" dust as defined by the British Medical Research Council Criteria, (1) and as sampled by a device producing equivalent results.(2)
  (1) Hatch, T. E. and Gross: *Pulmonary Deposition and Retention of Inhaled Aerosols,* p. 149. Academic Press, New York, (1964).
  (2) AIHA Aerosol Technology Committee: Interim Guide for Respirable Mass Sampling. *Am. Ind. Hyg. Assoc. J. 31(2)*:133 (1970).

NOTICE OF INTENDED CHANGES (for 1983-84)

These substances, with their corresponding values, comprise those for which either a limit has been proposed for the first time, or for which a change in the "Adopted" listing has been proposed. In both cases, the proposed limits should be considered trial limits that will remain in the listing for a period of at least two years. If, after two years no evidence comes to light that questions the appropriateness of the values herein, the values will be reconsidered for the "Adopted" list. Documentation is available for each of these substances.

	TWA		STEL	
Substance [CAS #]	**ppm[a)]**	**mg/m^3[b)]**	**ppm[a)]**	**mg/m^3[b)]**
Acrylonitrile [107-13-1] — Skin	2, A2	4.5, A2	—	—
†1, 3-Butadiene [106-99-0]	A2	A2	—	—
Cobalt metal, dust & fume [7440-48-4], as Co	—	0.05	—	0.1
Enflurane [13838-16-9]	75	575	—	—
2-Ethoxyethanol [110-80-5] — Skin	5	19	—	—
2-Ethoxyethyl acetate [111-15-9] — Skin	5	27	—	—
Ethylene glycol [107-21-1], particulate DELETE, *see* Appendix G				
†*Ethylene glycol dinitrate* [628-96-6] — Skin	0.05	0.3	—	—
Ethylene oxide [75-21-8]	1, A2	2, A2	—	—
Fenamiphos [22224-92-6] — Skin	—	0.1	—	—
†Formaldehyde [50-00-0]	1, A2	1.5, A2	2, A2	3, A2
Grain dust	—	4	—	—
Halothane [151-67-7]	50	400	—	—
†Lead arsenate [10102-48-4], as $Pb_3(AsO_4)_2$	—	0.15	—	—
2-Methoxyethanol [109-86-4] — Skin	5	16	—	—
2-Methoxyethyl acetate [110-49-6] — Skin	5	24	—	—
Metribuzin [21087-64-9]	—	5	—	—
p-Nitrochlorobenzene [100-00-5] — Skin	0.5	3	—	—
†Nitroglycerin [55-63-0] — Skin	0.05	0.5	—	—
2-Nitropropane [79-46-9]	10, A2	35, A2	20, A2	70, A2
Perchloroethylene [127-18-4]	50	335	200	1,340
Persulfates, alkali metal, as S_2O_8	—	2	—	—
Phenylhydrazine [100-63-0] — Skin	5, A2	20, A2	10, A2	45, A2
†Propylene glycol dinitrate [6423-43-4] — Skin	0.05	0.3	—	—
Rhodium, Insoluble compounds, as Rh	—	1	—	—
Soluble compounds, as Rh	—	0.01	—	—
Sulprofos [35400-43-2]	—	1	—	—
o-Toluidine [95-53-4] — Skin	2, A2	9, A2	—	—
Trichloroethylene [79-01-6]	50	270	200	1,080
Vinylidene chloride [75-35-4]	5	20	20	80

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
†1983 Revision or Addition.

Capital letters A, B, D & E refer to Appendices; C denotes ceiling limit.
†1983 Revision or Addition.

NOTICE OF INTENDED CHANGES DUSTS

Substance	**TLV**
SILICA, SiO_2	
Crystalline	
Quartz [14808-60-7]	0.1 mg/m^3, Respirable dust 0.3 mg/m^3, Total dust
Cristobalite [14464-46-1]	0.05 mg/m^3, Respirable dust 0.15 mg/m^3, Total dust
Tridymite [15468-32-3]	0.05 mg/m^3, Respirable dust 0.15 mg/m^3, Total dust
Silica, fused [60676-86-0]	Use quartz values.
Tripoli [1317-95-9]	Use respirable quartz value.
Amorphous	
Diatomaceous earth (uncalcined) [60676-86-0]	5 mg/m^3, Respirable dust 10 mg/m^3, Total dust
Precipitated silica and silica gel	*5 mg/m^3, Respirable dust* 10 mg/m^3, Total dust
SILICATES and OTHER DUSTS (< 1% quartz)	
Graphite (natural) [7782-42-5]	2.5 mg/m^3, Respirable dust 5 mg/m^3, Total dust
Mica [12001-26-2]	3 mg/m^3, Respirable dust 6 mg/m^3, Total dust
Perlite	5 mg/m^3, Respirable dust 10 mg/m^3, Total dust
Portland Cement	5 mg/m^3, Respirable dust 10 mg/m^3, Total dust
Soapstone	3 mg/m^3, Respirable dust 6 mg/m^3, Total dust
Talc (containing asbestos fibers)	Use asbestos TLV. However, should not exceed 2 mg/m^3 respirable dust.

COAL DUST

If > 5% quartz, use respirable quartz value.

Generic Listing

All mppcf values for mineral dusts will be eliminated in favor of equivalent respirable mass or total mass values, i.e., Appendix F.

Footnote

j) Containing < 1% quartz; if quartz content > 1%, use quartz values.

APPENDIX A
Carcinogens

The Committee lists below those substances in industrial use that have proven carcinogenic in man, or have induced cancer in animals under appropriate experimental conditions. Present listing of those substances carcinogenic for man takes two forms: Those for which a TLV has been assigned (1a) and those for which environmental conditions have not been sufficiently defined to assign a TLV (1b).

A1a. *Human Carcinogens*. Substances, or substances associated with industrial processes, recognized to have carcinogenic or cocarcinogenic potential, with an assigned TLV:

	TLV
** Acrylonitrile — Skin.....	2 ppm
Asbestos	
Amosite...............	0.5 fiber > 5μm/cc
Chrysotile.............	2 fibers > 5μm/cc
Crocidolite............	0.2 fiber > 5μm/cc
Other forms	2 fibers > 5μm/cc
bis (Chloromethyl) ether	0.001 ppm
Chromite ore processing (chromate)	0.05 mg/m^3, as Cr
Chromium (VI), certain water insoluble compounds...........	0.05 mg/m^3, as Cr
Coal tar pitch volatiles ..	0.2 mg/m^3, as benzene solubles
Nickel sulfide roasting, fume & dust..........	1.0 mg/m^3, as Ni
Vinyl chloride	5 ppm

* * *

A1b. *Human Carcinogens*. Substances, or substances associated with industrial processes, recognized to have carcinogenic potential without an assigned TLV:

4-Aminodiphenyl (p-Xenylamine) — Skin
Benzidine — Skin
β-Naphthylamine
4-Nitrodiphenyl

For the substances in 1b, no exposure or contact by any route — respiratory, skin or oral, as detected by the most sensitive methods — shall be permitted. The worker should be properly equipped to insure virtually no contact with the carcinogen.

A2. *Industrial Substances Suspect of Carcinogenic Potential for MAN*. Chemical substances or substances associated with industrial processes, which are suspect of inducing cancer, based on either (1) limited epidemiologic evidence, exclusive of clinical reports of single cases, or (2) demonstration of carcinogenesis in one or more animal species by appropriate methods.

Acrylonitrile — Skin	2 ppm
Amitrol	—
Antimony trioxide production*	—
Arsenic trioxide production	—
Benzene	10 ppm
Benzo(a)pyrene	—
Beryllium	2.0 μg/m^3
†1, 3-Butadiene	—
Cadmium oxide production	—
Carbon tetrachloride — Skin	5 ppm
Chloroform	10 ppm
‡Chloromethyl methyl ether	—
Chromates of lead and zinc, as Cr	0.05 mg/m^3
Chrysene	—
3, 3′-Dichlorobenzidine — Skin	—
Dimethylcarbamyl chloride	—
1, 1-Dimethyl hydrazine — Skin	0.5 ppm
Dimethyl sulfate — Skin	0.1 ppm
Ethylene dibromide — Skin	—
Ethylene oxide	1 ppm
†Formaldehyde	1 ppm
Hexachlorobutadiene	0.02 ppm
Hexamethyl phosphoramide — Skin	—
Hydrazine — Skin	0.1 ppm
4, 4′-Methylene bis (2-chloroaniline) — Skin	0.02 ppm
Methyl hydrazine — Skin	C 0.2 ppm
Methyl iodide — Skin	2 ppm
2-Nitropropane	10 ppm
N-Nitrosodimethylamine — Skin	—
N-Phenyl-beta-naphthylamine	—
Phenylhydrazine — Skin	5 ppm
Propane sultone	—
beta-Propiolactone	0.5 ppm
‡Propyleneimine — Skin	2 ppm
o-Tolidine	—
o-Toluidine — Skin	2 ppm
Vinyl bromide	5 ppm
Vinyl cyclohexene dioxide	10 ppm

For the above, worker exposure by all routes should be carefully controlled to levels consistent with the animal and human experience data (see Documentation), including those substances with a listed TLV.

THE COMMITTEE GUIDELINES FOR CLASSIFICATION OF EXPERIMENTAL ANIMAL CARCINOGENS

The following guidelines are offered in the present state of knowledge as an aid in classifying substances in the occupational environment found to be carcinogenic in experimental animals. A need was felt by the Threshold Limits Committee for such a classification in order to take the first step in developing an appropriate TLV for occupational exposure.

Determination of Approximate Threshold of Response Requirement. In order to determine in

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**See Notice of Intended Changes.

*Cigarette smoking can enhance the incidence of respiratory cancers from this or others of these substances or processes.

†1983 Addition.

‡1983 Adoption.

which category to classify an experimental carcinogen for the purpose of assigning an industrial air limit (TLV), an approximate threshold of neoplastic response must be determined. Because of practical experimental difficulties, a precisely defined threshold cannot be attained. For the purposes of standard-setting, this is of little moment, as an appropriate risk, or safety, factor can be applied to the approximate threshold, the magnitude of which is dependent on the degree of potency of the carcinogenic response.

To obtain the best 'practical' threshold of neoplastic response, dosage decrements should be less than logarithmic. This becomes particularly important at levels greater than 10 ppm (or corresponding mg/m^3). Accordingly, after a range-finding determination has been made by logarithmic decreases, two additional dosage levels are required within the levels of "effect" and "no effect" to approximate the true threshold of neoplastic response.

The second step should attempt to establish a metabolic relationship between animal and man for the particular substance found carcinogenic in animals. If the metabolic pathways are found comparable, the substance should be classed highly suspect as a carcinogen for man. If no such relation is found, the substance should remain listed as an experimental animal carcino gen until evidence to the contrary is found.

Proposed Classification of Experimental Animal Carcinogens. Substances occurring in the occupational environment found carcinogenic for animals may be grouped into three classes, those of high, intermediate and low potency. In evaluating the incidence of animal cancers, significant incidence of cancer is defined as a neoplastic response which represents, in the judgment of the Committee, a significant excess of cancers above that occurring in negative controls.

EXCEPTIONS: No substance is to be considered an occupational carcinogen of any practical significance which reacts by the respiratory route at or above 1000 mg/m^3 for the mouse, 2000 mg/m^3 for the rat; by the dermal route, at or above 1500 mg/kg for the mouse, 3000 mg/kg for the rat; by the gastrointestinal route at or above 500 mg/kg/d for a lifetime, equivalent to about 100 g T.D. for the rat, 10 g T.D. for the mouse.

These dosage limitations exclude such substances as dioxane and trichlorethylene from consideration as carcinogens.

Examples: Dioxane — rats, hepatocellular and nasal tumors from 1015 mg/kg/d, oral

Trichloroethylene — female mice, tumors (30/98 @ 900 mg/kg/d), oral

A. *Industrial Substances of High Carcinogenic Potency in Experimental Animals.*

1. A substance to qualify as a carcinogen of high potency must fulfill one of the three following conditions in two animal species:

1a. *Respiratory*. Elicit cancer from (1) dosages below 1 mg/m^3 (or equivalent ppm) via the respiratory tract in 6- 7-hour daily repeated inhalation exposures throughout lifetime; or (2) from a single intratracheally administered dose not exceeding 1 mg of particulate, or liquid, per 100 ml or less of animal minute respiratory volume;

Examples: bis-Chloromethyl ether, malignant tumors, rats, @ 0.47 mg/m^3 (0.1 ppm) in 2 years;

Hexamethyl phosphoramide, nasal squamous cell carcinoma, rats, @ 0.05 ppm, in 13 months

OR

1b. *Dermal*. Elicit cancer within 20 weeks by skin-painting, twice weekly at 2 mg/kg body weight or less per application for a total dose equal to or less than 1.5 mg, in a biologically inert vehicle;

Examples: 7, 12-Dimethylbenz(a)anthracene — skin tumors @ 0.12-0.8 mg T.D. in four weeks

Benzo(a)pyrene, mice 12 μg, 3X/wk for 18 mos. T.D. 2.6 mg, 90.9% skin tumors

OR

1c. *Gastrointestinal*. Elicit cancer by daily intake via the gastrointestinal tract, within six months, with a six-month holding period, at a dosage below 1 mg/kg body weight per day; total dose, rat, ≦ 50 mg; mouse, ≦ 3.5 mg;

Examples: 7, 12-Dimethylbenz(a)anthracene — mammary tumors from 10 mg 1X

3-Methylcholanthrene — Tumors @ 3 sites from 8 mg in 89 weeks

Benzo(a)pyrene, mice, 3.9% leukemias, from 30 mg T.D. 198 days

2. Elicit cancer by all three routes in at least two animal species at dose levels prescribed for high or intermediate potency.

B. *Industrial Substances of Intermediate Carcinogenic Potency in Experimental Animals.*

To qualify as a carcinogen of intermediate potency, a substance should elicit cancer in two animal species at dosages intermediate between those described in A and C by two routes of administration.

Example: Carbamic acid ethyl ester

Dermal, mammary tumors, mice, 100%, 63 weeks, 500–1400 mg T.D.

Gastrointestinal, various type tumors, mice 42 weeks, 320 mg T.D.

Gastrointestinal, various type tumors, rats, 60 weeks, 110–930 mg T.D.

C. *Industrial Substances of Low Carcinogenic Potency in Experimental Animals.*

To qualify as a carcinogen of low potency, a substance should elicit cancer in one animal species by any *one* of three routes of administration at the following prescribed dosages and conditions:

1a. *Respiratory*. Elicit cancer from (1) dosages greater than 10 mg/m^3 (or equivalent ppm) via the respiratory tract in 6- 7-hour, daily repeated inhalation exposures, for 12 months' exposure and 12 months' observation period; or (2) from intratracheally administered dosages totaling more than 10 mg of particulate or liquid per 100 ml or more of animal minute respiratory volume;

Examples: Beryl (beryllium aluminum silicate) malig. lung tumors, rats, @ 15 mg/m^3 @ 17 months

Benzidine, var. tumors, rats, 10–20 mg/m^3 @ > 13 mos.

OR

1b. *Dermal*. Elicit cancer by skin-painting of mice in twice weekly dosages of > 10 mg/kg body weight in a biologically inert vehicle for at least 75 weeks, i.e., ≧ 1.5g T.D.

Examples: Shale tar, mouse, 0.1 ml × 50 = 5g T.D. 59/60 skin tumors

Arsenic trioxide, man, dose unknown, but estimated to be high

1c. *Gastrointestinal*. Elicit cancer from daily oral dosages of 50 mg/kg/day or greater during the lifetime of the animal.

APPENDIX B
SUBSTANCES OF VARIABLE COMPOSITION

B1 *Polytetrafluoroethylene* decomposition products*. Thermal decomposition of the fluorocarbon chain in air leads to the formation of oxidized products containing carbon, fluorine and oxygen. Because these products decompose in part by hydrolysis in alkaline solution, they can be quantitatively determined in air as fluoride to provide an index of exposure. No TLV is recommended pending determination of the toxicity of the products, but air concentrations should be minimal.

B2 *Welding Fumes — Total Particulate (NOC)†*
TLV, 5 mg/m^3

Welding fumes cannot be classified simply. The composition and quantity of both are dependent on the alloy being welded and the process and electrodes used. Reliable analysis of fumes cannot be made without considering the nature of the welding process and system being examined; reactive metals and alloys such as aluminum and titanium are arc-welded in a protective, inert atmosphere such as argon. These arcs create relatively little fume, but an intense radiation which can produce ozone. Similar processes are used to arc-weld steels, also creating a relatively low level of fumes. Ferrous alloys also are arc-welded in oxidizing environments which generate considerable fume, and can produce carbon monoxide instead of ozone. Such fumes generally are composed of discreet particles of amorphous slags containing iron, manganese, silicon and other metallic constituents depending on the alloy system involved. Chromium and nickel compounds are found in fumes when stainless steels are arc-welded. Some coated and flux-cored electrodes are formulated with fluorides and the fumes associated with them can contain significantly more fluorides than oxides. Because of the above factors, arc-welding fumes frequently must be tested for individual constituents which are likely to be present to determine whether specific TLV's are exceeded. Conclusions based on total fume concentration are generally adequate if no toxic elements are present in welding rod, metal, or metal coating and conditions are not conducive to the formation of toxic gases.

Most welding, even with primitive ventilation, does not produce exposures inside the welding helmet above 5 mg/m^3. That which does, should be controlled.

APPENDIX C
MIXTURES

C.1 THRESHOLD LIMIT VALUES FOR MIXTURES

When two or more hazardous substances, which act upon the same organ system, are present, their combined effect, rather than that of either individually, should be given primary consideration. In the absence of information to the contrary, the effects of the different hazards should be considered as additive. That is, if the sum of the following fractions,

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots \frac{C_n}{T_n}$$

exceeds unity, then the threshold limit of the mixture should be considered as being exceeded. C_1 indicates the observed atmospheric concentration, and T_1 the corresponding threshold limit (See Example 1A.a. and 1A.c.).

Exceptions to the above rule may be made when there is a good reason to believe that the chief effects of the different harmful substances are not in fact additive, but *independent* as when purely local effects on different organs of the body are produced by the various components of the mixture. In such cases the threshold limit ordinarily is exceeded only when at least one member of the series $\left(\frac{C_1}{T_1} + \text{or} + \frac{C_2}{T_2} \text{ etc.}\right)$ itself has a value exceeding unity (See Example 1A.c.).

Synergistic action or potentiation may occur with some combinations of atmospheric contaminants. Such cases at present must be determined individually. Potentiating or synergistic agents are not necessarily harmful by themselves. Potentiating effects of exposure to such agents by routes other than that of inhalation is also possible, e.g. imbibed alcohol and inhaled narcotic (trichloroethylene). Potentiation is characteristically exhibited at high concentrations, less probably at low.

When a given operation or process characteristi-

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*Trade Names: Algoflon, Fluon, Halon, Teflon, Tetran.

†Not otherwise classified (NOC).

cally emits a number of harmful dusts, fumes, vapors or gases, it will frequently be only feasible to attempt to evaluate the hazard by measurement of a single substance. In such cases, the threshold limit used for this substance should be reduced by a suitable factor, the magnitude of which will depend on the number, toxicity and relative quantity of the other contaminants ordinarily present.

Examples of processes which are typically associated with two or more harmful atmospheric contaminants are welding, automobile repair, blasting, painting, lacquering, certain foundry operations, diesel exhausts, etc.

C.1A Examples of THRESHOLD LIMIT VALUES FOR MIXTURES

The following formulae apply only when the components in a mixture have similar toxicologic effects; they should not be used for mixtures with widely differing reactivities, e.g. hydrogen cyanide & sulfur dioxide. In such case the formula for Independent Effects (1A.c.) should be used.

1A.a. General case, where air is analyzed for each component:

a. *Additive effects. (Note: It is essential that the atmosphere be analyzed both qualitatively and quantitatively for each component present, in order to evaluate compliance or non-compliance with this calculated TLV.)*

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_3}{T_3} + \ldots = 1$$

Example No. 1A.a.: Air contains 400 ppm of acetone (TLV = 750 ppm) 150 ppm of sec-butyl acetate (TLV = 200 ppm) and 100 ppm of methyl ethyl ketone (TLV = 200 ppm)

Atmospheric concentration of mixture = 400 + 150 + 100 = 650 ppm of mixture

$$\frac{400}{750} + \frac{150}{200} + \frac{100}{200} = 0.53 + 0.75 + 0.5 = 1.78$$

Threshold Limit is exceeded.

1A.b. Special case when the source of contaminant is a liquid mixture and the atmospheric composition is *assumed* to be similar to that of the original material; e.g. on a time-weighted average exposure basis, all of the liquid (solvent) mixture eventually evaporates.

Additive effects (approximate solution)

1. The percent composition (by weight) of the liquid mixture is known, the TLVs of the constituents must be listed in mg/m³.

(Note: In order to evaluate compliance with this TLV, field sampling instruments should be calibrated, in the laboratory, for response to this specific quantitative and qualitative air-vapor mixture, and also to fractional concentrations of this mixture; e.g., 1/2 the TLV; 1/10 the TLV; 2 × the TLV; 10 × the TLV; etc.)

$$\text{TLV of mixture} = \frac{1}{\frac{f_a}{TLV_a} + \frac{f_b}{TLV_b} + \frac{f_c}{TLV_c} + \ldots \frac{f_n}{TLV_n}}$$

Example No. 1A.b.: Liquid contains (by weight)

50% heptane: TLV = 400 ppm or 1600 mg/m³
1 mg/m³ ≡ 0.25 ppm
30% methyl chloroform: TLV = 350 ppm or 1900 mg/m³
1 mg/m³ ≡ 0.18 ppm
20% perchloroethylene: TLV = 50 ppm or 335 mg/m³
1 mg/m³ ≡ 0.15 ppm

$$\text{TLV of Mixture} = \frac{1}{\frac{0.5}{1600} + \frac{0.3}{1900} + \frac{0.2}{335}}$$

$$= \frac{1}{0.00031 + 0.00016 + 0.0006}$$

$$= \frac{1}{0.00107} = 935 \text{ mg/m}^3$$

of this mixture

50% or (935) (0.5) = 468 mg/m³ is heptane
30% or (935) (0.3) = 281 mg/m³ is methyl chloroform
20% or (935) (0.2) = 187 mg/m³ is perchloroethylene

These values can be converted to ppm as follows:

heptane: 468 mg/m³ × 0.25 = 117 ppm
methyl chloroform: 281 mg/m³ × 0.18 = 51 ppm
perchloroethylene: 187 mg/m³ × 0.15 = 29 ppm

TLV of mixture = 117 + 51 + 29 = 197 ppm, or 935 mg/m³

1A.c. *Independent effects*.

Air contains 0.15 mg/m³ of lead (TLV, 0.15) and 0.7 mg/m³ of sulfuric acid (TLV, 1).

$$\frac{0.15}{0.15} = 1; \quad \frac{0.7}{1} = 0.7$$

Threshold limit is not exceeded.

1B. TLV for Mixtures of Mineral Dusts.

For mixtures of biologically active mineral dusts the general formula for mixtures given in 1A.b. may be used.

APPENDIX D
Some Nuisance Particulates[o]

‡TLV, (30 mppcf) or 10 mg/m^3 of total
dust < 1% quartz, or, 5 mg/m^3
respirable dust

- α-Alumina (Al_2O_3)
- Calcium carbonate
- Calcium silicate
- Cellulose (paper fiber)
- Emery
- Glycerin Mist
- Graphite (synthetic)
- Gypsum
- Kaolin
- Limestone
- Magnesite
- Marble
- Mineral Wool Fiber
- Pentaerythritol
- Plaster of Paris
- Portland Cement
- Rouge
- Silicon
- Silicon Carbide
- Starch
- Sucrose
- Titanium Dioxide
- Vegetable oil mists (except castor, cashew nut, or similar irritant oils)
- Zinc Stearate
- Zinc oxide dust

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[o] When toxic impurities are not present, e.g. quartz < 1%.

APPENDIX E
Some Simple Asphyxiants[p]

- Acetylene
- Argon
- Ethane
- Ethylene
- Helium
- Hydrogen
- Methane
- Neon
- Propane
- Propylene

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[p] As defined on pg. 6.

