NEW JERSEY HAZMAT EMERGENCY RESPONSE COURSE

LEVEL 2 HAZMAT TRAINING COURSE NUMBER: 06009

OPERATIONS

PRESENTED THROUGH:

NEW JERSEY STATE POLICE
HOMELAND SECURITY BRANCH, SPECIAL OPERATIONS SECTION
TECHNCIAL RESPONSE BUREAU
HAZARDOUS MATERIALS RESPONSE UNIT

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LEVEL 2 OPERATIONS

SURVIVING THE HAZARDOUS MATERIALS INCIDENT

PRE-TEST

(circle the most appropriate answer)

1. OSHA has defined the actions of "first responder-operations" (which would include firefighters, some police officers, emergency medical services personnel, and industrial spill teams) as:

   A. identifying the problem and plugging and patching the leak as necessary
   B. notifying more qualified responders and taking no action
   C. containing the spill and minimizing harm to people and environment
   D. contacting outside specialists and taking action only upon their arrival

2. The three preferred methods of protecting responders at hazmat incidents are:

   A. Level A, Level B, and Level C
   B. Time, Distance, and Shielding
   C. Inhalation, Ingestion, and Absorption
   D. Metering, Zones, and ICS

3. The ________________ is the temperature to which a material must be heated to produce enough vapor for sustained combustion.

   A. fire point B. flash point
   C. flammable ignition D. flammable range

4. The ________________ is the minimum temperature to which a liquid must be heated to produce a vapor flash if an ignition source is present.

   A. fire point B. flash point
   C. ignition temperature D. flammable range

5. A pan of oil, left on an electric range where there is heat but no apparent spark or flame, which suddenly bursts into flames is an example of:

   A. external ignition
   B. spontaneous ignition
   C. auto-ignition
   D. oxidizing ignition

6. Which emergency response guide (in the DOT guidebook) should be used when the material cannot be identified?

   A. Guide #111
   B. Guide #31
   C. Guide #1
   D. Guide #121

7. When attempting to control and extinguish a fire involving flammable hydrocarbon fuels that don't mix with water, the best agent to use is:

   A. any type of foam
   B. aqueous film forming foam (AFFF)
   C. mechanical foam
   D. chemical foam made of an aqueous solution of sodium bicarbonate, aluminum sulfate, and a stabilizer

8. Sodium metal is an example of which of the following hazard classes:

   A. Class 1, Division 1.1
   B. Class 2, Division 2.1
   C. Class 3, Division 3.2
   D. Class 4, Division 4.3

9. An MC 306 non-pressure liquid carrier, easily identified by its polished aluminum color and its elliptical shape, usually transports:

   A. alcohol, gasoline, fuel oils, combustible liquids
   B. flammable corrosives and poisons
   C. water
   D. cryogenic liquids

10. Pale, cool, moist skin, heavy sweating, dizziness, nausea, and fainting are signs and symptoms of:

    A. Heat rash B. Heat cramps
    C. Heatstroke D. Heat exhaustion

11. Liquid nitrogen would most likely be transported in what specification cargo tank?

    A. MC-331 B. MC-312
    C. MC-307 D. MC-338

12. While in transit, shipping papers must be kept:

    A. in the trailer with the cargo in a clearly labeled pouch that is accessible to emergency responders
    B. in the vehicle's cab in a properly labeled pouch on the passenger's door
    C. in the vehicle's cab in the sleeper berth
    D. in the vehicle's cab within reach of the driver while wearing a seat belt

13. A flammable material with a wide flammable range, such as acetylene, is than a material with a small flammable range.