‡APPENDIX F
Conversion of mppcf to Mass Concentration

Calculations for Conversion of Particle Count Concentration (by Standard Light Field — Midget Impinger Techniques), in mppcf, to Respirable Mass Concentration (by Respirable Sampler) in mg/m^3.(1)

1. In 1967, Jacobsen and Tomb,(1) derived an empirical relationship of 5.6 mppcf to 1 milligram of respirable dust per cubic meter of air, based on 23 sets of samples, mostly coal dust. Studies on conversion factors have been undertaken and preliminary evidence suggests that the application of any single conversion factor may not be adequate for use in risk assessments, epidemiology studies, or setting TLVs.

   The following calculation results in an equivalence of 6.37 mppcf to 1 mg/m^3 of respirable dust. Thus, an approximate ratio of 6 mppcf to 1 mg/m^3 of respirable dust is suggested for conversion of TLVs from a count to a mass basis when the density and mass median diameter have not been determined.

2. Basic assumptions:

   a) Average density for silica containing dusts $\approx$ 2.5 g/cm^3 (2500 mg/cm^3). Pulmonary significant dust densities may vary from 1.2 g/cm^3 for coal dust to 3.1 g/cm^3 for Portland Cement. Silica densities vary from 2.2 (amorphous) to 2.3 (cristobalite and tridymite) to 2.5 (alpha-quartz.) gms per cm^3.

   b) The mass median diameter (mmd) of particles collected in midget impinger samplers and counted by the standard light field technique, *and* collected in a respirable sampler is approximately 1.5 μm or 1.5×10^{-4} cm. This assumption is, of course, quite arbitrary since the mmd of all dust clouds is quite variable, depending on many independent parameters, such as source of dust, age of dust cloud, meteorological conditions, processes and equipment changes, etc. If the density and the mass median diameter of the dust particles are known, the nomograph in Figure 1 can be used to convert dust count concentrations (mppcf) to respirable mass concentrations (mg/m^3).

3. Calculation:

   a) vol. per particle: $4/3\ \pi\ r^3$; $r = 0.75 \times 10^{-4}$ cm
   $= 4/3 \cdot \pi \cdot (0.75 \times 10^{-4})^3$
   $= 1.77 \times 10^{-12}\ cm^3$

   b) wt. per particle = vol. × density
   $= 1.77 \times 10^{-12}\ cm^3 \times 2.5 \times 10^3\ mg/cm^3$
   $= 4.425 \times 10^{-9}$ mg/particle

   c) 1 particle/ft.^{3} = 35.3 part./m^3
   (since 35.5 cu ft = 1 cu m.)
   10^6 part./ft^3 = mppcf = 35.3×10^6 part./m^3

   wt. of 1 mppcf $\equiv$ 35.5×10^6 part./m^3 × 4.425×10^{-9} mg/part.

   1 mppcf $\equiv$ 0.157 mg/m^3
   or
   6.37 mppcf $\equiv$ 1 mg/m^3
   or approximately 6 mpccf $\equiv$ 1 mg/m^3.

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‡See Notice of Intended Changes.

Reference

1. **Jacobson, M. and T. F. Tomb:** Relationship Between Gravimetric Respirable Dust Concentration and Midget Impinger Number Concentration. *Am. Ind. Hyg. Assoc. J. 28:*554 (Nov.-Dec. 1967).

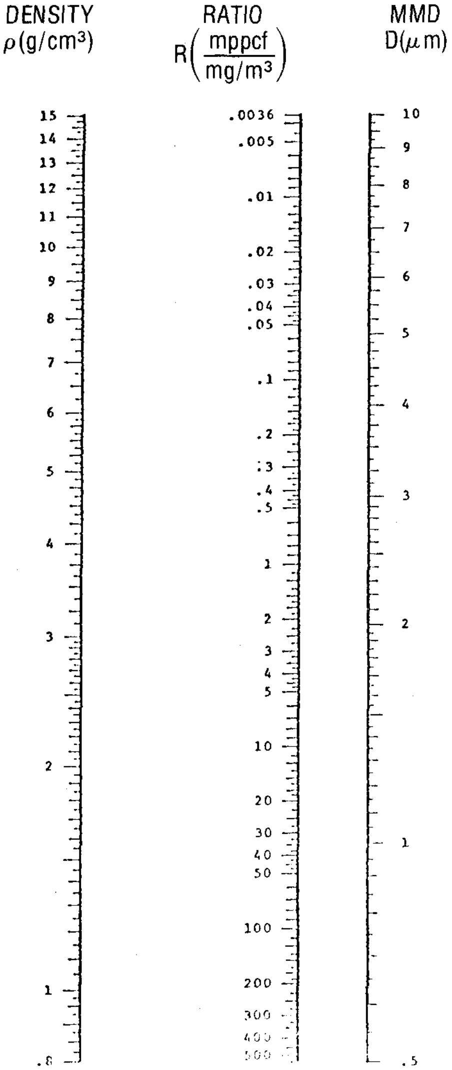

Figure 1 — Ratio of Particle Count — mppcf to Respirable Mass Concentration — mg/m³ (as function of density and mmd)†

†Prepared by P. E. Caplan and R. J. Smith

Table 1

Equivalent TLVs in mppcf and mg/m³ (Respirable Mass) for Mineral Dusts†

Substance	Threshold Limit Value		
	Count mppcf	Resp. Mass mg/m³	Total Mass* mg/m³
Silica (SiO_2)			
Amorphous	20	(3)**	(6)
Cristobalite	1.5	0.05	0.15
Fused silica	3	0.1	0.3
Quartz	3	0.1	0.3
Tridymite	1.5	0.05	0.15
Coal Dust	(12)	2	(4)
Diatomaceous earth, natural	—	1.5	—
Graphite (natural)	15	(2.5)	(5)
Mica	20	(3)	(6)
Mineral wool fiber	—	(5)	10
Nuisance particulates	30	(5)	10
Perlite	30	(5)	(10)
Portland Cement	30	(5)	(10)
Soapstone	20	(3)	(6)
Tripoli	(3)	0.1	(0.3)

†Assuming that the mass median diameter is 1.5 μm and density is 2.5 g/cm³.

*Unless otherwise specified, respirable mass is presumed to equal approximately 50% of total mass.

**All values in parentheses ( ) represent newly calculated values based on equivalence of 6 mppcf = 1 mg/m³ respirable mass and respirable mass = 50% total mass.

APPENDIX G

Chemical Substances and Other Issues Under Study[1]

Chemical Substances

Acetonitrile
Acrolein
Acrylic acid
Allyl chloride
Amorphous silica
Asbestos
Atrazine
Bismuth telluride
1,3-Butadiene
Carbonyl fluoride
Chlorinated naphthalenes
Chlorine
o-Chlorobenzlidene
bis-Chloromethyl ether
Chloromethyl methyl ether
o-Chlorotoluene
Chrysene
Copper dust & fume
Cyclohexanone
Diatomaceous earth
Diethylenetriamine
Epichlorohydrin
Ethyl chloride
Ethylene dichloride
Ethyl methacrylate
Gasoline
Glycol ethers
Graphite
Hexachlorocyclopentadiene
Isocyanates
Isoflurane
Isooctyl alcohol
Jet fuels
Methylenedianiline
Methyl methacrylate
Methyl tetiary butyl ether
Nickel, metal & soluble compounds
p-Nitrochlorobenzene
Osmium tetroxide
Perfluorinated chemicals
Piperizine
Propylene chloride
Propylene oxide
Styrene, monomer
Tetrachloronaphthalene
Tin hydride
1,2,3-Trichloropropane
Trimellitic anhydride
m-Xylene 2,2'-diamine (MXDA; meta-meta-xylenediamine)

Other Issues

1. Is the current aspect ratio better than other ratios for health protection and/or differentiation of asbestos fibers.
2. *Ceiling Limits* — In light of today's instrumentation (quick response) and STELS, are ceiling limits needed and, if so, what criteria would determine their appropriateness.
3. *Soluble Inorganic Compounds* — What quantitative criteria should be used in differentiating between soluble and insoluble for TLV use.
4. Dual vapor and particulate TLVs.[2]

5. Should welding fume value (not otherwise classified, NOC) be retained or should specific analytical determinations be made for metals and other compounds and these values be compared to specific TLVs?

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[1] Information, data especially, and comments are solicited to assist the committee in its deliberations and in the development of draft documents. Draft documentations are used by the committee to decide what action, if any, to recommend on a given substance or question.

[2] Study papers appear in the *Annals of the American Conference of Governmental Industrial Hygienists*, Volume 4, *ACGIH Transactions – 1982*, pp. 153-155 (1983).

APPENDIX H
Registered® Trade Names

Trade Name	Generic Name	CAS No.
Abate	Temephos	3383-96-8
Ammate	Ammonium sulfamate	7773-06-0
Azodrin	Monocrotophos	6923-22-4
Baygon	Propoxur	114-26-1
Baytex	Fenthion	55-38-9
Bidrin	Dicrotophos	141-66-2
Bolstar	Sulprofos	35400-43-2
Butyl Cellosolve	2-Butoxyethanol	111-76-2
Cellosolve acetate	2-Ethoxyethyl acetate	111-15-9
Coyden	Clopidol	2971-90-6
Crag herbicide	Sesone	136-78-7
Dasanit	Fensulfothion	115-90-2
Delnav	Dioxathion	78-34-2
Dibrom	Naled	300-76-5
Difolatan	Captafol	2425-06-1
Disyston	Disulfoton	298-04-4
Dursban	Chlorpyrifos	2921-88-2
Dyfonate	Fonofos	944-22-9
Furadan	Carbofuran	1563-66-2
Guthion	Azinphos-methyl	86-50-0
Lannate	Methomyl	16752-77-5
Methyl Cellosolve	2-Methoxyethanol	109-84-4
Methyl Cellosolve acetate	2-Methoxyethyl acetate	110-49-6
Nemacur	Fenamiphos	22224-92-6
Nialate	Ethion	563-12-2
N-Serve	Nitrapyrin	1929-82-4
Pival	Pindone	83-26-1
Plictran	Cyhexatin	13121-70-5
Sencor	Metribuzin	21087-64-9
Sevin	Carbaryl	63-25-2
Teflon	Polytetrafluoroethylene	9002-84-0
Thimet	Phorate	298-02-2
Thiodan	Endosulfan	115-29-7
Tordon	Picloram	1918-02-1
Zoalene	Dinitolmide	148-01-6

PREFACE

PHYSICAL AGENTS

These threshold limit values refer to levels of physical agents and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Because of wide variations in individual susceptibility, exposure of an occasional individual at, or even below, the threshold limit may not prevent annoyance, aggravation of a pre-existing condition, or physiological damage.

These threshold limits are based on the best available information from industrial experience, from experimental human and animal studies, and when possible, from a combination of the three.

These limits are intended for use in the practice of industrial hygiene and should be interpreted and applied only by a person trained in this discipline. They are not intended for use, or for modification for use, (1) in the evaluation or control of the levels of physical agents in the community, (2) as proof or disproof of an existing physical disability, or (3) for adoption by countries whose working conditions differ from those in the United States of America.

These values are reviewed annually by the Committee on Threshold Limits for Physical Agents for revisions or additions, as further information becomes available.

Notice of Intent — At the beginning of each year, proposed actions of the Committee for the forthcoming year are issued in the form of a "Notice of Intent." This notice provides not only an opportunity for comment, but solicits suggestions of physical agents to be added to the list. The suggestions should be accompanied by substantiating evidence.

As Legislative Code — The Conference recognizes that the Threshold Limit Values may be adopted in legislative codes and regulations. If so used, the intent of the concepts contained in the Preface should be maintained and provisions should be made to keep the list current.

THRESHOLD LIMIT VALUES

HEAT STRESS

These Threshold Limit Values refer to heat stress conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse health effects. The TLVs shown in Table 1 are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C.(1, 2)

Since measurement of deep body temperature is impractical for monitoring the workers' heat load, the measurement of environmental factors is required which most nearly correlate with deep body temperature and other physiological responses to heat. At the present time Wet Bulb Globe Temperature Index (WBGT) is the simplest and most suitable technique to measure the environmental factors. WBGT values are calculated by the following equations:

1. Outdoors with solar load:
   $WBGT = 0.7\ NWB + 0.2\ GT + 0.1\ DB$
2. Indoors or Outdoors with no solar load:
   $WBGT = 0.7\ NWB + 0.3\ GT$

where:

WBGT = Wet Bulb Globe Temperature Index
NWB = Natural Wet-Bulb Temperature
DB = Dry-Bulb Temperature
GT = Globe Temperature

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer.

Higher heat exposures than shown in Table 1 are permissible if the workers have been undergoing medical surveillance and it has been established that they are more tolerant to work in heat than the average worker. Workers should not be permitted to continue their work when their deep body temperature exceeds 38.0°C.

TABLE 1

Permissible Heat Exposure Threshold Limit Values
(Values are given in °C. WBGT)

	Work Load		
Work — Rest Regimen	Light	Moderate	Heavy
Continuous work	30.0	26.7	25.0
75% Work — 25% Rest, Each hour	30.6	28.0	25.9
50% Work — 50% Rest, Each hour	31.4	29.4	27.9
25% Work — 75% Rest, Each hour	32.2	31.1	30.0

EVALUATION AND CONTROL

I. *Measurement of the Environment*

The instruments required are a dry-bulb, a natural wet-bulb, a globe thermometer, and a stand. The measurement of the environmental factors shall be performed as follows:

A. The range of the dry and the natural wet bulb thermometer shall be −5°C to 50°C with an accuracy of ±0.5°C. The dry bulb thermometer must be shielded from the sun and the other radiant surfaces of the environment without restricting the airflow around the bulb. The wick of the natural wet-bulb thermometer shall be kept wet with distilled water for at least 1/2 hour before the temperature reading is made. It is not enough to immerse the other end of the wick into a reservoir of distilled water and wait until the whole wick becomes wet by capillarity. The wick shall be wetted by direct application of water from a syringe 1/2 hour before each reading. The wick shall extend over the bulb of the thermometer, covering the stem about one additional bulb length. The wick should always be clean and new wicks should be washed before using.

B. A globe thermometer, consisting of a 15 cm. (6-inch) diameter hollow copper sphere painted on the outside with a matte black finish or equivalent, shall be used. The bulb or sensor of a thermometer (range −5°C to 100°C with an accuracy of ±0.5°C) must be fixed in the center of the sphere. The globe thermometer shall be exposed at least 25 minutes before it is read.

C. A stand shall be used to suspend the three thermometers so that they do not restrict free air flow around the bulbs, and the wet-bulb and globe thermometer are not shaded.

D. It is permissible to use any other type of temperature sensor that gives identical reading as that of a mercury thermometer under the same conditions.

E. The thermometers must be so placed that the readings are representative of the condition where the men work or rest, respectively.

The methodology outlined above is more fully explained by Minard.(3–4)

II. *Work Load Categories*

Heat produced by the body and the environmental heat together determine the total heat load. Therefore, if work is to be performed under hot environmental conditions, the workload category of each job shall be established and the heat exposure limit pertinent to the work load evaluated against the applicable standard in order to protect the worker from exposure beyond the permissible limit.

A. The work load category may be established by ranking each job into light, medium, and heavy categories on the basis of type of operation. Where the work load is ranked into one of said three categories, i.e.

(1) light work (up to 200 kcal/hr or 800 Btu/hr): e.g., sitting or standing to control machines, performing light hand or arm work,

(2) moderate work (200–350 kcal/hr or 800–1400 Btu/hr): e.g., walking about with moderate lifting and pushing,

(3) heavy work (350–500 kcal/hr or 1400–2000 Btu/hr): e.g., pick and shovel work,

the permissible heat exposure limit for that work load shall be determined from Table 1.

B. The ranking of the job may be performed either by measuring the worker's metabolic rate while performing his job or by estimating his metabolic rate with the use of Tables 2 and 3. Additional tables available in the literature(5–8) may be utilized also. When this method is used the permissible heat exposure limit can be determined by Figure 1.

III. *Work-Rest Regimen*

The permissible exposure limits specified in Table 1 and Figure 1 are based on the assumption that the WBGT value of the resting place is the same or very close to that of the work place. Where the WBGT of the work area is different from that of the rest area a time-weighted average value should be used for both environmental and metabolic heat. When time-weighted average values are used the appropriate curve on Figure 1 is the solid line labeled "continuous."

The time-weighted average metabolic rate (M) shall be determined by the equation:

$$\text{Av. M} = \frac{M_1 \times t_1 + M_2 \times t_2 + \ldots. + M_n \times t_n}{t_1 + t_2 + \ldots. + t_n}$$

where M_1, M_2 . . . and M_n are estimated or measured metabolic rates for the various activities and rest periods of the worker during the time periods t_1, t_2 . . . and t_n (in minutes) as determined by a time study.

The time-weighted average WBGT shall be determined by the equation:

$$\text{Av. WBGT} = \frac{\text{WBGT}_1 \times t_1 + \text{WBGT}_2 \times t_2 + \ldots + \text{WBGT}_n \times t_n}{t_1 + t_2 + \ldots + t_n}$$

where WBGT_1, WBGT_2 . . . and WBGT_n are calculated values of WBGT for the various work and rest occupied during total time periods t_1, t_2 . . . and t_n are the elapsed times in minutes spent in the corresponding areas which are determined by a time study. Where exposure to hot environmental conditions is continuous for several hours or the entire work day, the time-weighted averages shall be calculated as hourly time-weighted average i.e., $t_1 + t_2 + \ldots + t_n = 60$ minutes. Where the exposure is intermittent, the time-weighted averages shall be calculated as two-hour time-weighted averages, i.e., $t_1 + t_2 + \ldots + t_n = 120$ minutes.

The permissible exposure limits for continuous work are applicable where there is a work-rest regimen of a 5-day work week and an 8-hour work day with a short morning and afternoon break (approximately 15 minutes) and a longer lunch break (approximately 30 minutes). Higher exposure limits are permitted if additional resting time is allowed. All breaks, including unscheduled pauses and administrative or operational waiting periods during work may be counted as rest time when additional rest allowance must be given because of high environmental temperatures.

IV. *Water and Salt Supplementation*

During the hot season or when the worker is exposed to artificially generated heat, drinking water shall be made available to the workers in such a way that they are stimulated to frequently drink small amounts, i.e., one cup every 15–20 minutes (about 150 ml or 1/4 pint).

The water shall be kept reasonably cool (10°–15°C or 50.0°–60.0°F) and shall be placed close to the workplace so that the worker can reach it without abandoning the work area.

The workers should be encouraged to salt their food abundantly during the hot season and particularly during hot spells. If the workers are unacclimatized, salted drinking water shall be made available in a concentration of 0.1% (1g NaCl to 1.0 liter or 1 level tablespoon of salt to 15 quarts of water). The added salt shall be completely dissolved before the water is distributed, and the water shall be kept reasonably cool.

TABLE 2

Assessment of Work Load[9]

Average values of metabolic rate during different activities.

A. Body position and movement	kcal/min
Sitting	0.3
Standing	0.6
Walking	2.0–3.0
Walking up hill	add 0.8 per meter (yard) rise

B. Type of Work		Average kcal/min	Range kcal/min
Hand work			
	light	0.4	0.2–1.2
	heavy	0.9	
Work with one arm			
	light	1.0	0.7–2.5
	heavy	1.8	
Work with both arms			
	light	1.5	1.0–3.5
	heavy	2.5	
Work with body			
	light	3.5	2.5–15.0
	moderate	5.0	
	heavy	7.0	
	very heavy	9.0	

TABLE 3

Activity Examples[9]

Light hand work: writing, hand knitting

Heavy hand work: typewriting

Heavy work with one arm: hammering in nails (shoemaker, upholsterer)

Light work with two arms: filing metal, planing wood, raking of a garden

Moderate work with the body: cleaning a floor, beating a carpet

Heavy work with the body: railroad track laying, digging, barking trees

Sample Calculation

Assembly line work using a heavy hand tool.

A. Walking along	2.0 kcal/min
B. Intermediate value between heavy work with two arms and light work with the body	3.0 kcal/min
	5.0 kcal/min
C. Add for basal metabolism	1.0 kcal/min
Total	6.0 kcal/min

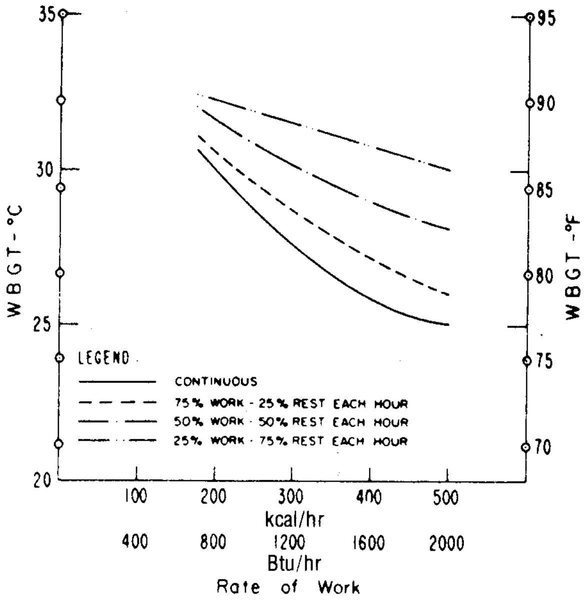

Figure 1 — Permissible Heat Exposure Threshold Limit Value

V. *Other Considerations*

A. *Clothing:* The permissible heat exposure TLVs are valid for light summer clothing as customarily worn by workers when working under hot environmental conditions. If special cothing is required for performing a particular job and this clothing is heavier or it impedes sweat evaporation or has higher insulation value, the worker's heat tolerance is reduced, and the permissible heat exposure limits indicated in Table 1 and Figure 1 are not applicable. For each job category where special clothing is required, the permissible heat exposure limit shall be established by an expert.

B. *Acclimatization and Fitness:* Acclimatization to heat involves a series of physiological and psychological adjustments that occur in an individual during his first week of exposure to hot environmental conditions. The recommended heat stress TLVs are valid for acclimated workers who are physically fit. Extra caution must be employed when unacclimated or physically un-fit workers must be exposed to heat stress conditions.

References:

1. *Health Factors Involved in Working Under Conditions of Heat Stress.* WHO Technical Report Series No. 412 (1969).
2. **Dukes-Dobos, F. N. and A. Henschel:** Development of Permissible Heat Exposure Limits for Occupational Work. *ASHRAE Journal 15(9):*57–62 (Sept. 1973).
3. **Minard, D.:** *Prevention of Heat Casualties in Marine Corps Recruits, Period of 1955–60, with Comparative Incidence Rates and Climatic Heat Stresses in Other Training Categories.* Research Report No. 4, Contract No. MR 005.01-0001.01, Naval Medical Research Institue, Bethesda, MD (Feb. 21, 1961). Published in *Military Medicine 126(44):*261–272 (April 1961).
4. **Minard, D. and R. L. O'Brien:** *Heat Casualties in the Navy and Marine Corps 1959–1962 with Appendices on the Field Use of the Wet Bulb-Globe Temperature Index.* Research Report No. 7, Contract No. MR 005.01-0001.01, Naval Medical Research Institute, Bethesda, MD (March 12, 1964).
5. **Astrand, Per-Olof and Kaare Rodahl:** *Textbook of Work Physiology.* McGraw-Hill Book Co., New York, San Francisco (1970).

6. Ergonomics Guide to Assessment of Metabolic and Cardiac Costs of Physical Work. *Am. Ind. Hyg. Assoc. J. 32:*560 (1971).
7. *Energy Requirements for Physical Work*. Research Progress Report No. 30. Purdue Farm Cardiac Project, Agricultural Experiment Station, West Lafayette, IN (1961).
8. **Dumin, J. V. G. A. and R. Passmore:** *Energy, Work and Leisure*. Heinemann Educational Books, Ltd., London (1967).
9. **Lehmann, G. E., A. Muller and H. Spitzer:** Der Kalorienbedarf bie Gewerblicher Arbeit. *Arbeitsphysiol. 14:*166 (1950).