    A. more difficult to ignite
    B. easier to ignite
    C. more difficult to control and extinguish
    D. easier to control and extinguish

14. The percentage of vapor needed in the air for combustion is called the explosive limit, and is also known as the:

    A. fire point
    B. flammable range
    C. flash point
    D. specific gravity range

15. Any liquid that spontaneously ignites in the air at or below 130°F is:

    A. a combustible liquid
    B. a flammable liquid
    C. a pyrophoric liquid
    D. a cryogenic liquid

LEVEL 2

FIRST RESPONDER OPERATIONS

MODULE 1

INTRODUCTION

Outline

- How the training modules were designed The role of the Operational responder Content of training
- Frequency of training References
- Using the Incident Command System

MODULE 1

INTRODUCTION

Objectives

The students will be able to:

1. Describe the modular nature of this course and the two ways that it can be presented.
2. Describe the role of the operational responder.
3. List the two sources that the course content was based on.
4. Describe the six competencies required by Federal OSHA and the seven competencies required by the National Fire Protection Association.
5. List the amount of initial and refresher training required by Federal OSHA.
6. Understand the community planning mechanisms existing in New Jersey.
7. Describe the elements of the Incident Command System.

FROM OSHA's FINAL RULE

29 C F R Part 1910.120

March 6, 1989

(q) Emergency response to hazardous substance releases.

(6) Training. Training shall be based on the duties and function to be performed by each responder of an emergency response organization. The skill and knowledge levels required for all new responders, those hired after the effective date of this standard, shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident. Employees who participate, or are expected to participate, in emergency response, shall be given training in accordance with the following paragraphs:

(i) First responder awareness level.
First responders at the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond notifying the authorities of the release. First responders at the awareness level shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

(A) An understanding of what hazardous materials are, and the risks associated with them in an incident.

(B) An understanding of the potential outcomes associated with an emergency created when hazardous materials are present.

(C) The ability to recognize the presence of hazardous materials in an emergency. (D)

The ability to identify the hazardous materials, if possible.

(E) An understanding of the role of the first responder awareness individual in the employer's emergency response plan including site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.

(F) The ability to realize the need for additional resources, and to make appropriate notifications to the communication center.

(ii) First responder operations level.
First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:

(A) Knowledge of the basic hazard and risk assessment techniques.

(B) Know how to select and use proper personal protective equipment provided to the first responder operational level.
(C) An understanding of basic hazardous materials terms.
(D) Know how to perform basic control, containment and/or confinement operations within the capabilities of the resources and personal protective equipment available within their unit.
(E) Know how to implement basic decontamination procedures.
(F) An understanding of the relevant standard operating procedures and termination procedures.

(8) Refresher training

(i) Those employees who are trained in accordance with paragraph (q)(6) of this section shall receive annual refresher training of sufficient content and duration to maintain their competencies, or shall demonstrate competency in those areas at least yearly.

(ii) A statement shall be made of the training or competency, and if a statement of competency is made, the employer shall keep a record of the methodology used to demonstrate competency.

Defensive

The act or actions taken during a hazardous material emergency/incident in which there is no intentional contact with the specific product.

It involves, but is not limited to:

☐ -elimination of ignition sources

☐ -vapor suppression

It requires notification and possible evacuation, but does not involve plugging, patching or cleanup of spilled or leaking materials.

Offensive

The action or actions taken by a hazardous materials technician/specialist, in appropriate chemical protective clothing, to handle an emergency/incident which may result in contact with the released material.

This involves, but is not limited to: patching or plugging to slow or stop a leak, containing of a material in its own container or package, and cleanup operations which may or may not require overpacking or transfer of a product to another container.

FROM NFPA 472
STANDARD FOR PROFESSIONAL COMPETENCE OF RESPONDERS TO HAZARDOUS MATERIALS INCIDENTS

Chapter 2-First Responder

2-1 General. First responders are divided into two levels of competency: first responder awareness and first responder operational. First responders at the awareness level shall be trained to meet all of the requirements of Section 2-2 of this chapter and first responders at the operational level shall be trained to meet all of the requirements of Section 2-2 and Section 2-3 of this chapter. All first responders shall receive training to meet federal Occupational Safety and Health Administration (OSHA) or Environmental Protection Agency (EPA) requirements, whichever is appropriate for their jurisdiction.

2-2 First Responder Awareness Level.