IONIZING RADIATION

The Committee accepts the philosophy and recommendations of the National Council on Radiation Protection and Measurements (NCRP) for the ionizing radiation TLV. The NCRP is charted by Congress to, in part, collect, analyze, develop and disseminate information and recommendations about protection against radiation and about radiation measurements, quantities and units, including development of basic concepts in these areas. NCRP Report No. 39 provides basic philosophy and concepts leading to protection criteria established in the same report.(1) Other NCRP reports address specific areas of radiation protection and, collectively, provide an excellent basis for establishing a sound program for radiation control. The Committee recommends the listed references as substantative documentation of a sound basis for ionizing radiation protection. The committee also strongly recommends that all exposures to ionizing radiations be kept as low as reasonably achievable within the stated guidance.

References:

1. *Basic Radiation Protection Criteria.* NCRP Report No. 39 (January 15, 1971).
2. *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure.* National Bureau of Standards Handbook 69, (June 5, 1959), with *Addendum 1* (August 1963). Available as NCRP Report No. 22.

The above documents, as well as information on numerous other NCRP Reports addressing specific subjects in ionizing radiation protection are available from: NCRP Publications, PO Box 30175, Washington, DC 20014.

LASERS

The threshold limit values are for exposure to laser radiation under conditions to which nearly all workers may be exposed without adverse effects. The values should be used as guides in the control of exposures and should not be regarded as fine lines between safe and dangerous levels. They are based on the best available information from experimental studies.

Limiting Apertures

The TLVs expressed as radiant exposure or irradiance in this section may be averaged over an aperture of 1 mm except for TLVs for the eye in the spectral range of 400–1400 nm, which should be averaged over a 7 mm limiting aperture (pupil); and except for all TLVs for wavelengths between 0.1–1 mm where the limiting aperture is 10 mm. No modification of the TLVs is permitted for pupil sizes less than 7 mm.

The TLVs for "extended sources" apply to sources which subtend an angle greater than α (Table 7) which varies with exposure time. This angle is *not* the beam divergence of the source.

Correction Factors A and B (C_A and C_B)

The TLVs for ocular exposure in Tables 4 and 5 are to be used as given for all wavelength ranges. The TLVs for wavelengths between 700 nm and 1049 nm are to be increased by a uniformly extrapolated factor (C_A) as shown in Figure 2. Between 1049 nm and 1400 nm, the TLV has been increased by a factor (C_A) of five. For certain exposure times at wavelengths between 550 nm and 700 nm, correction factor (C_B) must be applied.

The TLVs for skin exposure are given in Table 6. The TLVs are to be increased by a factor (C_A) as shown in Figure 2 for wavelengths between 700 nm and 1400 nm. To aid in the determination of TLVs for exposure durations requiring calculations of fractional powers Figures 3, 4, 5 and 6 may be used.

Repetitively Pulsed Lasers

Since there are few experimental data for multiple pulses, caution must be used in the evaluation of such exposures. The protection standards for irradiance or radiant exposure in multiple pulse trains have the following limitations:

(1) The exposure from any single pulse in the train is limited to the protection standard for a single comparable pulse.

(2) The average irradiance for a group of pulses is limited to the protection standard as given in Tables 4, 5, or 7 of a single pulse of the same duration as the entire pulse group.

(3) When the Instantaneous Pulse Repetition Frequency (PRF) of any pulses within a train exceeds one, the protection standard applicable to each pulse is reduced as shown in Figure 6 for pulse durations less than 10^{-5} second. For pulses of greater duration, the following formula should be followed:

$$\text{Standard}\left(\begin{array}{l}\text{single pulse}\\ \text{in train}\end{array}\right) = \frac{\text{Standard (pulse } n\tau)}{n}$$

where:

n = number of pulses in train
τ = duration of a single pulse in the train
Standard ($n\tau$) = protection standard of one pulse having a duration equal to $n\tau$ seconds.

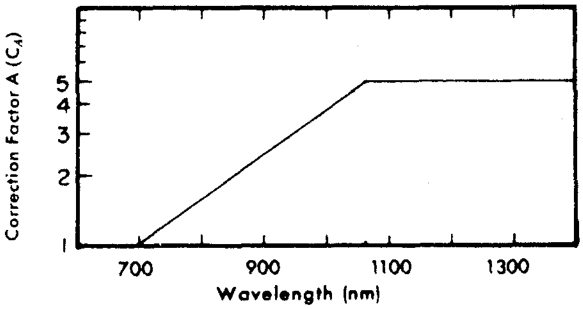

Figure 2 — TLV correction factor for λ = 700 – 1400 nm*

*For $\lambda = 700 - 1049$ nm, $C_A = 10^{[0.002(\lambda - 700)]}$
For $\lambda = 1050 - 1400$ nm, $C_A = 5$

TABLE 4

Threshold Limit Value for Direct Ocular Exposures
(Intrabeam Viewing) from a Laser Beam

Spectral Region	Wave Length	Exposure Time, (t) Seconds	TLV	
UVC	200 nm to 280 nm	10^{-9} to 3×10^4	3 mJ • cm^{-2}	*not to exceed $0.56\, t^{1/4}$ J • cm^{-2} for t ≦ 10 s.
UVB	280 nm to 302 nm	"	3 "	
	303 nm	"	4 "	
	304 nm	"	6 "	
	305 nm	"	10 "	
	306 nm	"	16 "	
	307 nm	"	25 "	
	308 nm	"	40 "	
	309 nm	"	63 "	
	310 nm	"	100 "	
	311 nm	"	160 "	
	312 nm	"	250 "	
	313 nm	"	400 "	
	314 nm	"	630 "	
UVA	315 nm to 400 nm	10^{-9} to 10	$.56\, t^{1/4}$ J • cm^{-2}	
	" "	10 to 10^3	1.0 J • cm^{-2}	
	" "	10^3 to 3×10^4	1.0 mW • cm^{-2}	
Light	400 nm to 700 nm	10^{-9} to 1.8×10^{-5}	5×10^{-7}J • cm^{-2}	
	400 nm to 700 nm	1.8×10^{-5} to 10	1.8 $(t/\sqrt[4]{t})$ mJ • cm^{-2}	
	400 nm to 549 nm	10 to 10^4	10 mJ • cm^{-2}	
	550 nm to 700 nm	10 to T_1	1.8 $(t/\sqrt[4]{t})$ mJ • cm^{-2}	
	550 nm to 700 nm	T_1 to 10^4	10 C_B mJ • cm^{-2}	
	400 nm to 700 nm	10^4 to 3×10^4	C_B μW • cm^{-2}	
IR-A	700 nm to 1049 nm	10^{-9} to 1.8×10^{-5}	5 $C_A \times 10^{-7}$ J • cm^{-2}	
	700 nm to 1049 nm	1.8×10^{-5} to 10^3	1.8 C_A $(t/\sqrt[4]{t})$ mJ • cm^{-2}	
	1050 nm to 1400 nm	10^{-9} to 10^{-4}	5×10^{-6} J • cm^{-2}	
	1050 nm to 1400 nm	10^{-4} to 10^3	$9(t/\sqrt[4]{t})$ mJ • cm^{-2}	
	700 nm to 1400 nm	10^3 to 3×10^4	320 C_A μW • cm^{-2}	
IR-B & C	1.4 μm to 10^3 μm	10^{-9} to 10^{-7}	10^{-2} J • cm^2	
	" "	10^{-7} to 10	0.56 $\sqrt[4]{t}$ J • cm^{-2}	
	" "	10 to 3×10^4	0.1 W • cm^{-2}	

C_A – See Fig. 2.
$C_B = 1$ for $\lambda = 400$ to 549 nm; $C_B = 10^{[0.015\,(\lambda - 550)]}$ for $\lambda = 550$ to 700 nm.
$T_1 = 10$ s for $\lambda = 400$ to 549 nm; $T_1 = 10 \times 10^{[0.02\,(\lambda - 550)]}$ for $\lambda = 550$ to 700 n.

TABLE 5

Threshold Limit Values for Viewing a Diffuse Reflection
of a Laser Beam or an Extended Source Laser

Spectral Region	Wave Length	Exposure Time, (t) Seconds	TLV
UV	200 nm to 400 nm	10^{-9} to 3×10^4	Same as Table 4
Light	400 nm to 700 nm	10^{-9} to 10	10 $\sqrt[3]{t}$ J • cm^{-2} • sr^{-1}
	400 nm to 549 nm	10 to 10^4	21 J • cm^{-2} • sr^{-1}
	550 nm to 700 nm	10 to T_1	3.83 $(t/\sqrt[4]{t})$ J • cm^{-2} • sr^{-1}
	550 nm to 700 nm	T_1 to 10^4	21 C_B J • cm^{-2} • sr^{-1}
	400 nm to 700 nm	10^4 to 3×10^4	2.1 $C_B t \times 10^{-3}$ W • cm^{-2} • sr^{-1}
IR-A	700 nm to 1400 nm	10^{-9} to 10	10 C_A $\sqrt[3]{t}$ J • cm^{-2} • sr^{-1}
	700 nm to 1400 nm	10 to 10^3	3.83 C_A $(t/\sqrt[4]{t})$ J • cm^{-2} • sr^{-1}
	700 nm to 1400 nm	10^3 to 3×10^4	0.64 C_A W • cm^{-2} • sr^{-1}
IR-B & C	1.4 μm to 10^3 μm	10^{-9} to 3×10^4	Same as Table 4

C_A, C_B, and T_1 are the same as in footnote to Table 4.

TABLE 6

Threshold Limit Value for Skin Exposure from a Laser Beam

Spectral Region	Wave Length	Exposure Time, (t) Seconds	TLV
UV	200 nm to 400 nm	10^{-9} to 3×10^4	Same as Table 4
Light &	400 nm to 1400 nm	10^{-9} to 10^{-7}	$2\ C_A \times 10^{-2}$ J • cm^{-2}
IR-A	" "	10^{-7} to 10	$1.1\ C_A \sqrt[4]{t}$ J • cm^{-2}
IR-A	" "	10 to 3×10^4	$0.2\ C_A$ W • cm^{-2}
IR-B & C	1.4 μm to 10^3 μm	10^{-9} to 3×10^4	Same as Table 4

$C_A = 1.0$ for $\lambda = 400$–700 nm; see Figure 2 for $\lambda = 700$ to 1400 nm.

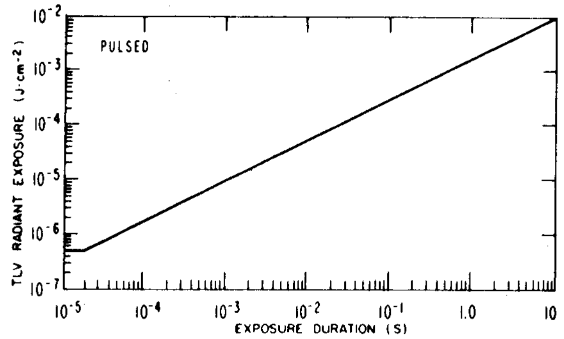

Figure 3a — TLV for intrabeam (direct) viewing of laser beam (400–700 nm).

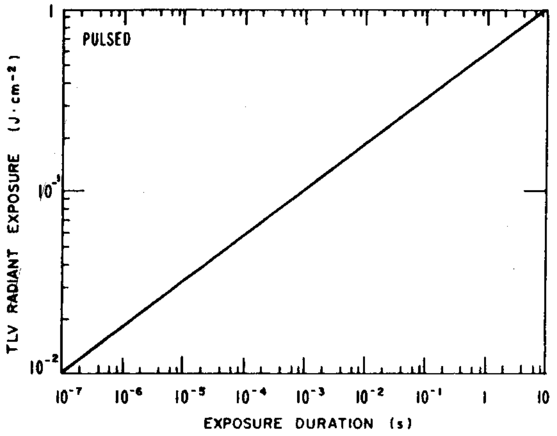

Figure 4a — TLV for laser exposure of skin and eyes for far-infrared radiation (wave-lengths greater than 1.4 μm).

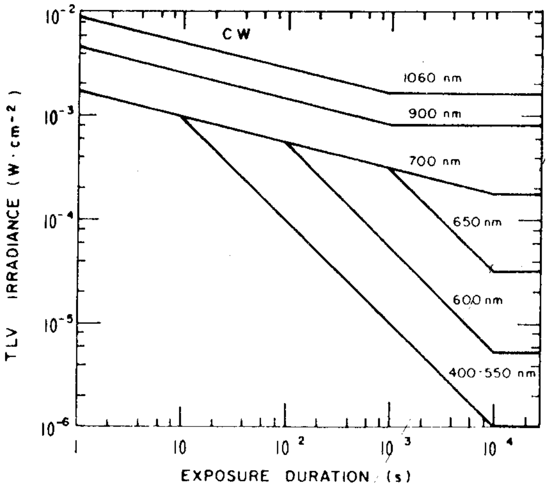

Figure 3b — TLV for intrabeam (direct) viewing of CW laser beam (400–1400 nm)

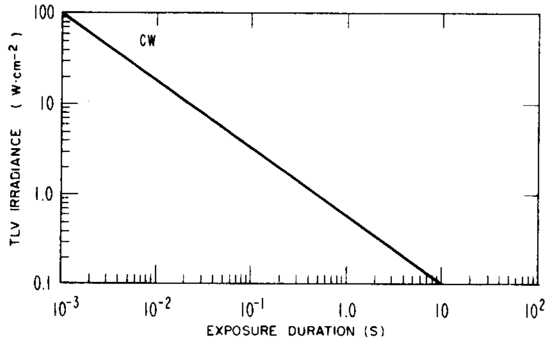

Figure 4b — TLV for CW laser exposure of skin and eyes for far-infrared radiation (wave-lengths greater than 1.4 μm).

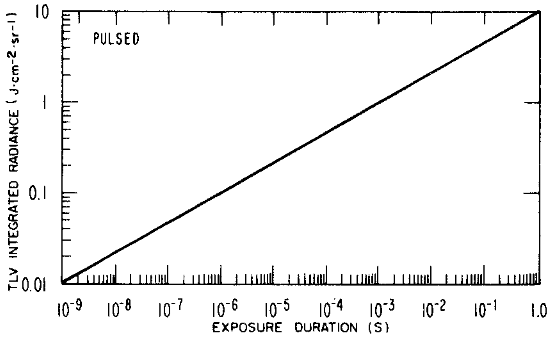

Figure 5a — TLV for extended sources or diffuse reflections of laser radiation (400–700 nm).

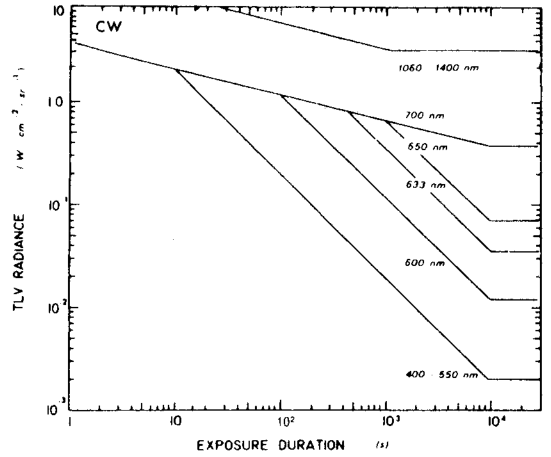

Figure 5b — TLV for extended sources or diffuse reflections of laser radiation (400–1400 nm).

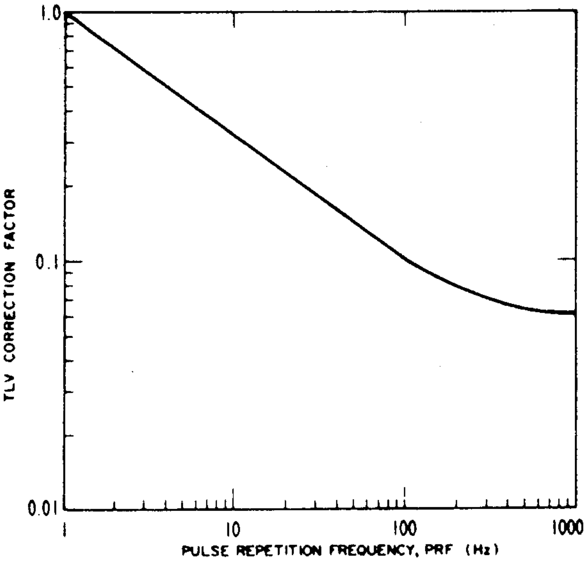

Figure 6 — Multiplicative correction factor for repetitively pulsed lasers having pulse durations less than 10^{-5} second. TLV for a single pulse of the pulse train is multiplied by the above correction factor. Correction factor for PRF greater than 1000 Hz is 0.06.

TABLE 7

Limiting Angle to Extended Source Which May Be Used for Applying Extended Source TLVs

Exposure Duration(s)	Angle α (mrad)	Exposure Duration(s)	Angle α (mrad)
10^{-9}	8.0	10^{-2}	5.7
10^{-8}	5.4	10^{-1}	9.2
10^{-7}	3.7	1.0	15
10^{-6}	2.5	10	24
10^{-5}	1.7	10^2	24
10^{-4}	2.2	10^3	24
10^{-3}	3.6	10^4	24

NOISE

These threshold limit values refer to sound pressure levels and durations of exposure that represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect on their ability to hear and understand normal speech. Prior to 1979, the medical profession had defined hearing impairment as an average hearing threshold level in excess of 25 decibels (ANSI-S3.6-1969) at 500, 1000, and 2000 Hz, and the limits which are given have been established to prevent a hearing loss in excess of this level.[a] The values should be used as guides in the control of noise exposure and, due to individual susceptibility, should not be regarded as fine lines between safe and dangerous levels.

It should be recognized that the application of the TLV for noise will not protect all workers from the adverse effects of noise exposure. A hearing conservation program with audiometric testing is necessary when workers are exposed to noise at or above the TLV levels.

Continuous or Intermittent

The sound level shall be determined by a sound level meter, conforming as a minimum to the requirements of the American National Standard Specification for Sound Level Meters, S1.4 (1971) Type S2A, and set to use the A-weighted network with slow meter response. Duration of exposure shall not exceed that shown in Table 8.

These values apply to total duration of exposure per working day regardless of whether this is one continuous exposure or a number of short-term exposures and does include the impact and impulsive type of noise that contributes to the sound level meter reading at slow response.

When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions:

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots \frac{C_n}{T_n}$$

exceeds unity, then, the mixed exposure should be considered to exceed the threshold limit value, C_1 indicates the total duration of exposure at a specific noise level, and T_1 indicates the total duration of exposure permitted at that level. All on-the-job noise exposures of 80 dBA or greater shall be used in the above calculations.

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[a] In 1979, the American Academy of Ophthalmology and Otolargyngology (AAOO) included 3000 Hz in their hearing impairment formula.

Table 8
Threshold Limit Values

Duration per Day Hours	Sound Level dBA†
16	80
8	85
4	90
2	95
1	100
1/2	105
1/4	110
1/8	115*

†Sound level in decibels are measured on a sound level meter, conforming as a minimum to the requirements of the American National Standard Specification for Sound Level Meters, S1.4 (1971) Type S2A, and set to use the A-weighted network with slow meter response.

*No exposure to continuous or intermittent in excess of 115 dBA

IMPULSIVE OR IMPACT NOISE

It is recommended that exposure to impulsive or impact noise shall not exceed the limits listed in Table 9 or taken from Figure 7. No exposures in excess of 140 decibels peak sound pressure level are permitted. Impulsive or impact noise is considered to be those variations in noise levels that involve maxima at intervals of greater than one per second. Where the intervals are less than one second, it should be considered continuous.

Table 9
Threshold Limit Values Impulsive or Impact Noise

Sound Level dB**	Permitted Number of Impulses or Impacts per day
140	100
130	1000
120	10,000

**Decibels peak sound pressure level, re 20 μPa

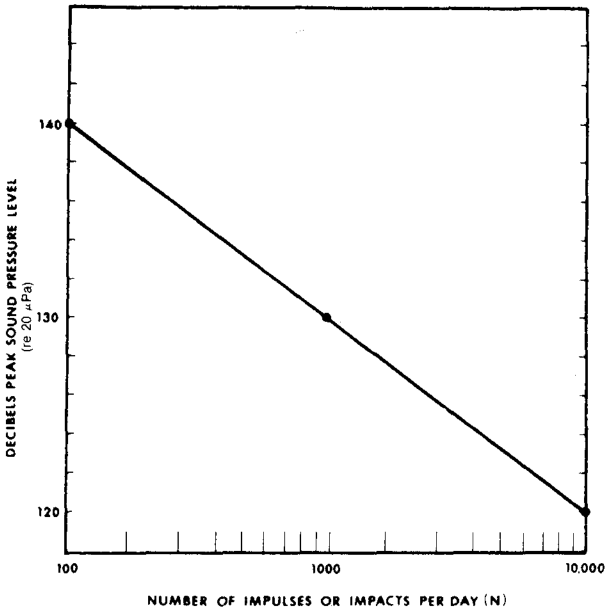

Figure 7 — Threshold Limit Values for Impulse/Impact Noise.

‡RADIOFREQUENCY/MICROWAVE RADIATION

These Threshold Limit Values (TLVs) refer to radiofrequency (RF) and microwave radiation in the frequency range from 10 kHz to 300 GHz, and represent conditions under which it is believed workers may be repeatedly exposed without adverse health effects. The TLVs shown in Table 10 are selected to limit the average whole body specific absorption rate (SAR) to 0.4 W/kg in any six minutes (0.1 hr) period for 3 MHz to 300 GHz, see Figure 8. Between 10 kHz and 3 MHz the average whole body SAR is still limited to 0.4 W/kg, but the plateau at 100 mW/cm^2 was set to protect against shock and burn hazards.

Since it is usually impractical to measure the SAR, the TLVs are expressed in units that are measurable, viz, squares of the electric and magnetic field strengths, averaged over any 0.1 hour period. This

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‡1983 Adoption.

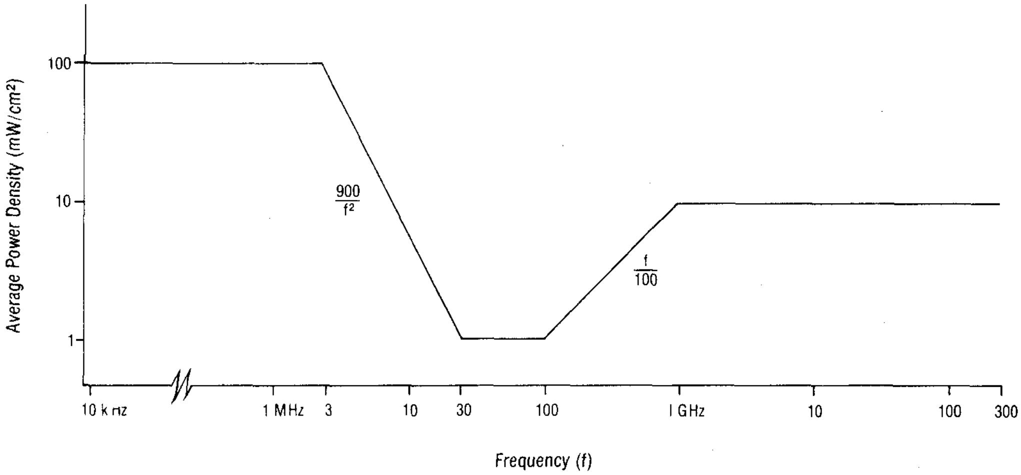

Figure 8 — Threshold Limit Values (TLV) for Radiofrequency/Microwave Radiation in Workplace (Whole Body SAR Less Than 0.4 W/kg).

TABLE 10

Radiofrequency/Microwave Threshold Limit Values

Frequency	Power Density (mW/cm²)	Electric Field Strength Squared (V²/m²)	Magnetic Field Strength Squared (A²/m²)
10 kHz to 3 MHz	100	377,000	2.65
3 MHz to 30 MHz	$900/f^{2*}$	$3770 \times 900/f^{2*}$	$900/(37.7 \times f^{2*})$
30 MHz to 100 MHz	1	3770	0.027
100 MHz to 1000 MHz	$f^*/100$	$3770 \times f^*/100$	$f^*/37.7 \times 100$
1 GHz to 300 GHz	10	37,700	0.265

*f = frequency in MHz

can be expressed in units of equivalent plane wave power density for convenience. The electric field strength (E) squared, magnetic field strength (H) squared, and power density (PD) values are shown in Table 10. For near field exposures PD cannot be measured directly, but equivalent plane wave power density can be calculated from the field strength measurement data as follows:

$$\text{PD in mW/cm}^2 = \frac{E^2}{3770}$$

where:

E^2 is in volts squared (V^2) per meter squared (m^2).

$$\text{PD in mW/cm}^2 = 37.7\ H^2$$

where:

H^2 is in amperes squared (A^2) per meter squared (m^2).