2-2.1 GOAL. The goal at the first responder awareness level shall be to provide those persons, who in the course of their normal duties may be the first on the scene of a hazardous materials incident, with the following competencies to respond in a safe manner when confronted with a hazardous materials incident. These personnel are not expected to take any actions other than to recognize that a hazard exists, call for trained personnel, and secure the area.

(a) An understanding of what hazardous materials are, and the risks associated with them in an incident;
(b) An understanding of the potential outcomes associated with an emergency created when hazardous materials are present;
(c) The ability to recognize the presence of hazardous materials in an emergency
(d) The ability to identify the hazardous materials and determine basic hazard and response information;
(e) An understanding of the role of the first responder on the scene of a hazardous materials incident as identified in the local contingency plan for hazardous materials incidents;
(f) The ability to recognize the need for additional resources and make appropriate notifications; and
(g) The ability to initiate scene management (i.e., implement the Incident Command System, isolate the immediate site, deny entry to unauthorized persons, and evacuate).

2-3 First Responder Operational Level.

2-3.1 Introduction. First responders at the operational level shall be trained to meet all competencies at the first responder awareness level and the competencies of this chapter. They shall also receive any additional training to meet applicable DOT, EPA, OSHA, and other state, local, or provincial occupational health and safety regulatory requirements.

2-3.2 Goal. The goal of the competencies at the operational level shall be to provide first responders, whose duties include responding to the scene of emergencies that may involve hazardous materials, with the knowledge and skills to perform these tasks safely, effectively and efficiently.

2-3.3 The first responder at the operational level shall be able to perform the following tasks:

1) Analyze a hazardous materials incident to determine the magnitude of the problem in terms of outcomes by completing the following tasks:
   - (a) Survey the hazardous materials incident to identify the containers and materials involved, determine whether hazardous materials have been released, and evaluate the surrounding conditions.
   - (b) Collect hazard and response information from MSDS; CHEMTREC/CANUTEC/ SETIQ; local, state and federal authorities; and shipper/manufacturer contacts.
   - (c) Predict the likely behavior of a material as well as its container.
   - (d) Estimate the potential harm at a hazardous materials incident.

(2) Plan an initial response within the capabilities and competencies of available personnel, personal protective equipment, and control equipment by completing the following tasks:
   - (a) Describe the response objectives for hazardous materials incidents.
   - (b) Describe the defensive options available for a given response objective.
   - (c) Determine whether the personal protective equipment provided is appropriate for implementing each defensive option.
   - (d) Identify the emergency decontamination procedures.

(3) Implement the planned response to favorably change the outcomes consistent with the local emergency response plan and the organization's standard operating procedures by completing the following tasks:
   - (a) Establish and enforce scene control procedures including control zones, emergency decontamination, and communications.
   - (b) Initiate an incident management system (IMS) for hazardous materials incidents.
   - (c) Don, work in, and doff personal protective equipment provided by the authority having jurisdiction.
   - (d) Perform defensive control functions identified in the plan of action.

(4) Evaluate the progress of the actions taken to ensure that the response objectives are being met safely, effectively, and efficiently by completing the following tasks:
   - (a) Evaluate the status of the defensive actions taken in accomplishing the response objectives.
   - (b) Communicate the status of the planned response.

2-4 Competencies-Analyzing the Incident.

2-4.1 Surveying the Hazardous Materials Incident. Given examples of both facility and transportation scenarios involving hazardous materials, the first responder at the operational level shall survey the incident to identify the containers and materials involved, determine whether hazardous materials have been released, and evaluate the surrounding conditions and also shall meet the requirements in 5.2.1.1 through 5.2.1.6.

2-4.2 Given three examples each of liquid, gas, and solid hazardous materials, including various hazard classes, the first responder at the operational level shall identify the general shapes of containers in which the hazardous materials are typically found.

(A) Given examples of the following tank cars, the first responder at the operational level shall identify each tank car by type as follows:

  (1) Cryogenic liquid tank cars

  (2) High-pressure tube cars

  (3) Non-pressure tank cars

  (4) Pneumatically unloaded hopper cars

  (5) Pressure tank cars

(B) Given examples of the following intermodal tanks, the first responder at the operational level shall identify each intermodal tank by type and identify at least one material and its hazard class that is typically found in each tank as follows:

  (1) Non-pressure intermodal tanks, such as the following:

    (a) IM-101 (IMO Type 1 internationally) portable tank

    (b) IM-102 (IMO Type 2 internationally) portable tank

  (2) Pressure intermodal tanks

  (3) Specialized intermodal tanks, such as the following:

    (a) Cryogenic intermodal tanks

    (b)Tube modules

(C) Given examples on the following cargo tanks, the first responder at the operational level shall identify each cargo tank by type as follows:

  (1) Nonpressure liquid tanks
  (2) Low pressure chemical tanks
  (3) Corrosive liquid tanks
  (4) High pressure tanks
  (5) Cryogenic liquid tanks
  (6) Dry bulk cargo tanks
  7) Compressed gas tube trailers

(D) Given examples of the following tanks, the first responder at the operational level shall identify at least one material, and its hazard, that is typically found in each tank as follows:

(1) Non-pressure tank

(2) Pressure tank

(3) Cryogenic liquid tank

(E) Given examples of the following non-bulk packages, the first responder at the operational level shall identify each package by type as follows:

(1) Bags
(2) Carboys
(3) Cylinders
(4) Drums

(F) Given examples of the following radioactive material containers, the first responder at the operational level shall identify each container/package by type as follows:
(1) Type A

(2) Type B

(3) Industrial

(4) Excepted

(5) Strong, tight containers

2-4.3 Given examples of facility and transportation containers, the first responder at the operational level shall identify the markings that differentiate one container from another.

(A) Given examples of the following marked transport vehicles and their corresponding shipping papers, the first responder at the operational level shall identify the vehicle or tank identification marking as follows:

(1) Rail transport vehicles, including tank cars
(2) Intermodal equipment including tank containers
(3) Highway transport vehicles, including cargo tanks

(B) Given examples of facility containers, the first responder at the operational level shall identify the markings indicating container size, product contained, and/or site identification numbers.

2-4.4 Given examples of facility and transportation situations involving hazardous materials, the first responder at the operational level shall identify the name(s) of the hazardous material(s) in each situation.

(A) The first responder at the operational level shall identify the following information on a pipeline marker:

(1) Product
(2) Owner
(3) Emergency telephone number

(B) Given a pesticide label, the first responder at the operational level shall identify each of the following pieces of information, then match the piece of information to its significance in surveying the hazardous materials incident:

(1) Name of pesticide
(2) Signal word
(3) Pest control product (PCP) number (in Canada)
(4) Precautionary statement
(5) Hazard statement
(6) Active ingredient

(C) Given a label for a radioactive material, the first responder at the operational level shall identify vertical bars, contents, activity, and transport index.

2-4.5 The first responder at the operational level shall identify and list the surrounding conditions that should be noted by the first responders when surveying hazardous materials incidents.

2-4.6 The first responder at the operational level shall give examples of ways to verify information obtained from the survey of a hazardous materials incident.
2-4.7 The first responder at the operational level shall identify at least three additional hazards that could be associated with an incident involving criminal or terrorist activity.

2-4.8 Collective Hazard and Response Information. Given known hazardous materials, the first responder at the operational level shall collect hazard and response information using MSDS; CHEMTREC/CANUTEC/ SETIQ; local, state, and federal authorities; and contacts with the shipper/manufacturer, and also shall meet the following requirements:

(1) Match the definitions associated with the UN/DOT hazard classes and divisions of hazardous materials, including refrigerated liquefied gases and cryogenic liquids, with the class or division.

(2) Identify two ways to obtain an MSDS in an emergency.