These values should be used as guides in the evaluation and control of exposure to radiofrequency/microwave radiation, and should not be regarded as a fine line between safe and dangerous levels.

Notes:

1. All Radiofrequency Radiation (RFR) exposures should be kept as low as reasonably possible given the current state of knowledge on human effects, particularly non-thermal effects.
2. For fields consisting of a number of frequencies, the fraction of the protection guide incurred within each frequency level should be determined and the sum of all fractions should not exceed unity.
3. For pulsed and continuous wave fields, the power density is averaged over the six minute period.
4. For partial body exposures at frequencies between 10 kHz and 1.0 GHz, the protection guides in Table 10 may be exceeded if the output power of a radiating device is 7 watts or less. For example, if a hand held transmitter operating at 27 MHz has a maximum output of 5 watts, it would be excluded from any further field measurements.
5. The TLVs in Table 10 may be exceeded if the exposure conditions can be demonstrated to produce a SAR of less than 0.4 W/kg as averaged over the whole body and spatial peak SAR values less than 8.0 W/kg as averaged over any 1.0 gram of tissue.

   For example, for frequencies from 3 to 30 MHz, the equivalent power density can be increased by a factor of 10 up to a limit of 100 mW/cm², if it can be assured that exposed individuals are not in contact with the ground plate.
6. At frequencies below 30 MHz, ungrounded objects such as vehicles, fences, etc., can strongly couple to RF fields. For field strengths near the TLV, shock and burn hazards can exist. Care should be taken to eliminate ungrounded objects, to ground such objects, or use insulated gloves when ungrounded objects must be handled.
7. No measurement should be made within 5 cm of any object.
8. All exposures should be limited to a maximum (peak) electric field intensity of 100 kV/m.

ULTRAVIOLET RADIATION*

These threshold limit values refer to ultraviolet radiation in the spectral region between 200 and 400 nm and represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect. These values for exposure of the eye or the skin apply to ultraviolet radiation from arcs, gas, and vapor discharges, fluorescent, and incandescent sources, and solar radiation, but do not apply to ultraviolet lasers.* These values do not apply to ultraviolet radiation exposure of photosensitive individuals or of individuals concomitantly exposed to photosensitizing agents.(1) These values should be used as guides in the control of exposure to continuous sources where the exposure duration shall not be less than 0.1 sec.

These values should be used as guides in the control of exposure to ultraviolet sources and should not be regarded as a fine line between safe and dangerous levels.

Recommended Values:

The threshold limit value for occupational exposure to ultraviolet radiation incident upon skin or eye where irradiance values are known and exposure time is controlled are as follows:

1. For the near ultraviolet spectral region (320 to 400 nm) total irradiance incident upon the unprotected skin or eye should not exceed 1 mW/cm² for periods greater than 10^3 seconds (approximately 16 minutes) and for exposure times less than 10^3 seconds should not exceed one J/cm².
2. For the actinic ultraviolet spectral region (200 — 315 nm), radiant exposure incident upon the unprotected skin or eye should not exceed the values given in Table 11 within an 8-hour period.
3. To determine the effective irradiance of a broadband source weighted against the peak of the spectral effectiveness curve (270 nm), the following weighting formula should be used:

$$E_{eff} = \sum E_\lambda S_\lambda \Delta\lambda$$

where:

E_{eff} = effective irradiance relative to a monochromatic source at 270 nm in W/cm² (J/s/cm²)

E_λ = spectral irradiance in W/cm²/nm

S_λ = relative spectral effectiveness (unitless)

$\Delta\lambda$ = band width in nanometers

4. Permissible exposure time in seconds for exposure to actinic ultraviolet radiation incident upon the unprotected skin or eye may be computed by dividing 0.003 J/cm² by E_{eff} in W/cm². The exposure time may also be determined using Table 12 which provides exposure times corresponding to effective irradiances in μW/cm².
5. All the preceding TLVs for ultraviolet energy apply to sources which subtend an angle less than 80°. Sources which subtend a greater angle need to be measured only over an angle of 80°.

---

*See Laser TLVs.

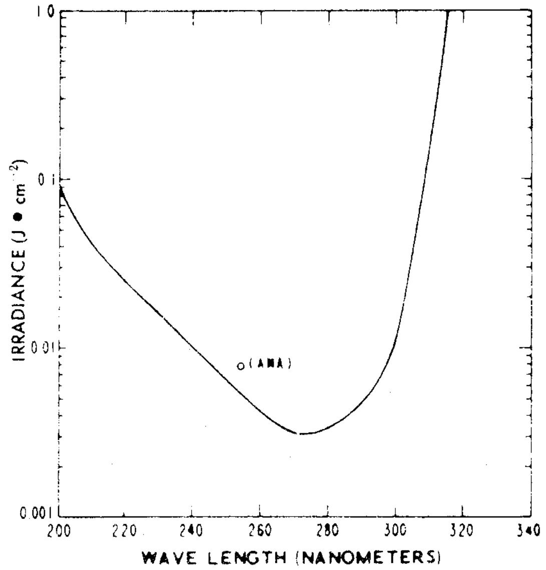

Figure 9 — Threshold Limit Values for Ultraviolet Radiation

Conditioned (tanned) individuals can tolerate skin exposure in excess of the TLV without erythemal effects. However, such conditioning may not protect persons against skin cancer.

Reference:

1. *Sunlight and Man*. Fitzpatrick *et al*, Eds. Univ. of Tokyo Press, Tokyo, Japan (1974).

NOTICE OF INTENDED CHANGES
(for 1983-84)

These physical agents, with their corresponding values, comprise those for which either a limit has been proposed for the first time, or for which a change in the "Adopted" listing has been proposed. In both cases, the proposed limits should be considered trial limits that will remain in the listing for a period of at least one year. If after one year no evidence comes to light that questions the appropriateness of the values herein the values will be reconsidered for the "Adopted" list.

NOTICE OF INTENT TO ESTABLISH THRESHOLD LIMIT VALUES

LASERS

It is proposed that the following footnote be added to Table 6 (Threshold Limit Value for Skin Exposure from a Laser Beam).

The IR-B and IR-C exposures to skin surface areas A(cm^2) exceeding 1000 cm^2, the TLV is

$$(100{,}000/A) \bullet (mW/cm^2);$$

for areas greater than 10,000 cm^2, the TLV is 10 mW/cm^2.

LIGHT AND NEAR-INFRARED RADIATION

These Threshold Limit Values refer to visible and near-infrared radiation in the wavelength range of 400 nm to 1400 nm and represent conditions under which it is believed that nearly all workers may be exposed without adverse effect. These values should be used as guides in the control of exposure to light and should not be regarded as a fine line between safe and dangerous levels.

Recommended Values:

The Threshold Limit Value for occupational exposure to broad-band light and near-infrared radiation for the eye apply to exposure in any eight-hour workday and require knowledge of the spectral radiance (L_λ) and total irradiance (E) of the source as measured at the position(s) of the eye of the worker. Such detailed spectral data of a white light source is generally only required if the luminance of the source exceeds 1 cd cm^{-2}. At luminances less than this value the TLV would not be exceeded.

The TLV's are:

1. To protect against retinal thermal injury, the spectral radiance of the lamp weighted against the function R (Table 13) should not exceed:

$$\sum_{400}^{1400} L_\lambda R_\lambda \Delta\lambda \leqq 1/\alpha\, t^{1/2} \qquad (1)^*$$

where L_λ is in W cm^{-2} sr^{-1} nm^{-1} and t is the viewing duration (or pulse duration if the lamp is pulsed) limited to 1 μs to 10 s, and α is the angular subtense of the source in radians. If the lamp is oblong, α refers to the longest dimension that can be viewed. For instance, at a viewing distance r = 100 cm from a tubular lamp of length l = 50 cm, the viewing angle is:

$$\alpha = l/r = 50/100 = 0.5 \text{ rad} \qquad (2)$$

2. To protect against retinal photochemical injury from chronic blue-light exposure the integrated spectral radiance of a light source weighted against the blue-light hazard function B_λ (Table 13) should not exceed:

$$\sum_{400}^{1400} L_\lambda t B_\lambda \Delta\lambda \leqq 100 \text{ Jcm}^{-2} \text{ sr}^{-1} \ (t \leqq 10^4 s) \qquad (3a)$$

$$\sum_{400}^{1400} L_\lambda B_\lambda \Delta\lambda \leqq 10^{-2} \text{ Wcm}^{-2} \text{ sr}^{-1} \ (t > 10^4 s) \qquad (3b)$$

The weighted product of L_λ and B_λ is termed L(blue). For a source radiance L weighted against the blue-light hazard function [L(blue)] which exceeds 10 mW•cm^{-2}•sr^{-1} in the blue spectral region, the permissible exposure duration t_{max} in seconds is simply:

$$t_{max} = 100 \text{ J cm}^{-2} \text{ sr}^{-1}/\text{L (blue)} \qquad (4)$$

The latter limits are greater than the maximum permissible exposure limits for 440 nm laser radiation (see Laser TLV) because a 2–3 mm pupil is assumed rather than a 7 mm pupil for the Laser TLV. For a light source subtending an angle α less than 11 mrd (0.011 radian) the above limits are relaxed such that the spectral irradiance weighted against the blue-light hazard function B_λ should not exceed E(blue).

$$\sum_{400}^{1400} E_\lambda \bullet t \bullet B_\lambda \bullet \Delta\lambda \leqq 10 \text{ mJ} \bullet \text{cm}^{-2} \ (t \leqq 10^4 \text{ s}) \qquad (5a)$$

$$\sum_{400}^{1400} E_\lambda \bullet B_\lambda \bullet \Delta\lambda \leqq 1\mu\text{W} \bullet \text{cm}^2 \ (t \geqq 10^4 \text{ s}) \qquad (5b)$$

For a source where the blue light weighted irradiance E (blue) exceeds 1 μW • cm^{-2} is the maximum permissible exposure duration t_{max} in seconds is:

$$t_{max} = 10 \text{ mJ} \bullet \text{cm}^{-2} \text{ E (blue)} \qquad (6)$$

3. *Infrared Radiation:* To avoid possible delayed effects upon the lens of the eye (cataractogenesis), the infrared radiation ($\lambda > 770$ nm) should be limited to 10 mWcm^{-2}. For an infrared heat lamp or any near-infrared source where a strong visual stimulus is absent, the near infrared (770–1400 nm) radiance as viewed by the eye should be limited to:

$$\sum_{770}^{1400} L_\lambda \, \Delta\lambda \leqq 0.6/\alpha \qquad (7)^*$$

for extended duration viewing conditions. This limit is based upon a 7 mm pupil diameter.

TABLE 11

Relative Spectral Effectiveness by Wavelength*

Wavelength (nm)	TLV (mJ/cm^2)	Relative Spectral Effectiveness S_λ
200	100	0.03
210	40	0.075
220	25	0.12
230	16	0.19
240	10	0.30
250	7.0	0.43
254	6.0	0.5
260	4.6	0.65
270	3.0	1.0
280	3.4	0.88
290	4.7	0.64
300	10	0.30
305	50	0.06
310	200	0.015
315	1000	0.003

*See Laser TLVs.

TABLE 12

Permissible Ultraviolet Exposures

Duration of Exposure Per Day	Effective Irradiance, E_{eff} (μW/cm^2)
8 hrs	0.1
4 hrs	0.2
2 hrs	0.4
1 hr	0.8
30 min	1.7
15 min	3.3
10 min	5
5 min	10
1 min	50
30 sec	100
10 sec	300
1 sec	3,000
0.5 sec	6,000
0.1 sec	30,000

TABLE 13

Spectral Weighting Functions for Assessing Retinal Hazards from Broad-Band Optical Sources

Wavelength (nm)	Blue-Light Hazard Function B_λ	Burn Hazard Function R_λ
400	0.10	1.0
405	0.20	2.0
410	0.40	4.0
415	0.80	8.0
420	0.90	9.0
425	0.95	9.5
430	0.98	9.8
435	1.0	10.0
440	1.0	10.0
445	0.97	9.7
450	0.94	9.4
455	0.90	9.0
460	0.80	8.0
465	0.70	7.0
470	0.62	6.2
475	0.55	5.5
480	0.45	4.5
485	0.40	4.0
490	0.22	2.2
495	0.16	1.6
500–600	$10^{[(450-\lambda)/50]}$	1.0
600–700	0.001	1.0
700–1049	0.001	$10^{[(700-\lambda)/505]}$
1050–1400	0.001	0.2

---

*Formulae (1) and (7) are empirical and are not, strictly speaking, dimensionally correct. To make the formulae dimensionally correct, one would have to insert a dimensional correction factor k in the right hand numerator in each formula. For formula (1) this would be $k_1 = 1$ W • rad • s½/(cm^2 • sr), and for formula (7) $k_2 = 1$ W • rad/(cm^2 • sr).

AIRBORNE UPPER SONIC AND ULTRASONIC ACOUSTIC RADIATION

These threshold limit values refer to sound pressure levels that represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect. The values listed in Table 14 should be used as guides in the control of noise exposure and, due to individual susceptibility, should not be regarded as fine lines between safe and dangerous levels. The levels for the third octave bands centered below 20 kHz are below those which cause subjective effects. Those levels for 1/3 octaves above 20 kHz are for prevention of possible hearing losses from subharmonics of these frequencies.

TABLE 14

Permissible Ultrasound Exposure Levels

Mid-Frequency of Third-Octave Band kHz	One-Third Octave — Band Level in dB re 20 μPa
10	80
12.5	80
16	80
20	105
25	110
31.5	115
40	115
50	115

PHYSICAL AGENTS UNDER STUDY

The Physical Agents Committee of ACGIH has examined the current literature and has not found sufficient information to propose a TLV. However, these agents will remain under study during the coming year to examine new evidence indicating the need and feasibility for establishing a proposed TLV. Comments and suggestions, accompanied by substantive documentation are solicited and should be forwarded to the Executive Secretary, ACGIH, Documentation summarizing the current status of the biological effects literature is available on those agents preceded by an asterisk (*).

1. **Extremely Low Frequency (ELF) Radiation*. Specifically, that portion of the spectrum from 0 to 300 Hz.
2. *Magnetic Fields*. Both pulsed and *continuous.
3. *Laser Radiation*. Specifically laser exposures of less than one (1) nanosecond.
4. *Vibration*. Segmental and whole-body.
5. *Cold Stress.*
6. *Pressure Variations.*

APPENDIX E
CHEMICAL DATA SHEETS

Information specific to emergency hazardous and infectious waste handling and disposal is provided in this section. Many substances common to health care institutions have been included. The scope of this precludes inclusion of detailed information on all potential exposure contingencies.* It is imperative that the health care institution gather all available and current information on hazardous and infectious materials in developing specific environmental response plans.

A blank Material Safety Data Sheet (MSDS) is provided for reference.

*The Chemical Data Sheets were extracted and edited from Hazardline®, a computerized health information network provided by Occupational Health Services, Inc.

JAMES TECHNICAL SERVICES

MATERIAL SAFETY DATA SHEET

CLASSIFICATION

SECTION I

MANUFACTURER'S NAME

EMERGENCY TELEPHONE NO.

ADDRESS (Number, Street, City, State, Zip)

NAME (Print)

SIGNATURE

TITLE

DATE

CHEMICAL NAME AND SYNONYMS

TRADE NAME AND SYNONYMS

CHEMICAL FAMILY

FORMULA

SECTION II — HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, AND SOLVENTS	%	TLV (UNITS)	*ACC. TLV LEVELS	ALLOYS AND METALLIC COATINGS	%	TLV (UNITS)	*ACC. TLV LEVELS
PIGMENTS				BASE METAL			
CATALYST				ALLOYS			
VEHICLE				METALLIC COATINGS			
SOLVENTS				FILLER METAL PLUS COATING OR CORE FLUX			
ADDITIVES				OTHERS			
OTHERS							

***USING NFPA, OSHA, OR OTHER APPLICABLE STANDARDS.**

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (UNITS)	*ACC. TLV LEVELS

SECTION III — PHYSICAL DATA

BOILING POINT (°F.)		SOLUBILITY IN WATER		PERCENT VOLATILE BY VOLUME (%)	
VAPOR PRESSURE (mmHg.)		SPECIFIC GRAVITY (H2O = 1)		EVAPORATION RATE (= 1)	
VAPOR DENSITY (AIR = 1)					

APPEARANCE AND ODOR

SECTION IV — FIRE & EXPLOSION HAZARD DATA

FLASH POINT (Method used)

FLAMMABLE LIMITS

LEL

UEL

EXTINGUISHING MEDIA

SPECIAL FIRE FIGHTING PROCEDURES

UNUSUAL FIRE AND EXPLOSION HAZARDS

FORM L6001-00-FI

SECTION V — HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

EFFECTS OF OVEREXPOSURE

EMERGENCY AND FIRST AID PROCEDURES

SECTION VI — REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE		

INCOMPATABILITY (Materials to avoid)

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR		

SECTION VII — SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

WASTE DISPOSAL METHOD

SECTION VIII — SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)

VENTILATION	LOCAL EXHAUST	SPECIAL
	MECHANICAL (General)	OTHER

PROTECTIVE GLOVES	EYE PROTECTION

OTHER PROTECTIVE EQUIPMENT

SECTION IX — SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

OTHER PRECAUTIONS

CHEMICAL DATA SHEETS

ACETIC ACID

Immediately dangerous to life or health concentration 1000 PPM.

Solubility in water, G/100 G water at 20C: 100 G
Flash point, closed cup, F (or open cup if OC): 104 F
Upper explosive limit in air, % by volume: 16%
Lower explosive limit in air, % by volume: 5.4%

Employee Should Wash:

Immediately if skin contaminated with solutions greater than or equal to 50% acetic acid.

Promptly if skin contaminated with solutions of 10-49% acetic acid.

The Following Equipment Should Be Available:

Eyewash, quick drench.

Corrosive liquid, N.O.S.
Corrosive material
UN 1760

If material on fire or involved in fire:

*Use water in flooding quantities as fog.

If material is not on fire and is not involved in fire:

*Keep sparks, flames and other ignition sources away.

Personal danger situation protection:

*Avoid breathing vapors or dust.
*Keep upwind.
*Avoid bodily contact with material.
*Wear boots, protective gloves & gas tight goggles.
*Do not handle broken packages without protective equipment.
*Wash away any materials which may have contacted the body with copious amounts of water or soap & water.
*If contact with material necessary, wear full protective clothing.
*Absorb bulk liquid with fly ash or cement powder or sand.
*Add caustic soda.

Water spill:

*Add caustic soda.

Air spill:

*Apply water spray to knock down vapors.
*Vapor knock-down water corrosive or toxic & should be diked for containment.

ACETONE

Immediately dangerous to life or health concentration 20,000 PPM.

Solubility in water, G/100 G water at 20C: >100 G
Flash point, closed cup, F (or open cup if OC): 4 F
Vapor pressure at 20 C MM HG: 26 MMHG at 77 F
Upper explosive limit in air, % by volume: 13%
Lower explosive limit in air, % by volume: 2.15%

Protective Equipment Requirements:

Prevent reasonable probability of skin contact:

Wear impervious clothing.
Wear gloves.

Wear faceshield (8 inch minimum).
Prevent repeated or prolonged skin contact.
Provide container to store clothing until laundered or discarded:

Wear splash/dust proof goggles.

Place contaminated clothing in closed container until laundered or discarded.

Employee Should Wash:

Promptly when skin becomes contaminated.

The Following Equipment Should Be Available:

Eyewash, quick drench.

Following data from bureau of explosives - emergency handling of hazardous materials.

If material on fire or involved in fire:

*Use water in flooding quantities as fog.

If material is not on fire & is not involved in fire:

*Keep sparks, flames & other ignition sources away.

Personal danger situation protection:

*Avoid breathing vapors or dust.
*Keep upwind.
*Wear boots, protective gloves & gas tight goggles.
*Do not handle broken packages without protective equipment.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

AMMONIUM HYDROXIDE

Immediately dangerous to life or health concentration 5000 PPM.

Solubility in water, G/100 G water at 20C: Soluble
Flash point, closed cup, F (or open cup if OC): Nonflammable
Upper explosive limit in air, % by volume: 27% as NH3
Lower explosive limit in air, % by volume: 16% as NH3

Protective Equipment Requirements:

No standard requirements, but advise employee wear clothing to:

Prevent reasonable probability of skin contact.
Prevent repeated or prolonged skin contact.
Prevent repeated or prolonged vapor contact:

Wear gloves.

Wear faceshield (8 inch minimum):

Wear splash/dust proof goggles.
Wear impervious boots.

Provide container to store clothing until laundered or discarded.
Inform persons handling contaminated clothing of hazardous properties of substance.

Employee Should Wash:

No standard requirement, but advise washing promptly; wash with soap when skin becomes contaminated; provide eyewash, quick drench.

Corrosive material UN 1759.

If material on fire or involved in fire:

*Extinguish fire using agent suitable for type of fire.

If material is not on fire & is not involved in a fire:

*Keep material out of water sources and sewers.
*Build dikes to contain flow as necessary.

Personal danger situation protection:

*Avoid breathing vapors or dust.
*Keep upwind.
*Wear self-contained breathing apparatus.
*Avoid bodily contact with material.
*Wear boots, protective gloves & gas tight goggles.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.
*If contact with material necessary, wear full protective clothing.
*Absorb bulk liquid with fly ash or cement powder.
*Neutralize with vinegar or other dilute acid.

ARSENIC

Immediately dangerous to life or health concentration 20 MG/KG.

Solubility in water, G/100 G water at 20C: Vary to miscible.
Flash point, closed cup, F (or open cup if OC): Incombustible
Upper explosive limit in air, % by volume: Incombustible
Lower explosive limit in air, % by volume: Incombustible

The Following Equipment Should Be Available:

Eyewash, quick drench.

No food or drink in work area.

Water fountain prohibited in work area.

Closed system if substance to be used.

If material on fire or involved in fire:

*Extinguish fire using agent suitable for type of fire.

If material not on fire and not involved in a fire:

*Keep material out of water sources and sewers.

Personal danger situation protection:

*Avoid breathing vapors or dust.
*Keep upwind.
*Avoid bodily contact with material.
*Wear full protective clothing (firemans gear inadequate).
*Do not handle broken packages without protective equipment.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

ASBESTOS

Immediately dangerous to life or health concentration potent cocarcinogen.

Flash point: Nonflammable

Protective Equipment Requirements:

Prevent repeated or prolonged skin contact:

Wear impervious clothing.
Wear gloves.

Wear faceshield (8 inch minimum).
Provide container to store clothing until laundered or discarded:

Wear splash/dust proof goggles.

Place contaminated clothing in closed container until laundered or discarded.
Inform persons handling contaminated clothing of hazardous properties or substance.

The Following Equipment Should Be Available:

Eyewash, quick drench.

No food or drink in work area.

Water fountain prohibited in work area.

Closed system if substance to be used.

Personal danger situation protection:

*Keep upwind.
*Wear boots, protective gloves and gas tight goggles.
*Avoid breathing fibres.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

BROMINE

Immediately dangerous to life or health concentration 10 PPM.

Solubility in water, G/100 G water at 20C: 3.5%
Flash point: Not combustible

Employee Should Wash:

Immediately when skin becomes contaminated and at the end of work shift.

The Following Equipment Should Be Available:

Eyewash, quick drench.

Corrosive poison.

Personal danger situation protection:

*Avoid breathing vapors or dust.
*Keep upwind.
*Wear self-contained breathing apparatus.
*Avoid bodily contact with material.
*Wear full protective clothing (firemans gear inadequate).
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

Evacuation procedure:

*If fire uncontrollable or container exposed to direct flame, evacuate for radius of 2500 feet.

CHLORINE

Immediately dangerous to life or health concentration 25 PPM.