(3) Using an MSDS for a specified material, identify the following hazard and response information:

  (a) Physical and chemical characteristics
  (b) Physical hazards of the material
  (c) Health hazards of the material
  (d) Signs and symptoms of exposure
  (e) Routes of entry
  (f) Permissible exposure limits
  (g) Responsible party contact
  (h) Precautions for safe handling (including hygiene practices, protective measures, procedures for cleanup of spills or leaks)
  (i) Applicable control measures including personal protective equipment

(j) Emergency and first-aid procedures

(4) Identify the following:

(a) Type of assistance provided by CHEMTREC/CANUTEC/ SETIQ and local, state, and federal authorities
(b) Procedure for contacting CHEMTREC/CANUTEC/SETIQ and local, state, and federal authorities
(c) Information to be furnished to CHEMTREC/CANUTEC/ SETIQ and local, state, and federal authorities.

(5) Identify two methods of contacting the manufacturer or shipper to obtain hazard and response information.
(6) Identify the type of assistance provided by local, state, and federal authorities with respect to criminal or terrorist activities involving hazardous materials.
(7) Identify the procedure for contacting local, state, and federal authorities as specified in the local emergency response plan (ERP) or the organization's standard operating procedures.
(8) Describe the properties and characteristics of the following:
(a) Alpha particles
(b) Beta particles
(c) Gamma rays
(d) Neutrons

2-4.9 Predicting the Behavior of a Material and its Container. Given an incident involving a single hazardous material, the first responder at the operational level shall predict the likely behavior of the material and its container and also shall meet the following requirements:

(1) Given two examples of scenarios involving known hazardous materials, interpret the hazard and response information obtained from the current edition of the *Emergency Response Guidebook;* MSDS; CHEMTREC/CANUTEC/SETIQ; local, state, and federal authorities; and shipper/manufacturer contacts as follows:

(a) Match the following chemical and physical properties with their significance and impact on the behavior of the container and/or its contents:

i. Boiling point

ii. Chemical reactivity iii. Corrosivity (pH)

iv. Flammable (explosive) range (LEL and UEL) v. Flash point

vi. Ignition (autoignition) temperature vii. Physical state (solid, liquid, gas) viii. Specific gravity

ix. Toxic products of combustion x. Vapor density

xi. Vapor pressure xii. Water solubility

xiii. Radiation (ionizing and non-ionizing)

(b) Identify the differences between the following pairs of terms:

i. Exposure and hazard
ii. Exposure and contamination

iii. Contamination and secondary contamination

iv. Radioactive material exposure (internal and external) and radioactive contamination

(2)* Identify three types of stress that could cause a container system to release its contents.
(3)" Identify five ways in which containers can breach.

(4)* Identify four ways in which containers can release their contents.

(5)" Identify at least four dispersion patterns that can be created upon release of a hazardous material.
(6)" Identify the three general time frames for predicting the length of time that exposures can be in contact with hazardous materials in an endangered area.
(7)* Identify the health and physical hazards that could cause harm.
(8)" Identify the health hazards associated with the following terms:
  (a) Asphyxiant
  (b)* Chronic health hazard
  (c) Convulsant
  (d) Irritant/corrosive
  (e) Sensitizer/allergen
  (f) Alpha, beta, gamma, and neutron radiation

(9)" Given the following types of warfare agents, identify the corresponding UN/DOT hazard class and division:
  (a) Nerve agents
  (b) Vesicants (blister agents)
  (c) Blood agents
  (d) Choking agents
  (e) Irritants (riot control agents)
  (f) Biological agents and toxins

2-4.10 Estimating the Potential Harm. The first responder at the operational level shall estimate the potential harm within the endangered area at a hazardous materials incident and also shall meet the following requirements:
(1) Identify a resource for determining the size of an endangered area of a hazardous materials incident.
(2) Given the dimensions of the endangered area and the surrounding conditions at a hazardous materials incident, estimate the number and type of exposures within that endangered area.
(3) Identify resources available for determining the concentrations of a released hazardous material within an endangered area.
(4)" Given the concentrations of the released material, identify the factors for determining the extent of physical, health, and safety hazards within the endangered area of a hazardous materials incident.
(5) Describe the impact that time, distance, and shielding have on exposure to radioactive materials specific to the expected dose rate.
(6) Describe the prioritization of emergency medical care and removal of victims from the hazard area relative to exposure and contamination concerns.