Solubility in water, G/100 G water at 20C: 0.7%
Flash point: Nonflammable

Poison Gas
Oxidizer

Personal danger situation protection:

- *Avoid breathing vapors or mist.
- *Keep upwind.
- *Wear self-contained breathing apparatus.
- *Avoid bodily contact with material.
- *Wear full protective clothing (firemans gear inadequate).
- *Do no handle broken packages without protective equipment.
- *Wash away any materials which may have contacted the body with copious amounts of water or soap and water.
- *Absorb bulk liquid with fly ash or cement powder.
- *Add caustic soda.
- *If dissolved, apply activated carbon at 10 times spilled amount at 10PPM or greater concentration.

Air spill:

- *Apply water spray to knock down vapors.

ETHYL ALCOHOL

Immediately dangerous to life or health concentration unspecified.

Solubility in water, G/100 G water at 20C: Soluble
Flash point, closed cup, F (or open cup if OC): 55F
Upper explosive limit in air, % by volume: 19%
Lower explosive limit in air, % by volume: 3.3%

If material on fire or involved in fire:

- *Use water in flooding quantities as fog.

If material is not on fire and is not involved in a fire:

- *Keep sparks, flames and other ignition sources away.
- *Keep material out of water sources and sewers.

ETHYLENE OXIDE

Immediately dangerous to life or health concentration 800 PPM.

Solubility in water, G/100 G water at 20C: Miscible
Flash point, closed cup, F (or open cup if OC): -4 F
Upper explosive limit in air, % by volume: 100%
Lower explosive limit in air, % by volume: 3.6%

Employee Should Wash:

Immediately when skin becomes contaminated.

Flammable Gas

If material is on fire or involved in a fire:

*Use alcohol foam or CO2 or dry chemical extinguishers.

If material is not on fire and is not involved in a fire:

*Keep sparks, flames and other ignition sources away.

Personal danger situation protection:

*Avoid breathing gas.
*Keep upwind.
*Wear self-contained breathing apparatus.
*Avoid bodily contact with material.
*Wear full protective clothing (firemans gear inadequate).
*Do not handle broken packages without protective equipment.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

Evacuation procedure:

*If fire uncontrollable or container exposed to direct flame, evacuate for radius of 5000 feet.

FORMALDEHYDE

Immediately dangerous to life or health concentration 100 PPM.

Solubility in water, G/100 G water at 20C: Miscible
Flash point, closed cup, F (or open cup if OC): 122F
Upper explosive limit in air, % by volume: 73%
Lower explosive limit in air, % by volume: 7%

Employee Should Wash:

Immediately when skin becomes contaminated.

If material on fire or involved in fire:

*Use alcohol foam or CO2 or dry chemical extinguishers.

If material is not on fire and is not involved in fire:

*Keep sparks, flames and other ignition sources away.

Personal danger situation protection:

*Avoid breathing vapors.
*Wear boots, protective gloves and gas tight goggles.
*Do not handle broken packages without protective equipment.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

Land spill:

*Absorb bulk liquid with fly ash or cement powder.
*Apply universal gelling agent to immobilize spill.

Water spill:

*Use surface active agent (detergents, soaps, alcohols) to compress and thicken spilled material.

FREON OR CHLORODIFLUOROMETHANE

Immediately dangerous to life or health concentration 50000 PPM.

Solubility in water, G/100 G water at 20C: Soluble
Flash point, closed cup, F (or open cup if OC): Nonflammable

Protective Equipment Requirements:

No standard requirement, but advise employee wear protective clothing and gloves.

*Avoid inhalation.
*Avoid direct contact, substance can cause irritation or burns.
*Burning not recommended, poisonous gas is formed.
*Substance shipped as gas or liquefied compressed gas, depending on atmospheric conditions; a large portion of the hazard will be dissipated with no action necessary.

GLUTARALDEHYDE

Immediately dangerous to life or health concentration 500 PPM.

Solubility in water, G/100 G water at 20C: Soluble
Flash point, closed cup, F (or open cup if OC): 175 F

If material on fire or involved in fire:

*Use water in flooding quantities as a fog.
*Use alcohol foam, carbon dioxide or dry chemical.

If material not on fire and not involved in fire:

*Keep sparks, flames and other ignition sources away.

Personal protection:

*Avoid breathing vapors.
*Keep upwind.
*Avoid bodily contact with the material.
*Do not handle broken packages without protective equipment.
*Wash away any material which may have contacted the body with copious amounts of water or soap and water.
*Wear self-contained breathing apparatus when fighting fires involving this material.
*If contact with material anticipated, wear full protective clothing.

HEXACHLOROBIPHENYL

Immediately dangerous to life or health concentration 5 MG/M3.

Solubility in water, G/100 G water at 20C: Variable
Flash point, closed cup, F (or open cup if OC): incombustible

Prevent skin contact:

*Wear impervious clothing.
*Wear gloves.

If material on fire or involved in fire:

*Extinguish fire using agent suitable for type of fire.

If material is not on fire and is not involved in fire:

*Keep material out of water sources and sewers.
*Build dikes to contain flow as necessary.

Personal danger situation protection:

*Keep upwind.
*Wear boots, protective gloves and gas tight goggles.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.
*Avoid breathing vapors.

Land spill:

*Dig a pit, pond, lagoon, holding area to contain liquid or solid material.
*Dike surface flow using soil, sandbags, foamed polyurethane or foamed concrete.
*Absorb bulk liquid with fly ash or cement powder.

Water spill:

*If dissolved, apply activiated carbon at 10 times spilled amount at 10 PPM or greater concentration.
*Use mechanical dredges or lifts to remove immobilized masses of pollution and precipitates.

HYDROGEN CHLORIDE

Immediately dangerous to life or health concentration 100 PPM.

Solubility in water, G/100 G water at 20C: 62%
Flash point, closed cup, F (or open cup if OC): Not flammable

Employee Should Wash:

Immediately if skin contact with hydrogen chloride solutions of less than PH 3 occurs.

Promptly if skin wet with hydrogen chloride solutions of greater than or equal to PH 3 occurs.

Poison Gas
Corrosive

If material on fire or involved in fire:

*Extinguish fire using agent suitable for type of fire.

If material not on fire and is not involved in fire:

*Keep material out of water sources and sewers.
*Neutralize spilled material with crushed limestone, soda ash or lime.

Personal danger situation protection:

*Avoid breathing vapors or dust.
*Keep upwind.
*Wear self-contained breathing apparatus.
*Avoid bodily contact with material.
*Wear full protective clothing (firemans gear inadequate).
*Do not handle broken packages without protective equipment.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

HYDROQUINONE

Immediately dangerous to life or health concentration 200 MG/M3.

Solubility in water, G/100 G water at 20C: 7%
Flash point, closed cup, F (or open cup if OC): 329F

Poison B

If material on fire or involved in fire:

*Extinguish fire using agent suitable for type of fire.

If material is not on fire and is not involved in fire:

*Keep amterial out of water sources and sewers.
*Build dikes to contain flow as necessary.

Personal danger situation protection:

*Keep upwind.
*Wear boots, protective gloves and gas tight goggles.
*Avoid breathing vapors or dust.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

IODINE

Immediately dangerous to life or health concentration 10 PPM.

Solubility in water, G/100 G water at 20C: 0.03%
Flash point, closed cup, F (or open cup if OC): Nonflammable

Prevent any possibility of contact with iodine solutions of greater than 7%.

Employee Should Wash:

Immediately if contaminated with iodine solutions of greater than 7%.

Promptly if contaminated with iodine solutions of less than 7%.

If material on fire or involved in fire:

*Extinguish using suitable material to surround fire.

If material is not on fire and is not involved in fire:

*Keep material out of water sources and sewers.
*Build dikes to contain flow as necessary.

Personal danger situation protection:

*Keep upwind.
*Wear boots, protective gloves and gas tight goggles.
*Avoid breathing vapors or dust.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

LEAD

Immediately dangerous to life or health concentration variable to inorganic compound.

Solubility in water, G/100 G water at 20C: Insoluble
Flash point, closed cup, F (or open cup if OC): Incombustible
Melting point, F: 473F

Prevent skin contact.

If material on fire or involved in fire:

*Extinguish using suitable material to surround fire.

If material is not on fire and is not involved in fire:

*Keep material out of water and sewer sources.
*Build dikes to contain flow as necessary.

Personal danger situation protection:

*Keep upwind.
*Wear boots, protective gloves and gas tight goggles.
*Avoid breathing dust or dross.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

MERCURY

Immediately dangerous to life or health concentration 28 MG/M3.

Solubility in water, G/100 G water at 20C: 0.002%
Flash point, closed cup, F (or open cut if OC): Not Combustible
Melting point, F: -38F

Prevent skin contact.

If material on fire or involved in fire:

*Extinguish fire using agent suitable for type of fire.
*Use water in flooding quantities as fog.
*Use alcohol foam or CO2 or dry chemical extinguishers.

If material is not on fire and is not involved in fire:

*Keep material out of water sources and sewers.

Personal danger situation protection:

*Keep upwind.
*Avoid breathing vapors or dust.
*Avoid bodily contact with material.
*Wear boots, protective gloves and gas tight goggles.
*Do not handle broken packages without protective equipment.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.
*Wear self-contained breathing apparatus.
*Wear full protective clothing (firemans gear inadequate).

METHYL ALCOHOL

Immediately dangerous to life or health concentration 25,000 PPM.

Solubility in water, G/100 G water at 20C: Miscible
Flash point, closed cup, F (or open cup if OC): 52F
Upper explosive limit in air, % by volume: 36%
Lower explosive limit in air, % by volume: 6.7%

Poison

If material on fire or involved in fire:

*Use water in flooding quantities as fog.
*Use alcohol foam or CO2 or dry chemical extinguishers.

If material is not on fire and not involved in fire:

*Keep sparks, flames and other ignition sources away.
*Keep material out of water sources and sewers.
*Build dikes to contain flow as necessary.

Personal danger situation protection:

*Avoid breathing vapors or dust.
*Wear boots, protective gloves and gas tight goggles.
*Wash away any materials which may have contacted the body with copious amounts of water and soap and water.

NITRIC ACID

Immediately dangerous to life or health concentration 100 PPM.

Solubility in water, G/100 G water at 20C: Miscible
Flash point, closed cup, F (or open cup if OC): Nonflammable

Protective Equipment Requirements:

Prevent any possibility of contact with nitric acid solutions of less than or equal to PH 2.5.

Oxidizer
Corrosive Material

If material on fire or involved in fire:

*Use water in flooding quantities as fog.

If material is not on fire and is not involved in fire:

*Keep material out of water sources and sewers.
*Build dikes to contain flow as necessary.
*Use water spray to knock down vapors.
*Neutralize spilled material with crushed limestone, soda ash or lime.

Personal danger situation protection:

*Keep upwind.
*Wear self-contained breathing apparatus.
*Avoid bodily contact with material.
*Wear full protective clothing (firemans geat inadequate).
*Do not handle broken packages without protective equipment.
*Avoid breathing vapors or dust.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

NITROUS OXIDE

Immediately dangerous to life or health concentration unspecified.

Solubility in water, G/100 G water at 20C: Slight in H20
Flash point: Noncombustible

Nonflammable Gas
Oxidizer

If material on fire or involved in fire:

*Dangerously explosive.
*Cool all affected containers with flooding quantities of water.
*Apply water from as far a distance as possible.

If material is not on fire and is not involved in fire:

*Avoid breathing vapors or dust.
*Keep upwind.
*Wear boots, protective gloves and gas tight goggles.
*Do not handle broken packages without protective equipment.
*Approach fire with caution.

Evacuation procedure:

*If material leaking (not on fire), downwind evacuation must be considered.

PHENOL

Immediately dangerous to life or health concentration 100 PPM.

Solubility in water, G/100 G water at 20C: 8.4%
Flash point, closed cup, F (or open cup if OC): 175F
Upper explosive limit in air, % by volume: 8.6%
Lower explosive limit in air, % by volume: 1.8%

Prevent any possibility of skin contact.

Poison

If material on fire or involved in fire:

*Extinguish fire using agent suitable for type of fire.
*Use water in flooding quantities as fog.
*Use alcohol foam or CO2 or dry chemical extinguishers.

If material is not on fire and is not involved in fire:

*Keep sparks, flames and other ignition sources away.
*Keep material out of water sources and sewers.

Personal danger situation protection:

*Avoid breathing vapors or dust.
*Keep upwind.
*Wear self-contained breathing apparatus.
*Avoid bodily contact with material.
*Wear full protective clothing (firemans gear inadequate).
*Do not handle broken packages without protective equipment.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

PHOSPHORIC ACID

Immediately dangerous to life or health concentration unspecified.

Solubility in water, G/100 G water at 20C: Miscible
Flash point, closed cup, F (or open cup if OC): Not combustible

Prevent any possibility of contact with phosphoric acid solutions of greater than 1.6%.

Corrosive Material

If material on fire or involved in fire:

*Extinguish fire using agent suitable for type of fire.

If material is not on fire and is not involved in fire:

*Keep material out of water sources and sewers.
*Build dikes to contain flow as necessary.
*Neutralize spilled material with crushed limestone, soda ash or lime.

Personal danger situation protection:

*Keep upwind.
*Avoid breathing vapors.
*Avoid bodily contact with material.
*Wear boots, protective gloves and gas tight goggles.
*Do not handle broken packages without protective equipment.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.
*Neutralize with agricultural lime (slaked lime), crushed limestone or sodium bicarbonate.

PICRIC ACID

Immediately dangerous to life or health concentration 100 MG/M3.

Solubility in water, G/100 G water at 20C: 1.4%
Flash point, closed cup, F (or open cup if OC): 302F
Upper explosive limit in air, % by volume: Explodes
Lower explosive limit in air, % by volume: Explodes

Explosive A (Mass Explosion Hazard).

If material on fire or involved in fire:

*Wear boots, protective gloves and gas tight goggles.
*Use water in flooding quantities as fog.
*Cool all affected containers with flooding quantities of water.
*Apply water from as far a distance as possible.

If material is not on fire and is not involved in fire:

*Keep sparks, flames and other ignition sources away.
*Keep material out of water sources and sewers.
*Cool all affected containers with flooding quantities of water.

Personal danger situation protection:

*Avoid bodily contact with material.
*Wear self-contained breathing apparatus.
*Do not handle broken packages without protective equipment.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.
*Wear boots, protective gloves and gas tight goggles.

Evacuation procedure:

*If fire uncontrollable or container exposed to direct flame, evacuate for radius of 5000 feet.

POLY CHLORONATED BIPHENYL, "PCB" OR AROCLOR 1242

There are many other formulations and trademarks - Possible physical properties will vary with the degree of chloronation.

Immediately dangerous to life or health concentration 10 MG/M3 OSHA.

Solubility in water, G/100 G water at 20C: 0.10 PPM at 75 F
Flash point, closed cup, F (or open cup if OC): 349 F

Prevent skin contact:

*Wear impervious clothing.
*Wear gloves.

If material on fire or involved in fire:

*Extinguish fire using agent suitable for type of fire.

If material is not on fire and is not involved in fire:

*Keep material out of water sources and sewers.
*Build dikes to contain flow as necessary.

Personal danger situation protection:

*Keep upwind.
*Wear boots, protective gloves and gas tight goggles.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.
*Avoid breathing vapors.

Land spill:

*Dig a pit, pond, lagoon, holding area to contain liquid or solid material.
*Dike surface flow using soil, sandbags, foamed polyurethane or foamed concrete.
*Absorb bulk liquid with fly ash or cement powder.

PROPANE

Immediately dangerous to life or health concentration 20,000 PPM.

Solubility in water, G/100 G water at 20C: Insoluble
Flash point, closed cup, F (or open cup if OC): -156F
Upper explosive limit in air, % by volume: 9.5%
Lower explosive limit in air, % by volume: 2.1%

Prevent skin freezing.

Flammable Gas

If material on fire or involved in fire:

*Do not extinguish fire unless flow can be stopped.
*Use water in flooding quantities as fog.
*Cool all affected containers with flooding quantities of water.
*Apply water from as far a distance as possible.

If material is not on fire and is not involved in fire:

*Keep sparks, flames and other ignition sources away.
*Keep material out of water sources and sewers.
*Attempt to stop leak if without hazard.
*Use water spray to knock down vapors.

Personal danger situation protection:

*Avoid breathing gas.
*Keep upwind.
*Wear boots, protective gloves and gas tight goggles.
*Do not handle broken packages without protective equipment.
*Approach fire with caution.

Evacuation procedure:

*If fire uncontrollable or container exposed to direct flame, evacuate for radius of 2500 feet.

POTASSIUM HYDROXIDE

Immediately dangerous to life or health concentration 365 MG/KG.

Solubility in water, G/100 G water at 20C: 111 G/100 ML at 68 F
Flash point, closed cup, F (or open cup if OC): Nonflammable

Corrosive

If material on fire or involved in fire:

- *Extinguish fire using agent suitable for type of fire.

Personal danger situation protection:

- *Avoid bodily contact with material.
- *Wear boots, protective gloves and gas tight goggles.
- *Do not handle broken packages without protective equipment.
- *Wash away any materials which may have contacted the body with copious amounts of water or soap and water.
- *If contact with material necessary, wear full protective clothing.
- *Neutralize with vinegar or other dilute acid.

SILVER

Immediately dangerous to life or health concentration unspecified.

Solubility in water, G/100 G water at 20C: Insoluble
Flash point, closed cup, F (or open cup if OC): Incombustible
Melting point, F: 1771F

Prevent reasonable probability of skin contact.

If material on fire or involved in fire:

- *Extinguish using suitable material to surround fire.

If material is not on fire and is not involved in fire:

- *Keep material out of water sources and sewers.

Personal danger situation protection:

- *Wear boots, protective gloves and gas tight goggles.
- *Avoid breathing vapors or dust.

SODIUM HYDROXIDE

Immediately dangerous to life or health concentration 200 MG/M3.

Solubility in water, G/100 G water at 20C: 50%
Flash point, closed cup, F (or open cup if OC): Nonflammable

Prevent any possibility of skin contact.

Corrosive Material

If material on fire or involved in fire:

*Extinguish fire using agent suitable for type of fire.

If material is not on fire and is not involved in fire:

*Keep material out of water sources and sewers.

Personal danger situation protection:

*Avoid bodily contact with material.
*Wear boots, protective gloves and gas tight goggles.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.
*Do not handle broken packages without protective equipment.
*Wear full protective clothing (firemans gear inadequate).

Water spill:

*Neutralize with vinegar or other dilute acid.

SULFURIC ACID

Immediately dangerous to life or health concentration 80 MG/M3.

Solubility in water, G/100 G water at 20C: Miscible
Flash point, closed cup, F (or open cup if OC): Not Combustible

Prevent any possibility of contact with sulfuric acid solutions of greater than 1%.

Employee Should Wash:

Immediately when skin becomes contaminated.

Corrosive Material

If material on fire or involved in fire:

*Extinguish fire using agent suitable for type of fire.

If material is not on fire and is not involved in fire:

*Keep material out of water sources and sewers.
*Neutralize spilled material with crushed limestone, soda ash or lime.

Personal danger situation protection:

*Avoid breathing vapors or mist.
*Avoid bodily contact with material.
*Do not handle broken packages without protective equipment.
*Wear full protective clothing (firemans gear inadequate).
*Wear boots, protective gloves and gas tight goggles.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

Water spill:

*Neutralize with agricultural lime (slaked lime), crushed limestone or sodium bicarbonate.

TOLUENE

Immediately dangerous to life or health concentration 2000 PPM.

Solubility in water, G/100 G water at 20C: 0.05%
Flash point, closed cup, F (or open cup if OC): 40F
Upper explosive limit in air, % by volume: 7.1%
Lower explosive limit in air, % by volume: 1.3%

If material on fire or involved in fire:

*Apply water from as far a distance as possible.
*Use alcohol foam or CO2 or dry chemical extinguishers.

If material is not on fire and is not involved in fire:

*Keep sparks, flames and other ignition sources away.
*Keep material out of water sources and sewers.
*Build dikes to contain flow as necessary.

Personal danger situation protection:

*Wear boots, protective gloves and gas tight goggles.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.
*Avoid breathing vapors.

Water spill:

*Use natural barriers or oil spill control booms to limit spill motion.
*Use surface active agent (detergents, soaps, alcohols) to compress and thicken spilled material.

XYLENE

Immediately dangerous to life or health concentration 10,000 PPM.

Solubility in water, G/100 G water at 20C: 0.00003%
Flash point, closed cup, F (or open cup if OC): >77F (TCC)
Upper explosive limit in air, % by volume: 7%
Lower explosive limit in air, % by volume: 1.0%

If material on fire or involved in fire:

*Apply water from as far a distance as possible.
*Use alcohol foam or CO2 or dry chemical extinguishers.

If material is not on fire and is not involved in fire:

*Keep sparks, flames and other ignition sources away.
*Keep material out of water sources and sewers.
*Build dikes to contain flow as necessary.

Personal danger situation protection:

*Avoid breathing vapors.
*Wear boots, protective gloves and gas tight goggles.
*Wash away any materials which may have contacted the body with copious amounts of water or soap and water.
*Do not handle broken packages without protective equipment.
*Apply universal gelling agent to immobilize spill.
*Apply fluorocarbon water foam to diminish vapor and fire hazard.

Water spill:

*Use natural barriers or oil spill control booms to limit spill motion.
*Use surface active agent (detergents, soaps, alcohols) to compress and thicken spilled material.

APPENDIX F

A-7

EPA

HAZARDOUS WASTE SITES

NATIONAL PRIORITIES LIST

*Current NPL in order of ranking

*406 Sites as of 1983

Reprint from an EPA Publication

GROUP 1

EPA REG	ST	SITE NAME	CITY/COUNTY	RESPONSE STATUS #			
02	NJ	Lipari Landfill	Pitman	V	R	E	
03	DE	Tybouts Corner Landfill*	New Castle County		R	E	
03	PA	Bruin Lagoon	Bruin Borough		R		
02	NJ	Helen Kramer Landfill	Mantua Township		R		
01	MA	Industri-Plex	Woburn	V	R	E	
02	NJ	Price Landfill*	Pleasantville		R	E	
02	NY	Pollution Abatement Services*	Oswego		R	E	
07	IA	Labounty Site	Charles City	V		E	
03	DE	Army Creek Landfill	New Castle County			E	
02	NJ	CPS/Madison Industries	Old Bridge Township			E	
01	MA	Nyanza Chemical Waste Dump	Ashland		R		
02	NJ	Gems Landfill	Gloucester Township		R	E	
05	MI	Berlin & Farro	Swartz Creek		R		
01	MA	Baird & McGuire	Holbrook		R	E	
02	NJ	Lone Pine Landfill	Freehold Township		R	E	
01	NH	Somersworth Sanitary Landfill	Somersworth				D
05	MN	FMC Corp.	Fridley	V		E	
06	AR	Vertac, Inc.	Jacksonville	V		E	
01	NH	KES - EPPING	Epping		R	E	
08	SD	Whitewood Creek*	Whitewood	V			
08	MT	Silver Bow/Deer Lodge	Silver Bow Creek				D
06	TX	French, Ltd.	Crosby		R		
01	NH	Sylvester*	Nashua		R	E	
05	MI	Liquid Disposal, Inc.	Utica		R		
03	PA	McAdoo Associates*	McAdoo Borough		R	E	
06	TX	Motco*	La Marque		R		
05	OH	Arcanum Iron & Metal	Darke County			E	
06	TX	Sikes Disposal Pits	Crosby		R		
04	AL	Triana Tennessee River	Limestone/Morgan			E	
09	CA	Stringfellow*	Glen Avon Heights		R	E	
01	ME	McKin Co.	Gray		R		
06	TX	Crystal Chemical Co.	Houston		R	E	
02	NJ	Bridgeport Rental & Oil	Bridgeport	V	R	E	
08	CO	Sand Creek	Commerce City				D
01	MA	W R Grace Co. (Acton Plant)	Acton	V		E	
05	MN	Reilly Tar*	St. Louis Park		R	E	
02	NJ	Burnt Fly Bog	Marlboro Township		R	E	
04	FL	Schuylkill Metals Corp.	Plant City				D
05	MN	New Brighton/Arden Hills	New Brighton		R	E	
02	NY	Old Bethpage Landfill	Oyster Bay			E	
04	FL	Reeves Se Galvanizing Corp.	Tampa				D
08	MT	Anaconda Smelter - Anaconda	Anaconda	V			
10	WA	Western Processing Co., Inc.	Kent			E	
04	FL	American Creosote Works	Pensacola				D
02	NJ	Caldwell Trucking Co.	Fairfield			E	
02	NY	Ge Moreau	South Glens Falls			E	
05	IN	Seymour Recycling Corp.*	Seymour	V	R	E	
06	OK	Tar Creek	Ottawa County		R		
07	KS	Cherokee County	Cherokee County				D
02	NJ	Brick Township Landfill	Brick			E	

#: V = VOLUNTARY OR NEGOTIATED RESPONSE; R = FEDERAL AND STATE RESPONSE;
E = FEDERAL AND STATE ENFORCEMENT; D = ACTIONS TO BE DETERMINED.

*: STATES' DESIGNATED TOP PRIORITY SITES.

GROUP 2

EPA REG	ST	SITE NAME	CITY/COUNTY	RESPONSE STATUS #
05	MI	Northernaire Plating	Cadillac	R
10	WA	Frontier Hard Chrome	Vancouver	R E
04	FL	Davie Landfill	Davie	D
04	FL	Gold Coast Oil Corp.	Miami	V
09	AZ	Tucson Int'l. Airport	Tucson	V R
02	NY	Wide Beach Development	Brant	D
09	CA	Iron Mountain Mine	Redding	R
02	NJ	Scientific Chemical Processing	Carlstadt	E
08	CO	California Gulch	Leadville	R
02	NJ	D'Imperio Property	Hamilton Township	R
05	MN	Oakdale Dump	Oakdale	V E
05	IL	A & F Materials	Greenup	R E
03	PA	Douglassville Disposal	Douglassville	D
02	NJ	Krysowaty Farm	Hillsborough	R
05	MN	Koppers Coke	St. Paul	D
01	MA	Plymouth Harbor/Cannon Eng	Plymouth	R E
10	ID	Bunker Hill Mining	Smelterville	E
02	NJ	Universal Oil Products(Chem Div)	East Rutherford	E
09	CA	Aerojet General Corp.	Rancho Cordova	E
10	WA	Com. Bay, S. Tacoma Channel	Tacoma	R E
03	PA	Osborne Landfill	Grove City	D
02	NY	Syosset Landfill	Oyster Bay	D
09	AZ	Nineteenth Avenue Landfill	Phoenix	E
10	OR	Teledyne Wah Chang	Albany	D
05	MI	Gratiot County Landfill*	St. Louis	V E
01	RI	Picillo Farm*	Coventry	R E
01	MA	New Bedford*	New Bedford	V R E
06	LA	Old Inger Oil Refinery*	Darrow	R
05	OH	Chem-Dyne*	Hamilton	V R E
04	SC	Scrdi Bluff Road*	Columbia	V R E
01	CT	Laurel Park, Inc.*	Naugatuck Borough	E
08	CO	Marshall Landfill*	Boulder County	D
05	IL	Outboard Marine Corp.*	Waukegan	R E
06	NM	South Valley*	Albuquerque	D
01	VT	Pine Street Canal*	Burlington	D
03	WV	West Virginia Ordinance*	Point Pleasant	R
07	MO	Ellisville Site*	Ellisville	R
08	ND	Arsenic Trioxide Site*	Southeastern	R
09	TT	PCB Wastes*	Pacific Trust Terr.	R
03	VA	Matthews Electroplating*	Roanoke County	R
07	IA	Aidex Corp.*	Council Bluffs	R E
09	AZ	Mountain View Mobile Homes*	Globe	R E
09	AS	Taputimu Farm*	American Samoa	D
04	TN	North Hollywood Dump*	Memphis	R
04	KY	A.L. Taylor(Valley of the Drums)	Brooks	R E
04	NC	PCB Spills*	210 Miles of Roads	R E
09	GU	Ordot Landfill*	Guam	R
08	UT	Rose Park Sludge Pit*	Salt Lake City	V
07	KS	Arkansas City Dump*	Arkansas City	R
09	CM	PCB Warehouse*	North Marianas	R

#: V = VOLUNTARY OR NEGOTIATED RESPONSE; R = FEDERAL AND STATE RESPONSE;
E = FEDERAL AND STATE ENFORCEMENT; D = ACTIONS TO BE DETERMINED.

*: STATES' DESIGNATED TOP PRIORITY SITES.

GROUP 3

EPA REG	ST	SITE NAME	CITY/COUNTY	RESPONSE STATUS #
02	NY	Sinclair Refinery	Wellsville	R
04	AL	Mowbray Engineering Co.	Greenville	D
05	MI	Spiegelberg Landfill	Green Oak Township	R
04	FL	Miami Drum Services	Miani	R E
02	NJ	Reich Farms	Pleasant Plains	E
02	NJ	South Brunswick Landfill	South Brunswick	V
04	FL	Kassauf-Kimerling Battery Disp.	Tampa	E
05	IL	Wauconda Sand & Gravel	Wauconda	R
01	NH	Ottati & Goss/Kingston Steel Drum	Kingston	R E
05	MI	Ott/Story/Cordova	Dalton Township	R
02	NJ	NL Industries	Pedricktown	E
02	NJ	Ringwood Mines/Landfill	Ringwood Borough	D
04	FL	Whitehouse Oil Pits	Whitehouse	R
05	MI	Velsicol Michigan	St. Louis	V E
05	OH	Summit National	Deerfield Township	V E
02	NY	Love Canal	Niagara FAlls	R E
05	IN	Fisher Calo	La Porte	V E
04	FL	Pioneer Sand Co.	Warrington	E
05	MI	Springfield Township Dump	Davisburg	R
03	PA	Hranica Landfill	Buffalo Township	D
04	NC	Martin Marietta, Sodyeco	Charlotte	D
04	FL	Zellwood Groundwater Contam	Zellwood	D
05	MI	Packaging Corp. of America	Filer City	D
02	NY	Hooker - S Area	Niagara Falls	E
03	PA	Lindane Dump	Harrison Township	E
08	CO	Central City, Clear Creek	Idaho Springs	R
04	FL	Taylor Road Landfill	Seffner	E
01	RI	Western Sand & Gravel	Burrillville	R E
02	NJ	Maywood Chemical Co.	Maywood/Rochelle Pk.	E
06	OK	Hardage/Criner	Criner	R E
05	MI	Rose Township Dump	Rose Township	R
05	MN	Waste Disposal Engineering	Andover	D
02	NJ	Kin-Buc Landfill	Edison Township	V R E
05	OH	Bowers Landfill	Circleville	D
02	NJ	Toms River Chemical	Toms River	D
05	MI	Butterworth #2 Landfill	Grand Rapids	E
02	NJ	American Cyanamid Co.	Bound Brook	E
03	PA	Heleva Landfill	North Whitehall TWP	D
02	NY	Batavia Landfill	Batavia	D
01	RI	L & RR, Inc.	North Smithfield	E
04	FL	NW 58th Street Landfill	Hialeah	E
04	FL	Sixty-Second Street Dump	Tampa	D
05	MI	G & H Landfill	Utica	R
02	NJ	Metaltec/Aerosystems	Franklin Borough	E
02	NJ	Lang Property	Pemberton Township	D
02	NJ	Sharkey Landfill	Parsippany, Troy HLS	D
09	CA	Selma Treating Co.	Selma	E
06	LA	Cleve Reber	Sorrento	D
05	IL	Velsicol Illinois	Marshall	V
05	MI	Tar Lake	Mancelona Township	R

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*: STATES' DESIGNATED TOP PRIORITY SITES.

GROUP 4

EPA REG	ST	SITE NAME	CITY/COUNTY	RESPONSE STATUS #
02	NJ	Combe Fill North Landfill	Mount Olive TWP	D
01	MA	Re-Solve, Inc.	Dartmouth	R E
02	NJ	Goose Farm	Plumstead Township	R
04	TN	Velsicol (Hardeman County)	Toone	V
02	NY	York Oil Co.	Moira	R
04	FL	Sapp Battery Salvage	Cottondale	R
07	KS	Doepke Disposal, Holliday	Johnson County	D
01	RI	Davis Liquid Waste	Smithfield	R E
01	MA	Charles-George Reclamation	Tyngsborough	E
02	NJ	King of Prussia	Winslow Township	D
03	VA	Chisman Creek	York County	D
05	OH	Nease Chemical	Salem	D
02	NJ	Chemical Control	Elizabeth	R E
05	OH	Allied Chemical & Ironton Coke	Ironton	D
05	MI	Verona Well Field	Battle Creek	R
01	CT	Beacon Heights Landfill	Beacon Falls	D
05	MN	Burlington Northern	Brainerd/Baxter	D
03	PA	Malvern TCE	Malvern	R
02	NY	Facet Enterprises, Inc.	Elmira	V
03	DE	Delaware Sand & Gravel Landfill	New Castle County	D
04	TN	Murray Ohio Dump	Lawrenceburg	D
05	IN	Envirochem	Zionsville	R
05	IN	MIDCO I	Gary	R E
04	FL	Coleman Evans Wood Preserving Co.	Whitehouse	E
04	FL	Florida Steel Corp.	Indiantown	D
09	AZ	Litchfield Airport Area	Goodyear/Avondale	D
02	NJ	Spence Farm	Plumstead Township	R
06	AR	Mid-South Wood Products	Mena	E
04	FL	Brown Wood Preserving	Live Oak	D
02	NY	Port Washington Landfill	Port Washington	E
02	NJ	Combe Fill South Landfill	Chester Township	D
02	NJ	JIS Landfill	Jamesburg/S. Brunswic	E
03	PA	Centre County Kepone	State College Borough	E
05	OH	Fields Brook	Ashtabula	R
01	CT	Solvents Recovery Service	Southington	V E
08	CO	Woodbury Chemical Co.	Commerce City	R
01	MA	Hocomonco Pond	Westborough	R
04	KY	Distler Brickyard	West Point	R
02	NY	Ramapo Landfill	Ramapo	E
09	CA	Coast Wood Preserving	Ukiah	E
02	NY	Mercury Refining, Inc.	Colonie	E
04	FL	Hollingsworth Solderless Term.	Ft. Lauderdale	D
02	NY	Olean Well Field	Olean	R
04	FL	Varsol Spill	Miami	V R
08	CO	Denver Radium Site	Denver	R
04	FL	Tower Chemical Co.	Clermont	R E
07	MO	Syntex Facility	Verona	V E
08	MT	Milltown Reservoir Sediments	Milltown	R
02	NJ	Pijak Farm	Plumstead Township	R
02	NJ	Syncon Resins	South Kearny	V E

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GROUP 5

EPA REG	ST	SITE NAME	CITY/COUNTY	RESPONSE STATUS #
09	CA	Liquid Gold Oil Corp.	Richmond	E
09	CA	Purity Oil Sales, Inc.	Malaga	D
01	NH	Tinkham Garage	Londonderry	R
04	FL	Alpha Chemical Corp.	Galloway	D
02	NJ	Bog Creek Farm	Howell Township	R
01	ME	Saco Tannery Waste Pits	Saco	R
04	FL	Pickettville Road Landfill	Jacksonville	D
03	PA	Palmerton Zinc Pile	Palmerton	D
05	IN	Neal's Landfill	Bloomington	E
01	MA	Silresim Chemical Corp.	Lowell	R E
01	MA	Wells G & H	Woburn	E
02	NJ	Chemsol, Inc.	Piscataway	D
05	MI	Petoskey Municipal Well Field	Petoskey	R
02	NJ	Fair Lawn Well Field	Fair Lawn	D
05	IN	Main Street Well Field	Elkhart	D
05	MN	Lehillier/Mankato	Lehillier	R
10	WA	Lakewood	Lakewood	E
02	NJ	Monroe Township Landfill	Monroe Township	E
02	NJ	Rockaway Borough Well Field	Rockaway Township	D
05	IN	Wayne Waste Oil	Columbia City	R E
07	IA	Des Moines TCE	Des Moines	D
02	NJ	Beachwood/Berkley Wells	Berkley Township	D
02	NY	Vestal Water Supply Well 4-2	Vestal	E
09	AZ	Indian Bend Wash Area	Scottsdale	D
10	WA	Com. Bay, Near Shore/Tide Flat	Pierce County	R E
05	IL	LaSalle Electric Utilities	LaSalle	R
05	IL	Cross Bros/Pembroke	Pembroke Township	R
09	CA	McColl	Fullerton	D
10	WA	Colbert Landfill	Spokane	R
02	PR	Frontera Creek	Rio Abajo	D
02	PR	Barceloneta Landfill	Florida Afuera	D
03	MD	Sand, Gravel and Stone	Elkton	E
05	MI	Spartan Chemical Co.	Wyoming	E
02	NJ	Roebling Steel Co.	Florence	D
04	TN	Amnicola Dump	Chattanooga	D
02	NJ	Vineland State School	Vineland	D
03	PA	Enterprise Avenue	Philadelphia	D
01	MA	Groveland Wells	Groveland	R
04	SC	Scrdi Dixiana	Cayce	E
07	MO	Fulbright Landfill	Springfield	D
03	PA	Presque Isle	Erie	D
02	NJ	Williams Property	Swainton	R
02	NJ	Renora, Inc.	Edison Township	D
02	NJ	Denzer & Schafer X-Ray Co.	Bayville	E
02	NJ	Hercules, Inc. (Gibbstown)	Gibbstown	D
05	IN	Ninth Avenue Dump	Gary	V E
06	AR	Gurley Pit	Edmondsen	D
01	RI	Peterson/Puritan, Inc.	Lincoln/Cumberland	V
07	MO	Times Beach	Times Beach	R
05	MI	Wash King Laundry	Pleasant Plains TWP	D

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GROUP 6

EPA REG	ST	SITE NAME	CITY/COUNTY	RESPONSE STATUS #
05	MN	NL Industries/Taracorp/Golden	St. Louis Park	V
01	MA	Cannon Engineering Corp. (CEC)	Bridgewater	R E
02	NY	Niagara County Refuse	Wheatfield	D
04	FL	Sherwood Medical Industries	Deland	D
05	MI	Southwest Ottawa Landfill	Park Township	E
02	NY	Kentucky Ave Well Field	Horseheads	D
02	NJ	Asbestos Dump	Millington	D
04	KY	Lee's Lane Landfill	Louisville	D
06	AR	Frit Industries	Walnut Ridge	V E
05	OH	Fultz Landfill	Jackson Township	D
05	OH	Coshocton Landfill	Franklin Township	D
03	PA	Lord-Shope Landfill	Girard Township	E
10	WA	FMC Corp. (Yakima)	Yakima	V
01	MA	PSC Resources	Palmer	V
05	MI	Forest Waste Products	Otisville	R
03	PA	Drake Chemical	Lock Haven	R
03	PA	Havertown PCP	Haverford	E
03	DE	New Castle Spill	New Castle County	D
05	IN	Lake Sandy Jo (M&M Landfill)	Gary	D
05	IL	Johns-Manville Corp.	Waukegan	D
05	MI	Chem Central	Wyoming Township	D
05	MI	Novaco Industries	Temperance	D
02	NJ	Jackson Township Landfill	Jackson Township	E
05	MI	K & L Avenue Landfill	Oshtemo Township	R
10	WA	Kaiser Mead	Mead	D
05	MI	Charlevoix Municipal Well	Charlevoix	D
02	NJ	Montgomery Township Housing Dev	Montgomery Township	D
02	NJ	Rocky Hill Municipal Well	Rocky Hill Borough	D
02	NY	Brewster Well Field	Putnam County	D
02	NY	Vestal Water Supply Well 1-1	Vestal	E
02	NJ	U.S. Radium Corp.	Orange	D
06	TX	Highlands Acid Pit	Highlands	R
03	PA	Resin Disposal	Jefferson Borough	E
08	MT	Libby Ground Water Contamination	Libby	D
04	KY	Newport Dump	Newport	E
03	PA	Moyers Landfill	Eagleville	E
04	FL	Parramore Surplus	Mount Pleasant	V
05	MI	Hedblum Industries	Oscoda	D
08	WY	Baxter/Union Pacific Tie Treating	Laramie	D
02	NJ	Sayreville Landfill	Sayreville	D
01	NH	Dover Municipal Landfill	Dover	D
02	NY	Ludlow Sand & Gravel	Clayville	D
07	MO	Minker/Stout/Romaine Creek	Imperial	R
01	CT	Yaworski Waste Lagoon	Canterbury	E
03	WV	Leetown Pesticide	Leetown	D
02	NJ	Evor Phillips Leasing	Old Bridge Township	D
03	PA	Wade (ABM)	Chester	R E
03	PA	Lackawanna Refuse	Old Force Borough	E
02	NJ	Mannheim Avenue Dump	Galloway Township	D
02	NY	Fulton Terminals	Fulton	V

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GROUP 7

EPA REG	ST	SITE NAME	CITY/COUNTY	RESPONSE STATUS #
01	NH	Auburn Road Landfill	Londonderry	E
03	WV	Fike Chemical, Inc.	Nitro	V
05	OH	Laskin/Poplar Oil Co.	Jefferson Township	R E
05	OH	Old Mill	Rock Creek	R
07	KS	Johns' Sludge Pond	Wichita	V E
02	NJ	Swope Oil & Chemical Co.	Pennsauken	D
01	ME	Winthrop Landfill	Winthrop	R
06	AR	Cecil Lindsey	Newport	D
05	OH	Zanesville Well Field	Zanesville	D
05	MI	Grand Traverse Overall Supply Co.	Greilickville	D
05	MN	South Andover Site	Andover	D
05	MI	Kentwood Landfill	Kentwood	R
05	IN	Marion (Bragg) Dump	Marion	D
05	OH	Pristine, Inc.	Reading	E
05	OH	Buckeye Reclamation	St. Clairsville	D
06	TX	Bio-Ecology Systems, Inc	Grand Prairie	R
01	VT	Old Springfield Landfill	Springfield	D
02	NY	Solvent Savers	Lincklaen	E
03	VA	U.S. Titanium	Piney River	E
05	IL	Galesburg/Koppers	Galesburg	D
02	NY	Hooker - Hyde Park	Niagara Falls	V E
05	MI	SCA Independent Landfill	Muskegon Heights	E
09	CA	MGM Brakes	Cloverdale	E
05	MI	Duell & Gardner Landfill	Dalton Township	R
02	NJ	Ellis Property	Evesham Township	R
04	KY	Distler Farm	Jefferson County	R
10	WA	Harbor Island Lead	Seattle	D
05	OH	E.H. Schilling Landfill	Hamilton Township	D
05	MI	Cliff/Dow Dump	Marquette	E D
06	NM	Homestake Mining Co.	Milan	V E
05	MI	Mason County Landfill	Pere Marquette TWP	E
05	MI	Cemetery Dump	Rose Center	R
01	RI	Stamina Mills, Inc.	North Smithfield	R E
01	ME	Pinette's Salvage Yard	Washburn	D
06	TX	Harris (Farley St)	Houston	V E
03	PA	Old City of York Landfill	Seven Valleys	E
05	IL	Byron Salvage Yard	Byron	R
03	PA	Stanley Kessler	King of Prussia	E
02	NJ	Friedman Property	Upper Freehold TWP	R
02	NJ	Imperial Oil/Champion Chemicals	Morganville	E
02	NJ	Myers Property	Franklin Township	D
02	NJ	Pepe Field	Boonton	D
05	MI	Ossineke Ground Water Contam	Ossineke	R
03	WV	Follansbee	Follansbee	D
05	MI	U.S. Aviex	Howard Township	E
06	NM	AT & SF/Clovis	Clovis	D
02	NY	American Thermostat Co.	South Cairo	E
04	TN	Lewisburg Dump	Lewisburg	D
05	MI	McGraw Edison Corp.	Albion	E
03	PA	Metal Banks	Philadelphia	E

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GROUP 8

EPA REG	ST	SITE NAME	CITY/COUNTY	RESPONSE STATUS #
04	KY	B.F. Goodrich	Calvert City	D
05	MI	Organic Chemicals, Inc.	Grandville	E
02	PR	Juncos Landfill	Juncos	D
04	FL	Munisport Landfill	North Miami	D
02	NJ	M & T Delisa Landfill	Asbury Park	D
10	OR	Gould, Inc.	Portland	E
05	MI	Auto Ion Chemicals, Inc.	Kalamazoo	R
04	SC	Carolawn, Inc.	Fort Lawn	R E
05	MI	Sparta Landfill	Sparta Township	E
05	IL	Acme Solvent/Morristown	Morristown	R
01	ME	O'Connor	Augusta	D
05	MI	Rasmussen's Dump	Brighton	R
03	PA	Westline	Westline	D
05	MI	Ionia City Landfill	Ionia	R
05	IN	Wedzeb, Inc.	Lebanon	E
02	PR	GE Wiring Devices	Juana Diaz	D
05	OH	New Lyme Landfill	New Lyme	D
02	PR	RCA Del Caribe	Barceloneta	D
03	PA	Brodhead Creek	Stroudsburg	R
05	MI	Anderson Development Co.	Adrian	E
05	MI	Shiawassee River	Howell	R
03	DE	Harvey & Knott Drum, Inc.	Kirkwood	R
04	TN	Gallaway Pits	Gallaway	E
05	OH	Big D Campground	Kingsville	D
03	DE	Wildcat Landfill	Dover	D
03	PA	Blosenski Landfill	West Caln Township	E
03	DE	Delaware City PVC Plant	Delaware City	D
03	MD	Limestone Road	Cumberland	E
02	NY	Hooker - 102 nd Street	Niagara Falls	E
03	DE	New Castle Steel	New Castle County	D
06	NM	United Nuclear Corp.	Church Rock	D
06	AR	Industrial Waste Control	Ft. Smith	D
09	CA	Celtor Chemical Works	Hoopa	R
04	AL	Perdido Ground Water Contam	Perdido	D
02	NY	Marathon Battery Corp.	Cold Springs	D
03	PA	Lehigh Electric & Eng. Co.	Old Forge Borough	R E
05	OH	Skinner Landfill	West Chester	D
04	NC	Chemtronics, Inc.	Swannanoa	D
07	MO	Shenandoah Stables	Moscow Mills	E
06	LA	Bayou Bonfouca	Slidell	D
03	VA	Saltville Waste Disposal Ponds	Saltville	D
03	PA	Kimberton	Kimberton Borough	D
03	MD	Middletown Road Dump	Annapolis	E
10	WA	Pesticide Lab	Yakima	D
05	IN	Lemon Lane Landfill	Bloomington	D
10	ID	Arrcom (Drexler Enterprises)	Rathdrum	D
03	PA	Fischer & Porter Co.	Warminster	E
09	CA	Jibboom Junkyard	Sacramento	D
02	NJ	A.O. Polymer	Sparta Township	R
02	NJ	Dover Municipal Well 4	Dover	D

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GROUP 9

EPA REG	ST	SITE NAME	CITY/COUNTY	RESPONSE STATUS #
02	NJ	Rockaway Township Wells	Rockaway	D
06	TX	Triangle Chemical Co.	Bridge City	R E
02	NJ	PJP Landfill	Jersey City	D
03	PA	Craig Farm Drum	Parker	D
03	PA	Voortman Farm	Upper Saucon TWP	D
05	IL	Belvidere Municipal Landfill	Belvidere	D

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NPL & PROPOSED UPDATE SITES BY STATE

\# Includes seven sites proposed in December, 1982 on which rulemaking is pending.

* Designated as State's top priority.

c Not included because site was cleaned up.

p Rulemaking pending.

s Not included because proposed score was revised.

t Not included because no longer designated as State's top priority.