2-5 Competencies-Planning the Response.

2-5.1 Describing Response Objectives for Hazardous Materials Incidents. Given at least two scenarios involving hazardous materials incidents (one facility and one transportation), the first responder at the operational level shall describe the first responder's response objectives for each problem and also shall meet the following requirements:

(1) Given an analysis of a hazardous materials problem and the exposures already lost, identify the steps for determining the number of exposures that could be saved by the first responder with the resources provided by the authority having jurisdiction and operating in a defensive fashion.
(2) Given an analysis of a hazardous materials incident, describe the steps for determining defensive response objectives.
(3) Describe how to assess the risk to a responder for each hazard class in rescuing injured persons at a hazardous materials incident.

2-5.2 Identifying Defensive Options. Given simulated facility and transportation hazardous materials problems, the first responder at the operational level shall identify the defensive options for each response objective and shall meet the following requirements:

1. Identify the defensive options to accomplish a given response objective.

2. Identify the purpose for, and the procedures, equipment, and safety precautions used with, each of the following control techniques:

(a) Absorption	(b) Dike, dam, diversion, retention
(c) Dilution	(d) Remote valve shutoff
(e) Vapor dispersion	(f) Vapor suppression

2-5.3 Determining Appropriateness of Personal Protective Equipment. Given the name of the hazardous material involved and the anticipated type of exposure, the first responder at the operational level shall determine whether available personal protective equipment is appropriate for implementing a defensive option and also shall meet the following requirements:

(1)* Identify the respiratory protection required for a given defensive option and the following:
  (a) Identify the three types of respiratory protection and the advantages and limitations presented by the use of each at hazardous materials incidents.
  (b) Identify the required physical capabilities and limitations of personnel working in positive pressure self-contained breathing apparatus.

(2) Identify the personal protective clothing required for a given defensive option and the following:
  (a) Identify skin contact hazards encountered at hazardous materials incidents.
  (b) Identify the purpose, advantages, and limitations of the following levels of protective clothing at hazardous materials incidents:
    i. Structural fire-fighting protective clothing
    ii. High temperature-protective clothing
    iii. Chemical-protective clothing
    iv. Liquid splash-protective clothing
    v. Vapor-protective clothing

2-5.4 Identifying Emergency Decontamination Procedures. The first responder at the operational level shall identify emergency decontamination procedures and shall meet the following requirements:

(1) Identify ways that personnel, personal protective equipment, apparatus, tools, and equipment become contaminated.
(2) Describe how the potential for secondary contamination determines the need for emergency decontamination procedures.
(3) Identify the purpose of emergency decontamination procedures at hazardous materials incidents.
(4) Identify the advantages and limitations of emergency decontamination procedures.
(5) Describe the procedure listed in the local emergency response plan or the organization's standard operating procedures for decontamination of a large number of people exposed to hazardous materials.
(6) Describe procedures, such as those listed in the local emergency response plan or the organization's standard operating procedures, to preserve evidence at hazardous materials incidents involving suspected criminal or terrorist acts.

2-6 Competencies-Implementing the Planned Response.

2-6.1 Establishing and Enforcing Scene Control Procedures. Given scenarios for facility and/or transportation hazardous materials incidents, the first responder at the operational level shall identify how to establish and enforce scene control including control zones, emergency decontamination, and communications and shall meet the following requirements:

(1) Identify the procedures for establishing scene control through control zones.