AK ALASKA

AL ALABAMA

MOWBRAY ENGINEERING CO., Greenville

PERDIDO GROUND WATER CONTAMINATION, Perdido

TRIANA-TENNESSEE RIVER (once listed as TRIANA (REDSTONE) ARSENAL), Limestone/Morgan Counties

CIBA-GEIGY CORP. (MCINTOSH PLANT), McIntosh

OLIN CORP. (MCINTOSH PLANT), McIntosh

STAUFFER CHEMICAL CO. (COLD CREEK PLANT), Bucks

STAUFFER CHEMICAL CO. (LEMOYNE PLANT), Axis

AR ARKANSAS

CECIL LINDSEY, Newport

CRITTENDEN COUNTY LANDFILL[s], Marion

FRIT INDUSTRIES, Walnut Ridge

GURLEY PIT, Edmondson

INDUSTRIAL WASTE CONTROL, Fort Smith

MID-SOUTH WOOD PRODUCTS, Mena

VERTAC, INC., Jacksonville

AS AMERICAN SAMOA

TAPUTIMU FARM*, Island of Tutuila

AZ ARIZONA

INDIAN BEND WASH AREA, Scottsdale-Tempe-Phoenix

KINGMAN AIRPORT INDUSTRIAL AREA[p], Kingman

LITCHFIELD AIRPORT AREA, Goodyear/Avondale

MOUNTAIN VIEW MOBILE HOME ESTATES*, (once listed as GLOBE), Globe

19th AVENUE LANDFILL, Phoenix

TUCSON AIRPORT AREA, Tucson

CA CALIFORNIA

AEROJET GENERAL CORP., Rancho Cordova

CELTOR CHEMICAL WORKS, Hoopa

COAST WOOD PRESERVING, Ukiah

IRON MOUNTAIN MINE, Redding

JIBBOOM JUNKYARD, Sacramento

LIQUID GOLD OIL CORP., Richmond

MGM BRAKES, Cloverdale

MCCOLL, Fullerton

PURITY OIL SALES, INC., Malaga

SELMA TREATING CO., Selma

STRINGFELLOW*, Glen Avon Heights

ATLAS ASBESTOS MINE, Fresno County

COALINGA ASBESTOS MINE, Coalinga

DEL NORTE COUNTY PESTICIDE STORAGE AREA, Crescent City

KOPPERS CO., INC. (OROVILLE PLANT), Oroville

SAN GABRIEL VALLEY (AREA 1), El Monte

SAN GABRIEL VALLEY (AREA 2), Baldwin Park Area

CA CALIFORNIA - Continued

SAN GABRIEL VALLEY (AREA 3), Alhambra

SAN GABRIEL VALLEY (AREA 4), La Puente

CM NORTHERN MARIANA ISLANDS*

PCB WAREHOUSE, Saipan

CO COLORADO

CALIFORNIA GULCH, Leadville

CENTRAL CITY CLEAR CREEK, Idaho Springs

DENVER RADIUM, Denver

MARSHALL LANDFILL*, Boulder County

SAND CREEK INDUSTRIAL, Commerce City

WOODBURY CHEMICAL CO., Commerce City

BRODERICK WOOD PRODUCTS, Denver

LINCOLN PARK, Canon City

LOWRY LANDFILL, Arapahoe County

CT CONNECTICUT

BEACON HEIGHTS LANDFILL, Beacon Falls

LAUREL PARK, INC. (once listed as LAUREL PARK LANDFILL), Naugatuck Borough

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, Southington

YAWORSKI WASTE LAGOON, Canterbury

KELLOGG-DEERING WELL FIELD, Norwalk

OLD SOUTHINGTON LANDFILL, Southington

DC DISTRICT OF COLUMBIA

DE DELAWARE

ARMY CREEK LANDFILL (once listed as DELAWARE SAND & GRAVEL-LLANGOLLEN ARMY CREEK LANDFILLS), New Castle County

DE DELAWARE - Continued

DELAWARE CITY PVC PLANT (once listed as STAUFFER CHEMICAL CO.), Delaware City

DELAWARE SAND & GRAVEL LANDFILL (once listed as DELAWARE SAND & GRAVEL-LLANGOLLEN ARMY CREEK LANDFILLS), New Castle County

HARVEY & KNOTT DRUM, INC., Kirkwood

NEW CASTLE SPILL (Once listed as TRIS SPILL), New Castle County

NEW CASTLE STEEL, New Castle County

TYBOUTS CORNER LANDFILL*, New Castle County

WILDCAT LANDFILL, Dover

OLD BRINE SLUDGE LANDFILL, Delaware City

FL FLORIDA

ALPHA CHEMICAL CORP., Galloway

AMERICAN CREOSOTE WORKS, Pensacola

BROWN WOOD PRESERVING, Live Oak

COLEMAN-EVANS WOOD PRESERVING CO., Whitehouse

DAVIE LANDFILL (once listed as BOWARD COUNTY SOLID WASTE DISPOSAL FACILITY), Davie

FLORIDA STEEL CORP., Indiantown

GOLD COAST OIL CORP., Miami

HOLLINGSWORTH SOLDERLESS TERMINAL CO., Ft. Lauderdale

KASSAUF KIMERLING BATTERY (once listed as TIMBER LAKE BATTERY DISPOSAL), Tampa

MIAMI DRUM SERVICES (once listed as part of BISCAYNE AQUIFER), Miami

MUNISPORT LANDFILL, North Miami

NORTHWEST 58TH STREET LANDFILL (once listed as part of BISCAYNE AQUIFER), Hialeah

PARRAMORE SURPLUS, Mount Pleasant

PICKETTVILLE ROAD LANDFILL, Jacksonville

PIONEER SAND CO., Warrington

REEVES SOUTHEASTERN GALVANIZING CORP., Tampa

FL FLORIDA - Continued

SAPP BATTERY SALVAGE, Cottondale

SCHUYLKILL METALS CORP., Plant City

SHERWOOD MEDICAL INDUSTRIES, Deland

62ND STREET DUMP, Tampa

TAYLOR ROAD LANDFILL, Seffner

TOWER CHEMICAL CO., Clermont

VARSOL SPILL (once listed as part of BISCAYNE AQUIFER), Miami

WHITEHOUSE OIL PITS, Whitehouse

ZELLWOOD GROUND WATER CONTAMINATION, Zellwood

CABOT/KOPPERS, Gainesville

HIPPS ROAD LANDFILL, Duval County

PEPPER STEEL & ALLOYS, INC., Medley

TRI-CITY OIL CONSERVATIONIST, INC., Temple Terrace

GA GEORGIA

HERCULES 009 LANDFILL, Brunswick

MONSANTO CORP. (AUGUSTA PLANT), Augusta

OLIN CORP. (AREAS 1, 2 & 4), Augusta

POWERSVILLE, Peach County

GU GUAM

ORDOT LANDFILL*, Ordot

HI HAWAII

IA IOWA

AIDEX CORP.*, Council Bluffs

DES MOINES TCE (once listed as DICO), Des Moines

LABOUNTY, Charles City

ID IDAHO

ARRCOM (DREXLER ENTERPRISES), Rathdrum

BUNKER HILL MINING & METALLURGICAL, Smelterville

FLYNN LUMBER CO.^{S}, Caldwell

PACIFIC HIDE & FUR RECYCLING CO., Pocatello

UNION PACIFIC RAILROAD CO., Pocatello

IL ILLINOIS

A & F MATERIALS RECLAIMING, INC., Greenup

ACME SOLVENT RECLAIMING, INC., Morristown

BELVIDERE MUNICIPAL LANDFILL, Belvidere

BYRON SALVAGE YARD, Byron

CROSS BROTHERS PAIL RECYCLING, Pembrook Township

GALESBURG/KOPPERS, Galesburg

JOHNS-MANVILLE CORP., Waukegan

LASALLE ELECTRIC UTILITIES, La Salle

OUTBOARD MARINE CORP.*, Waukegan

VELSICOL CHEMICAL CORP. (MARSHALL PLANT), Marshall

WAUCONDA SAND & GRAVEL, Wauconda

IN INDIANA

ENVIROCHEM CORP., Zionsville

FISHER CALO, LaPorte

LAKE SANDY JO (M&M LANDFILL), Gary

LEMON LANE LANDFILL, Bloomington

MAIN STREET WELL FIELD, Elkhart

MARION (BRAGG) DUMP, Marion

MIDCO I, Gary

NEAL'S LANDFILL, Bloomington

IN INDIANA - Continued

NINTH AVENUE DUMP, Gary

PARROT ROAD DUMP^s, New Haven

SEYMOUR RECYCLING CORP.*, Seymour

WAYNE WASTE OIL, Columbia City

WEDZEB ENTERPRISES, INC., Lebanon

AMERICAN CHEMICAL SERVICE, Griffith

BENNETT STONE QUARRY, Bloomington

NORTHSIDE SANITARY LANDFILL, Zionsville

POER FARM, Hancock County

REILLY TAR & CHEMICAL CORP., Indianapolis

KS KANSAS

ARKANSAS CITY DUMP*, Arkansas City

CHEROKEE COUNTY (once listed as TAR CREEK, Cherokee County), Cherokee County

DOEPKE DISPOSAL (HOLLIDAY), Johnson County

JOHN'S SLUDGE POND, Wichita

KY KENTUCKY

A. L. TAYLOR (VALLEY OF THE DRUMS)*, Brooks

AIRCO^p, Calvert

B. F. GOODRICH, Calvert City

DISTLER BRICKYARD, West Point

DISTLER FARM, Jefferson County

LEE'S LANE LANDFILL, Louisville

NEWPORT DUMP, Newport

LA LOUISIANA

BAYOU BONFOUCA, Slidell

BAYOU SORREL^p, Bayou Sorrell

LA LOUISIANA - Continued

CLEVE REBER, Sorrento

OLD INGER OIL REFINERY*, Darrow

PETRO-PROCESSORS, Scotlandville

MA MASSACHUSETTS

BAIRD & MCGUIRE, Holbrook

CANNON ENGINEERING CORP. (CEC), Bridgewater

CHARLES GEORGE RECLAMATION TRUST LANDFILL, Tyngsborough

GROVELAND WELLS, Groveland

HOCOMONCO POND, Westborough

INDUSTRI-PLEX 128 (once listed as MARK PHILLIP TRUST), Woburn

NEW BEDFORD*, New Bedford

NYANZA CHEMICAL WASTE DUMP, Ashland

PSC RESOURCES, Palmer

PLYMOUTH HARBOR/CANNON ENGINEERING CORP., Plymouth

RE-SOLVE, INC., Dartmouth

SILRESIM CHEMICAL CORP., Lowell

W. R. GRACE & CO., INC. (ACTON PLANT), Acton

WELLS G & H, Woburn

IRON HORSE PARK, Billerica

SULLIVAN'S LEDGE, New Bedford

MD MARYLAND

LIMESTONE ROAD, Cumberland

MIDDLETOWN ROAD DUMP, Annapolis

SAND, GRAVEL & STONE, Elkton

ME MAINE

F. O'CONNOR SITE, Augusta

ME MAINE - Continued

MCKIN CO., Gray

PINETTE'S SALVAGE YARD, Washburn

SACO TANNERY WASTE PITS, Saco

WINTHROP LANDFILL, Winthrop

MI MICHIGAN

ANDERSON DEVELOPMENT CO., Adrian

AUTO ION CHEMICALS, INC., Kalamazoo

BERLIN & FARRO, Swartz Creek

BUTTERWORTH NO. 2 LANDFILL, Grand Rapids

CEMETERY DUMP, Rose Center

CHARLEVOIX MUNICIPAL WELL, Charlevoix

CHEM CENTRAL, Wyoming Township

CLARE WATER SUPPLY[p], Clare

CLIFF/DOW DUMP, Marquette

DUELL & GARDNER LANDFILL, Dalton Township

ELECTROVOICE[p], Buchanan

FOREST WASTE PRODUCTS, Otisville

G & H LANDFILL, Utica

GRAND TRAVERSE OVERALL SUPPLY CO., Greilickville

GRATIOT COUNTY GOLF COURSE[c], St. Louis

GRATIOT COUNTY LANDFILL*, St. Louis

HEDBLUM INDUSTRIES, Oscoda

IONIA CITY LANDFILL, Ionia

K & L AVENUE LANDFILL, Oshtemo Township

KENTWOOD LANDFILL, Kentwood

LIQUID DISPOSAL, INC., Utica

LITTLEFIELD TOWNSHIP DUMP[p], Oden

MI MICHIGAN - Continued

MASON COUNTY LANDFILL, Pere Marquette Township

MCGRAW EDISON CORP., Albion

NORTHERNAIRE PLATING, Cadillac

NOVACO INDUSTRIES, Temperance

ORGANIC CHEMICALS, INC., Grandville

OSSINEKE GROUND WATER CONTAMINATION, Ossineke

OTT/STORY/CORDOVA CHEMICAL CO., Dalton Township

PACKAGING CORP. OF AMERICA, Filer City

PETOSKEY MUNICIPAL WELL FIELD, Petoskey

RASMUSSEN'S DUMP, Green Oak Township

ROSE TOWNSHIP DUMP, Rose Township

SCA INDEPENDENT LANDFILL, Muskegon Heights

SHIAWASSEE RIVER, Howell

SOUTHWEST OTTAWA COUNTY LANDFILL, Park Township

SPARTA LANDFILL, Sparta Township

SPARTAN CHEMICAL CO., Wyoming

SPIEGELBERG LANDFILL, Green Oak Township

SPRINGFIELD TOWNSHIP DUMP, Davisburg

TAR LAKE, Mancelona Township

U.S. AVIEX, Howard Township

VELSICOL CHEMICAL CORP. (ST. LOUIS PLANT), St. Louis

VERONA WELL FIELD, Butler Creek

WASH KING LAUNDRY, Pleasant Plains Township

WHITEHALL WELL FIELD[p], Whitehall

BURROWS SANITATION, Hartford

METAMORA LANDFILL, Metamore

STURGIS MUNICIPAL WELLS, Sturgis

MN MINNESOTA

BURLINGTON NORTHERN, Brainerd/Baxter

FMC CORP. (FRIDLEY PLANT), Fridley

KOPPERS COKE, St. Paul

LEHILLIER/MANKATO, Lehillier/Mankato

NL INDUSTRIES/TARACORP/GOLDEN AUTO, St. Louis Park

NEW BRIGHTON/ARDEN HILLS, New Brighton

OAKDALE DUMP, Oakdale

REILLY TAR & CHEMICAL CORP.*, St. Louis Park

SOUTH ANDOVER (once listed as ANDOVER SITES), Andover

WASTE DISPOSAL ENGINEERING, Andover

ARROWHEAD REFINERY CO., Hermantown

BOISE CASCADE/ONAN/MEDTRONICS, Fridley

GENERAL MILLS/HENKEL CORP., Minneapolis

JOSLYN MANUFACTURING & SUPPLY CO., Brooklyn Center

MACGILLIS & GIBBS CO./BELL LUMBER & POLE CO., New Brighton

MORRIS ARSENIC DUMP, Morris

NUTTING TRUCK & CASTER CO., Faribault

PERHAM ARSENIC, Perham

ST. LOUIS RIVER, St. Louis County

ST. REGIS PAPER CO., Cass Lake

UNION SCRAP, Minneapolis

WASHINGTON COUNTY LANDFILL, Lake Elmo

WHITTAKER CORP., Minneapolis

MO MISSOURI

ELLISVILLE*, Ellisville

FULBRIGHT LANDFILL, Springfield

MINKER/STOUT/ROMAINE CREEK (once listed as ARENA 2: FILLS 1 & 2), Imperial

MO MISSOURI - Continued

SHENANDOAH STABLES (once listed as ARENA 1: SHENANDOAH STABLES), Moscow Mills

SYNTEX FACILITY, Verona

TIMES BEACH, Times Beach

QUAIL RUN MOBILE MANOR, Gray Summit

MS MISSISSIPPI

PLASTIFAX, INC.[t], Gulfport

FLOWOOD*, Flowood

MT MONTANA

ANACONDA SMELTER, Anaconda

LIBBY GROUND WATER CONTAMINATION, Libby

MILLTOWN RESERVOIR SEDIMENTS, Milltown

SILVER BOW CREEK, Silver Bow/Deer Lodge Counties

EAST HELENA SMELTER, East Helena

NC NORTH CAROLINA

CHEMTRONICS, INC., Swannanoa

MARTIN MARIETTA, SODYEDO, INC., Charlotte

PCB SPILLS*, 210 Miles of Roads

ND NORTH DAKOTA

ARSENIC TRIOXIDE*, Southeastern

NE NEBRASKA

PHILLIPS CHEMICAL CO.[s], Beatrice

NH NEW HAMPSHIRE

AUBURN ROAD LANDFILL, Londonderry

DOVER MUNICIPAL LANDFILL, Dover

NH NEW HAMPSHIRE - Continued

KEEFE ENVIRONMENTAL SERVICES (KES), Epping

OTTATI & GOSS/KINGSTON STEEL DRUM, Kingston

SOMERSWORTH SANITARY LANDFILL, Somersworth

SYLVESTER*, Nashua

TINKHAM GARAGE, Londonderry

KEARSAGE METALLURGICAL CORP., Conway

SAVAGE MUNICIPAL WATER SUPPLY, Milford

SOUTH MUNICIPAL WATER SUPPLY WELL, Petersborough

NJ NEW JERSEY

A. O. POLYMER, Sparta Township

AMERICAN CYANAMID CO., Bound Brook

ASBESTOS DUMP, Millington

BEACHWOOD/BERKLEY WELLS, Berkley Township

BOG CREEK FARM, Howell Township

BRICK TOWNSHIP LANDFILL, Brick Township

BRIDGEPORT RENTAL & OIL SERVICES, Bridgeport

BURNT FLY BOG, Marlboro Township

CALDWELL TRUCKING CO., Fairfield

CHEMICAL CONTROL, Elizabeth

CHEMSOL, INC., Piscataway

COMBE FILL NORTH LANDFILL, Mount Olive Township

COMBE FILL SOUTH LANDFILL, Chester Township

CPS/MADISON INDUSTRIES, Old Bridge Township

D'IMPERIO PROPERTY, Hamilton Township

DENZER & SCHAFER X-RAY CO., Bayville

DOVER MUNICIPAL WELL 4, Dover Township

ELLIS PROPERTY, Evesham Township

NJ NEW JERSEY - Continued

EVOR PHILLIPS LEASING, Old Bridge Township

FAIR LAWN WELL FIELD, Fair Lawn

FRIEDMAN PROPERTY (once listed as UPPER FREEHOLD SITE), Upper Freehold Township

GEMS LANDFILL, Gloucester Township

GOOSE FARM, Plumstead Township

HELEN KRAMER LANDFILL, Mantua Township

HERCULES, INC. (GIBBSTOWN PLANT), Gibbstown

IMPERIAL OIL CO., INC./CHAMPION CHEMICALS (once listed as IMPERIAL OIL CO., INC.), Morganville

JIS LANDFILL, Jamesburg/South Brunswick Township

JACKSON TOWNSHIP LANDFILL, Jackson Township

KIN-BUC LANDFILL, Edison Township

KING OF PRUSSIA, Winslow Township

KRYSOWATY FARM, Hillsborough

LANG PROPERTY, Pemberton Township

LIPARI LANDFILL, Pitman

LONE PINE LANDFILL, Freehold Township

M & T DELISA LANDFILL, Asbury Park

MANNHEIM AVENUE DUMP, Galloway Township

MAYWOOD CHEMICAL CO., Maywood/Rochelle Park

METALTEC/AEROSYSTEMS, Franklin Borough

MONROE TOWNSHIP LANDFILL, Monroe Township

MONTGOMERY TOWNSHIP HOUSING DEVELOPMENT, Montgomery Township

MYERS PROPERTY, Franklin Township

NL INDUSTRIES, Pedricktown

PJP LANDFILL, Jersey City

PEPE FIELD, Boonton

PIJAK FARM, Plumstead Township

PRICE LANDFILL*, Pleasantville

REICH FARMS, Pleasant Plains

RENORA, INC., Edison Township

RINGWOOD MINES/LANDFILL, Ringwood Borough

ROCKAWAY BOROUGH WELL FIELD, Rockaway Township

ROCKAWAY TOWNSHIP WELLS, Rockaway

ROCKY HILL MUNICIPAL WELL, Rocky Hill Borough

ROEBLING STEEL CO., Florence

SAYREVILLE LANDFILL, Sayreville

SCIENTIFIC CHEMICAL PROCESSING, INC., Carlstadt

SHARKEY LANDFILL, Parsippany/Troy Hills

SOUTH BRUNSWICK LANDFILL, South Brunswick

SPENCE FARM, Plumstead Township

SWOPE OIL & CHEMICAL CO., Pennsauken

SYNCON RESINS, South Kearny

TOMS RIVER CHEMICAL, Toms River

U.S. RADIUM CORP., Orange

UNIVERSAL OIL PRODUCTS (CHEMICAL DIVISION), East Rutherford

VINELAND STATE SCHOOL, Vineland

WILLIAMS PROPERTY, Swainton

CHEMICAL LEAMAN TANK LINERS, INC., Bridgeport

COOPER ROAD, Voorhees Township

DE REWAL CHEMICAL CO., Kingwood Township

DELILAH ROAD, Egg Harbor Township

DIAMOND ALKALI CO., Newark

EWAN PROPERTY, Shamong Township

NJ NEW JERSEY - Continued

FLORENCE LAND RECONTOURING, INC., LANDFILL, Florence Township

HOPKINS FARM, Plumstead Township

LANDFILL & DEVELOPMENT CO., Mount Holly

NASCOLITE CORP., Millville

RADIATION TECHNOLOGY, INC., Rockaway Township

SHIELDALLOY CORP., Newfield Borough

TABERNACLE DRUM DUMP, Tabernacle Township

UPPER DEERFIELD TOWNSHIP SANITARY LANDFILL, Upper Deerfield Township

VENTRON/VELSICOL, Woodridge Borough

VINELAND CHEMICAL CO., INC., Vineland

W. R. GRACE & CO., INC. (WAYNE PLANT), Wayne Township

WILSON FARM, Plumstead Township

WOODLAND ROUTE 532 DUMP, Woodland Township

WOODLAND ROUTE 72 DUMP, Woodland Township

NM NEW MEXICO

AT & SF/CLOVIS, Clovis

HOMESTAKE MINING CO., Milan

SOUTH VALLEY*, Albuquerque

UNITED NUCLEAR CORP., Church Rock

NV NEVADA

NY NEW YORK

AMERICAN THERMOSTT CO., South Cairo

BATAVIA LANDFILL, Batavia

BREWSTER WELL FIELD, Putnam County

FACET ENTERPRISES, INC., Elmira

FULTON TERMINALS, Fulton

NY NEW YORK - Continued

GE MOREAU, South Glens Falls

HOOKER (HYDE PARK), Niagara Falls

HOOKER (102ND STREET), Niagara Falls

HOOKER (S-AREA), Niagara Falls

KENTUCKY AVENUE WELL FIELD, Horseheads

LOVE CANAL, Niagara Falls

LUDLOW SAND & GRAVEL, Clayville

MARATHON BATTERY CORP., Cold Springs

MERCURY REFINING, INC., Colonie

NIAGARA COUNTY REFUSE, Wheatfield

OLD BETHPAGE LANDFILL, Oyster Bay

OLEAN-WELL FIELD, Olean

POLLUTION ABATEMENT SERVICES (PAS)*, Oswego

PORT WASHINGTON LANDFILL, Port Washington

RAMAPO LANDFILL, Ramapo

SINCLAIR REFINERY, Wellsville

SOLVENT SAVERS, Lincklaen

SYOSSET LANDFILL, Oyster Bay

VESTAL WATER SUPPLY WELL 1-1, VESTAL WATER SUPPLY WELL 4-2, (once one site), Vestal

WIDE BEACH DEVELOPMENT, Brant

YORK OIL CO., Moria

GENERAL MOTORS/CENTRAL FOUNDRY DIVISION, Massena

HUDSON RIVER PCBs, Hudson River

OH OHIO

ALLIED CHEMICAL & IRONTON COKE, Ironton

ARCANUM IRON & METAL, Darke County

OH OHIO - Continued

BIG D CAMPGROUND, Kingsville

BOWERS LANDFILL, Circleville

BUCKEYE RECLAMATION, St. Clairsville

CHEM-DYNE*, Hamilton

COSHOCTON LANDFILL, Franklin Township

E. H. SCHILLING LANDFILL, Hamilton Township

FIELDS BROOK, Ashtabula

FULTZ LANDFILL, Jackson Township

LASKIN/POPLAR OIL CO. (once listed as POPLAR OIL CO.), Jefferson Township

NEASE CHEMICAL, Salem

NEW LYME LANDFILL, New Lyme

OLD MILL (once listed as ROCK CREEK/JACK WEBB), Rock Creek

PRISTINE, INC., Reading

SKINNER LANDFILL, West Chester

SUMMIT NATIONAL, Deerfield Township

VAN DALE JUNKYARD^S, Marietta

ZANESVILLE WELL FIELD, Zanesville

MIAMI COUNTY INCINERATOR, Troy

POWELL ROAD LANDFILL, Dayton

SOUTH POINT PLANT, South Point

UNITED SCRAP LEAD CO., INC., Troy

OK OKLAHOMA

HARDAGE/CRINER, Criner

TAR CREEK (OTTAWA COUNTY), Ottawa County

COMPASS INDUSTRIES, Tulsa

SAND SPRINGS PETROCHEMICAL COMPLEX, Sand Springs

OR OREGON

GOULD, INC., Portland

TELEDYNE WAH CHANG (ALBANY), Albany

UNITED CHROME PRODUCTS, INC., Corvallis

PA PENNSYLVANIA

BLOSENSKI LANDFILL, West Caln Township

BRODHEAD CREEK, Stoudsburg

BRUIN LAGOON, Bruin Borough

CENTRE COUNTY KEPONE, State College Borough

CRAIG FARM DRUM, Parker

DOUGLASSVILLE DISPOSAL, Douglassville

DRAKE CHEMICAL, Lock Haven

ENTERPRISE AVENUE, Philadelphia

FISCHER & PORTER CO., Warminster

HAVERTOWN PCP, Haverford

HELEVA LANDFILL, North Whitehall Township

HRANICA LANDFILL, Buffalo Township

KIMBERTON, Kimberton Borough

LACKAWANNA REFUSE, Old Forge Borough

LEHIGH ELECTRIC & ENGINEERING CO., Old Forge Borough

LINDANE DUMP, Harrison Township

LORD-SHOPE LANDFILL, Girard Township

MALVERN TCE, Malvern

MCADOO ASSOCIATES*, McAdoo Borough/Kline Township

METAL BANKS, Philadelphia

MOYERS LANDFILL, Eagleville

OLD CITY OF YORK LANDFILL, Seven Valleys

OSBORNE LANDFILL, Grove City

PA PENNSYLVANIA - Continued

PALMERTON ZINC PILE, Palmerton

PRESQUE ISLE, Erie

RESIN DISPOSAL, Jefferson Borough

STANLEY KESSLER, King of Prussia

VOORTMAN FARM, Upper Saucon Township

WADE (ABM) (once listed as ABM-WADE), Chester

WESTLINE, Westline

BERKS SAND PIT, Longswamp Township

DORNEY ROAD LANDFILL, Upper Macungie Township

EAST MOUNT ZION, Springettsbury Township

HENDERSON ROAD, Upper Merion Township

MILL CREEK DUMP, Erie

INDUSTRIAL LANE, Williams Township

TAYLOR BOROUGH DUMP, Taylor Borough

TYSONS DUMP, Upper Merion Township

WALSH LANDFILL, Honeybrook Township

PR PUERTO RICO

BARCELONETA LANDFILL, Florida Afuera

FRONTERA CREEK, Rio Abajo

GE WIRING DEVICES, Juana Diaz

JUNCOS LANDFILL, Juncos

RCA DEL CARIBE, Barceloneta

FIBERS PUBLIC SUPPLY WELLS, Jobos

UPJOHN FACILITY, Barceloneta

VEGA ALTA PUBLIC SUPPLY WELLS, Vega Alta

RI RHODE ISLAND

DAVIS LIQUID WASTE, Smithfield

LANDFILL & RESOURCE RECOVERY, INC. (L & RR), North Smithfield

PETERSON-PURITAN, INC., Lincoln/Cumberland

PICILLO FARM*, Coventry

STAMINA MILLS, INC. (once listed as FORESTDALE-STAMINA MILLS, INC.), North Smithfield

WESTERN SAND & GRAVEL, Burrillville

SC SOUTH CAROLINA

CAROLAWN, INC., Fort Lawn

SCRDI BLUFF ROAD*, Columbia

SCRDI DIXIANA, Cayce

GEIGER (C & M OIL), Rantoules

INDEPENDENT NAIL CO., Beaufort

KALAMA SPECIALTY CHEMICALS, Beaufort

KOPPERS CO., INC. (FLORENCE PLANT), Florence

LEONARD CHEMICAL CO., INC., Rock Hill

PALMETTO WOOD PRESERVING, Dixianna

WAMCHEM, INC., Burton

SD SOUTH DAKOTA

WHITEWOOD CREEK*, Whitewood

TN TENNESSEE

AMNICOLA DUMP, Chattanooga

GALLAWAY PITS, Gallaway

LEWISBURG DUMP, Lewisburg

MURRAY-OHIO DUMP, Lawrenceburg

NORTH HOLLYWOOD DUMP*, Memphis

TN TENNESSEE - Continued

VELSICOL CHEMICAL CORP. (HARDEMAN COUNTY), Toone

TT TRUST TERRITORIES

PCB WASTES*, Trust Territory of the Pacific Islands

TX TEXAS

BIO-ECOLOGY SYSTEMS, INC., Grand Prairie

CRYSTAL CHEMICAL CO., Houston

FRENCH, LTD., Crosby

HARRIS (FARLEY STREET), Houston

HIGHLANDS ACID PIT, Highlands

MOTCO, INC.*, La Marque

SIKES DISPOSAL PITS, Crosby

TRIANGLE CHEMICAL CO., Bridge City

GENEVA INDUSTRIES (FUHRMANN ENERGY CORP.), Houston

PIG ROAD, New Waverly

UNITED CREOSOTING CO., Conroe

UT UTAH

ROSE PARK SLUDGE PIT*, Salt Lake City

VA VIRGINIA

CHISMAN CREEK, Vork County

MATTHEWS ELECTROPLATING*, Roanoke County

SALTVILLE WASTE DISPOSAL PONDS, Saltville

U.S. TITANIUM, Piney River

VI VIRGIN ISLANDS

VT VERMONT

OLD SPRINGFIELD LANDFILL, Springfield

PINE STREET CANAL*, Burlington

WA WASHINGTON

COLBERT LANDFILL, Colbert

COMMENCEMENT BAY, NEAR SHORE/TIDEFLATS, Pierce County

COMMENCEMENT BAY, SOUTH TACOMA CHANNEL, Tacoma

FMC CORP. (YAKIMA), Yakima

FRONTIER HARD CHROME, INC., Vancouver

HARBOR ISLAND (LEAD), Seattle

KAISER ALUMINUM (MEAD WORKS), Mead

LAKEWOOD, Lakewood

PESTICIDE LAB (YAKIMA), Yakima

WESTERN PROCESSING CO., INC., Kent

AMERICAN LAKE GARDENS, Tacoma

GREENACRES LANDFILL, Spokane County

QUEEN CITY FARMS, Maple Valley

ROSCH PROPERTY, Roy

WI WISCONSIN

CITY DISPOSAL CORP. ALNDFILL, Dunn

DELAVAN MUNICIPAL WELL NO. 4, Delavan

EAU CLAIRE MUNICIPAL WELL FIELD, Eau Claire City

JANESVILLE ASH BEDS, Janesville

JANESVILLE OLD LANDFILL, Janesville

KOHLER CO. LANDFILL, Sheboygan

LAUER I SANITARY LANDFILL, Menomonee Falls

LEMBERGER TRANSPORT & RECYCLING, INC., Franklin Township

WI WISCONSIN - Continued

MASTER DISPOSAL SERVICE, INC., LANDFILL, Brookfield

MID-STATE DISPOSAL, INC. LANDFILL, Cleveland Township

MOSS-AMERICAN (KER-MCGEE OIL CO.), Milwaukee

MUSKEGO SANITARY LANDFILL, Muskego

NORTHERN ENGRAVING CO., Sparta

OCONOMOWOC ELECTROPLATING CO., INC., Ashippin

OMEGA HILLS NORTH LANDFILL, Germantown

ONALASKA MUNICIPAL LANDFILL, Onalaska

SCHMALZ DUMP, Harrison

SCRAP PROCESSING CO., INC., Medford

WASTE RESEARCH & RECLAMATION CO., Eau Claire

WHEELER PIT, La Prairie Township

WV WEST VIRGINIA

FIKE CHEMICAL, INC., Nitro

FOLLANSBEE, Follansbee

LEETOWN PESTICIDE, Leetown

WEST VIRGINIA ORDANCE*, Point Pleasant

WY WYOMING

BAXTER/UNION PACIFIC TIE TREATING, Laramie

APPENDIX G
EPA HAZARDOUS MATERIALS LIST

Introduction

Under RCRA the EPA has specifically listed certain process, chemicals, and infectious vectors to be regulated. If a material is Flammable (F), Reactive (R), Toxic (T), Corrosive (C), or Infectious (I), it may be included under the original EPA hazardous waste classifications (see RCRA section of this manual).

Specific hazardous waste definitions and criteria are provided in the RCRA section of this manual.

A partial listing of hazardous and infectious EPA waste classifications are provided in this appendix. The waste numbers are needed to properly complete the required RCRA waste manifest system.

Care should be exercised by the generator for hazardous waste materials not specifically listed as they may be listed under State Environmental Legislation by future amendments to RCRA or by other Federal statutes.

APPENDIX G
EPA HAZARDOUS MATERIALS LIST

Extracted from RCRA - R 299.6308 Table 301a.
Rule 308. Table 301a reads as follows:

U.S. EPA Hazardous Waste Number	**Hazardous Waste From Nonspecific Sources**	**Hazard Code**
F001	The spent halogenated solvents used in degreasing, tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichlorethane, carbon tetrachloride, and the chlorinated fluorocarbons; and sludges from the recovery of these solvents in degreasing operations.	(T)
F002	The spent halogenated solvents, tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloroethane, 1,2,2-trifluoroethane, o-dichlorobenzene, trichlorofluoromethane and the still bottoms from the recovery of these solvents.	(T)
F003	The spent non-halogenated solvents, xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, n-butyl alcohol, cyclohexanone, and the still bottoms from the recovery of these solvents.	(I)
F004	The spent non-halogenated solvents, cresols and cresylic acid, nitrobenzene, and the still bottoms from the recovery of these solvents.	(T)
F005	The spent non-halogenated solvents, methanol, toluene, methyl ethyl ketone, methyl isobutyl ketone, carbon disulfide, isobutanol, pyridine and the still bottoms from the recovery of these solvents.	(I,T)
F006	Wastewater treatment sludges from electroplating operations.	(T)
F007	Spent plating bath solutions from electroplating operations.	(R,T)
F008	Plating bath sludges from the bottom of plating baths from electroplating operations.	(R,T)
F009	Spent stripping and cleaning bath solutions from electroplating operations.	(R,T)
F010	Quenching bath sludge from oil baths from metal heat treating operations.	(R,T)

P029	Copper cyanide
	Coumadin see P001
	Coumafen see P001
P030	Cyanides
P031	Cyanogen
P032	Cyanogen bromide
P033	Cyanogen chloride
	Cyclodan see P050
P034	2-Cyclohexyl-4, 6-dinitrophenol
P035	2, 4-Dichlorophenoxyacetic acid (2,4-D)
P036	Dichlorophenylarsine
	Dicyanogen see P031
P037	Dieldrin
P038	Diethylarsine
P039	0,0-Diethyl-S-(2-(ethylthio)-ester of phosphorothioic acid
P040	0,0-Diethyl-0-(2pyrazinyl) phosphorthioate
P041	0,0-Diethyl phosphoric acid, 0-p-nitrophenyl ester
P042	3,4-Dihydroxy-alpha-(methylamino)-methyl benzyl alcohol
P043	Di-iso-propylfluorophosphate
	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1.4.4a,5,8,8a-hexahydro endo, endo see P060
P044	Dimethoate
P045	3,3-Dimethyl-1-(methylthio)-2-buanone-0-((methylamino)carbonyl) oxime
P046	alpha,alpha-Dimethylphenethylamine
	Dinitrocyclohexylphenol see P034
P047	4,6-Dinitro-o-cresol & salts
P048	2,4-Dinitrophenol
	Dinoseb see P020
	Disulfoton see P039
P049	2,4-Dithiobiuret
	DNBP see P020
P050	Endosulfan
P051	Endrin
	Epinephrine see P042
P052	Ethylcyanide
P053	Ethylenediamine
P054	Ethyleneimine
P055	Ferric cyanide
P056	Fluorine
P057	2-Fluoroacetamide
P058	Fluoroacetic acid, sodium salt
	Fulminate of mercury see P065
P059	Heptachlor
P060	1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-endo,endo-dimethanonaphthalene
P060	1,4,5,6,7,7-Hexachloro-cyclic-5-norbornene-2,3-dimethanol sulfite see P050
P061	Hexachloropropene
P062	Hexaethyl tetraphosphate
	Hydrazomethane see P068
P063	Hydrocyanic acid
	Indomethacin see P025
	Isodrin see P060
P106	Sodium cyanide
	Sodium fluoroacetate see P056
	Sodium warfarin see P001
P107	Strontium sulfide
P108	Strychnine & salts
P109	Tetraethyldithiopyrophosphate
P110	Tetraethyl lead
P111	Tetraethylpyrophosphate
P112	Tetranitromethane
	Tetraphosphoric acid, hexaethylester see P062
P113	Thallic oxide
	Thallium peroxide see P113
P114	Thallium selenite
P115	Thallium (I) sulfate
P116	Thiosemicarbazide
	Thiosulfan tionel see P050
P117	Thiram (Thiuram)
P118	Trichloromethanethiol
P119	Vanadic acid, ammonium salt
P120	Vanadium pentoxide
	Warfarin sodium see P001
P121	Zinc cyanide
P122	Zinc phosphide (R,T)
U034	Chloral
U035	Chlorambucil
U036	Chlordane
U037	Chlorobenzene
U038	Chlorobenzilate
U039	p-Chloro-m-cresol
U040	Chlorodibromomethane
U041	1-Chloro-2,3-epoxypropane
U042	Chloroethyl vinyl ether
U043	Chloroethene
U044	Chloroform (I,T)
U045	Chloromethane (I,T)
U046	Chloromethyl methyl ether
U047	2-Chloronaphthalene
U048	2-Chlorophenol
U049	4-Chloro-o-toluidine hydrochloride
U050	Chrysene
	C.I. 23060 see U073
U051	Creosote
U052	Cresols

U053	Crotonaldehyde
U054	Cresylic acid
U055	Cumene
	Cyanomethane see U003
U056	Cyclohexane (I)
U057	Cyclohexanone (I)
U058	Cyclophosphamide
U059	Daunomycin
U060	DDD
U061	DDT
U062	Diallate
U063	Dibenz (a,h) anthracene
	Dibenzo (a,h) anthracene see U063
U064	Dibenzo (a,i) pyrene
U065	Dibromochloromethane
U066	1,2-Dibromo-3-chloropropane
U067	1,2-Dibromoethane
U068	Dibromomethane
U069	Di-n-butyl phthalate
U070	1,2-Dichlorobenzene
U071	1,3-Dichlorobenzene
U072	1,4-Dichlorobenzene
U073	3,3'-Dichlorobenzidine
U074	1,4-Dichloro-2-butene
	3,3'-Dichloro-4,4'-diaminobiphenyl see U073
U075	Dichlorodifluoromethane
U076	1,1-Dichloroethane
U077	1,2-Dichloroethane
U078	1,1-Dichloroethylene
U079	1,2-trans-Dichloroethylene
U129	Hexachlorocyclohexane
U130	Hexachlorocyclopentadiene
U131	Hexachloroethane
U132	Hexachlorophene
U133	Hydrazine (R,T)
U134	Hydrofluoric acid (C,T)
U135	Hydrogen sulfide
	Hydroxybenzene see U188
U136	Hydroxydimethyl arsine oxide
	4,4'-(Imidocarbonyl)bis(n,N-dimethyl) aniline see U014
U137	Indeno (1,2,3-cd)pyrene
U138	Iodomethane
U139	Iron Dextran
U140	Isobutyl alcohol
U141	Isosafrole
U142	Kepone
U143	Lasiocarpine
U144	Lead acetate
U145	Lead phosphate
U146	Lead subacetate
U147	Maleic anhydride
U148	Maleic hydrazide
U149	Malononitrile
	MEK Peroxide see U160
U150	Melphalan
U151	Mercury
U152	Methacrylonitrile
U153	Methanethiol
U154	Methanol
U155	Methapyrilene
	Methyl alcohol see U154
U156	Methyl chlorocarbonate
	Methyl chloroform see U226
U157	3-Methylcholanthrene
	Methyl chloroformate see U156
U158	4,4'-Methylene-bis-(2-chloroaniline)
U159	Methyl ethyl ketone (MEK) (I,T)
U160	Methyl ethyl ketone peroxide (R)
	Methyl iodide see U138
U161	Methyl isobutyl ketone
U162	Methyl methacrylate (R,T)
U163	N-Methyl-N'-nitro-N-nitrosoguanidine
U164	Methylthiouracil
	Mitomycin C see U010
U165	Naphthalene
U166	1,4-Naphthoquinone
U167	1-Naphthylamine
U168	2-Naphthylamine
U169	Nitrobenzene (I,T)
	Nitrobenzol see U169
U170	4-Nitrophenol
U171	2-Nitropropane (I)
U172	N-Nitrosodi-n-butylamine
U173	N-Nitrosodiethanolamine
U174	N-Nitrosodiethylamine
U225	Tribromomethane
U226	1,1,1-Trichloroethane
U227	1,1,2-Trichloroethane
U228	Trichloroethane
	Trichloroethylene see U228
U229	Trichlorofluoromethane
U230	2,4,5-Trichlorophenol
U231	2,4,6-Trichlorophenol
U232	2,4,5-Trichlorophenoxyacetic acid
U233	2,4,5-Trichlorophenoxypropionic acid
	alpha,alpha,alpha-Trichlorotoluene see U023
U234	Trinitrobenzene (R,T)
U235	Tris(2,3-dibromopropyl) Phosphate

U236	Trypan blue
U237	Uracil mustard
U238	Urethane
	Vinyl chloride see U043
	Vinylidene chloride see U078
U239	Xylene

046U	Cycloheximide
047U	Demeton
048U	2,4-Diaminoanisole sulfate
049U	4,4'-Diaminodiphenyl ether
050U	2,4-Diaminotoluene
051U	Diazinon
052U	Dichlone
053U	3,3'-Dichlorobenzidine salts
054U	Dichlorvos
055U	Dichrotophos
056U	Diethyl sulfate
057U	Dinocap
058U	Dioxathion
059U	EPN
060U	2,3-Epoxy-1-propanal
061U	Ethion
062U	Ethylene dibromide
063U	Fensulfothion
064U	Fenthion
065U	Fluchloralin
066U	2-(2-Formylhydrazino)-4-(5-nitro-2-furyl)-thiazole
067U	Heptachlor epoxide
068U	Hexamethyl phosphoramide
069U	Hydrazobenzene
070U	Hydroquinone
071U	N-(2-Hydroxyethyl) ethyleneimine
072U	Hypochlorite & compounds
073U	Isonicotinic acid hydrazine
074U	Ketene
075U	Lactonitril
076U	Leptophos
077U	Lithium & compounds
078U	Malachite green
079U	Malathion
080U	Mestranol
081U	Methoxychlor
082U	4,4'-Methylenebis(2-methylaniline)
083U	4,4'-Methylenebis(n,N-dimethylaniline)
084U	1,2(Methylenedioxy)-4-propenyl benzene
085U	Methyl mercaptan
086U	1-Methylnaphthalene
087U	2-Methyl-1-nitroanthraquinone
088U	Mevinphos
089U	Mexacarbate
090U	Mirex
091U	Monocrotaline
092U	Monocrotophos
093U	Mustard gas
094U	Naled
095U	1,5-Napthalenediamine
096U	Nickel & compounds

R 299.6315 Table 303.
Rule 315. Table 303. reads as follows:

EPA Hazardous Waste No.	U.S. EPA Hazardous Waste No.	Material	Extract Concentration (milligrams per liter)
	D004	Arsenic	5.0
	D005	Barium	100.0
	D006	Cadmium	1.0
001D		Copper	100.0
	D007	Chromium	5.0
002D		Cyanide(s)	20.0
	D008	Lead	5.0
	D009	Mercury	0.2
	D010	Selenium	1.0
	D011	Silver	5.0
003D		Zinc	500.0
	D012	Endrin (1,2,3,4,10,10-Hexachloro-1, 7-Epoxy-1,4,4a,5,6,7,8,8a Octahydro-1,4-endo,endo-5,8-dimethano naphthalene)	0.02
	D013	Lindane (1,2,3,4,5,6-hexachlorocyclohexane, Gamma isomer)	0.4
	D014	Methoxychlor (1,1,1-trichloro-2, 2-bis (p-methoxyphenyl)ethane)	10.0
	D015	Toxaphene ($C_{10}H_{10}CL_8$, Technical chlorinated Camphene, 67-69 per cent chloride	0.5
	D016	2,4-D(2,4-Dichlorophenoxy Acetic Acid)	10.0
	D017	2,4,5 TP Silvex (2,4,5-Trichlorophenoxypropionic Acid)	1.0

029M Tick-borne encephalitis virus complex, including Russian spring-summer encephalitis, Kyasanur forest disease, Omsk hemorragic fever and Central European encephalitis viruses.

030M Venzuelan equine encephalitis virus.

(e) All animal agents excluded from the United States

031M Virus of foot and mouth disease.
032M African horse sickness virus.
033M African swine fever virus.
034M Besnoitia besnoiti.
035M Borna disease virus.
036M Bovine infectious petechial fever.
037M Camel pox virus.
038M Ephemeral fever virus.
039M Fowl plague virus.
040M Goat pox virus.
041M Hog cholera virus.
042M Louping ill virus.
043M Lumpy skin disease virus.
044M Nairobi sheep disease virus.
045M Newcastle disease virus (Asiatic strains).
046M Mycoplasma mycoides (contagious bovine pleuro-pneumonia).
047M Mycoplasma agalactiae (contagious agalactia of sheep).
048M Rickettsia ruminatium (heart water).
049M Rift valley fever virus.
050M Sheep pox virus.
051M Swine vesicular disease virus.
052M Teschen disease virus.
053M Trypanosoma vivax (Nagana).
054M Theileria parva (East Coast fever).
055M Theileria annulata.
056M Theileria lawrencei.
057M Theileria bovis.
058M Theileria hiroi.
059M Vesicular exanthema virus.
060M Wesselsbron disease virus.
061M Zyonema farciminosum (pseudofarcy).
062M Rinderpest virus.

APPENDIX H
REFERENCES & TECHNICAL LITERATURE

(a) Metry, A. A., "The Handbock of Hazardous Waste Management," Westport, CT: Technomic Publishing Co. - 1980.

(b) Cross, F. L., "Management Primer on Water Pollution Control," Westport, CT: Technomic Publishing Co. - 1974.

(c) Parker, S. P. ed., "McGraw-Hill Encyclopedia of Environmental Science," New York: McGraw-Hill - 1980.

(d) "Toxic Substances Control Source Book," available from the Center for Professional Advancement, East Brunswick, NJ 08816.

(e) Lowrance, W. W., "Of Acceptable Risk: Science and the Determination of Safety," Los Angeles, CA: William Kaufmann, Inc. - 1976.

(f) MDNR - A List of Licensed Hazardous Waste Haulers, Hazardous Waste Division.

(g) Michigan Critical Materials Register; MDNR Hazardous Materials Division, Lansing, Michigan.

(h) NFPA Guide on Hazardous Materials; NFPA, 470 Atlantic Avenue, Boston, Massachusetts. 1983

(i) NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, Third Volume; U.S. Department HHS, Public Health Service CDC, USDOL USGPO NIOSH No. 81-123.

(j) NFPA, National Fire Codes 1983, Volume 16; NFPA Battanymarch Park, Quincy, Massachusetts 02269.

(k) Stoner, D. L. et. al., Engineering a Safe Hospital Environment.

(l) NIOSH Registry of Toxic Effects of Chemicals, Second Volume; NIOSH USHHS, CDC, Cincinnati, Ohio 45226.

(m) CDC, Lab Safety; CDC USHHS Public Health Service Co. CDC77-8118, Atlanta, Georgia 30333.

(n) ACGIH, TLV's Threshold Limit Value for Chemical Substances and Physical Agents in the Work Environment with Intended Changes 1983-84.

(o) NIOSH/OSHA Pocket Guide to Chemical Hazards; USD of HHS, PHS, CDC, NIOSH, NIOSH No. 78-210.

(p) National Research Council, Prudent Practices for Handling Hazardous Chemicals in Laboratories; National Academy Press, Washington, D.C., 1981.