(2) Identify the criteria for determining the locations of the control zones at hazardous materials incidents.
(3) Identify the basic techniques for the following protective actions at hazardous materials incidents:

  (a) Evacuation
  (b) Sheltering in-place protection

(4) Identify the considerations associated with locating emergency decontamination areas.
(5)* Demonstrate the ability to perform emergency decontamination.
(6)* Identify the items to be considered in a safety briefing prior to allowing personnel to work at the following:
  (a) Hazardous materials incident
  (b)* Hazardous materials incident involving criminal or terrorist activities

2-6.2 Initiating the Incident Management System. Given simulated facility and/or transportation hazardous materials incidents, the first responder at the operational level shall initiate the incident management system specified in the local emergency response plan and the organization's standard operating procedures and shall meet the following related requirements:

(1) Identify the role of the first responder at the operational level during hazardous materials incidents as specified in the local emergency response plan and the organization's standard operating procedures.
(2) Identify the levels of hazardous materials incidents as defined in the local emergency response plan.
(3) Identify the purpose, need, benefits, and elements of an incident management system at hazardous materials incidents.

(4) Identify the considerations for determining the location of the command post for a hazardous materials incident.
(5) Identify the procedures for requesting additional resources at a hazardous materials incident.
(6)* Identify the authority and responsibilities of the safety officer.

2-6.3 Using Personal Protective Equipment. The first responder at the operational level shall demonstrate the ability to don, work in, and doff the personal protective equipment provided by the authority having jurisdiction, and shall meet the following relating requirements:

(1) Identify the importance of the buddy system in implementing the planned defensive options.
(2) Identify the importance of the backup personnel in implementing the planned defensive options.
(3) Identify the safety precautions to be observed when approaching and working at hazardous materials incidents.
(4) Identify the symptoms of heat and cold stress.
(5) Identify the physical capabilities required for, and the limitations of, personnel working in the personal protective equipment as provided by the authority having jurisdiction. (6) Match the function of the operational components of the positive pressure self-contained breathing apparatus provided to the hazardous materials responder with the name of the component.
(7) Identify the procedures for cleaning, disinfecting, and inspecting respiratory protective equipment.
(8) Identify the procedures for donning, working in, and doffing positive pressure self-contained breathing apparatus.
(9) Demonstrate donning, working in, and doffing positive pressure self-contained breathing apparatus.

2-6.4 Performing Defensive Control Actions. Given a plan of action for a hazardous materials incident within their capabilities, the first responder at the operational level shall demonstrate defensive control actions set out in the plan and shall meet the following related requirements:

(1) Using the type of fire-fighting foam or vapor suppressing agent and foam equipment furnished by the authority having jurisdiction, demonstrate the effective application of the fire-fighting foam(s) or vapor suppressing agent(s) on a spill or fire involving hazardous materials.
(2) Identify the characteristics and applicability of the following foams:
    (a) Protein
    (b) Fluoroprotein
    (c) Special purpose

        i. Polar solvent alcohol-resistant concentrates
        ii. Hazardous materials concentrates

(d) Aqueous film-forming foam (AFFF)

(e) High expansion

(3) Given the required tools and equipment, demonstrate how to perform the following defensive control activities:
    (a) Absorption
    (b) Damming
    (c) Diking
    (d) Dilution
    (e) Diversion
    (f) Retention

(g) Vapor dispersion
(h) Vapor suppression

(4) Identify the location and describe the use of the mechanical, hydraulic, and air emergency remote shutoff devices as found on cargo tanks.
(5) Describe the objectives and dangers of search and rescue missions at hazardous materials incidents.

(6) Describe methods for controlling the spread of contamination to limit impacts of radioactive materials.

2-7 Competencies-Evaluating Progress.

2-7.1 Evaluating the Status of Defensive Actions. Given simulated facility and/or transportation hazardous materials incidents, the first responder at the operational level shall evaluate the status of the defensive actions taken in accomplishing the response objectives and shall meet the following related requirements:

(1) Identify the considerations for evaluating whether defensive options are effective in accomplishing the objectives.
(2) Describe the circumstances under which it would be prudent to withdraw from a hazardous materials incident.

2-7.2 Communicating the Status of the Planned Response. The first responder at the operational level shall communicate the status of the planned response to the incident commander and other response personnel and shall meet the following related requirements:

(1) Identify the methods for communicating the status of the planned response to the incident commander through the normal chain of command.

(2) Identify the methods for immediate notification of the incident commander and other response personnel about critical emergency conditions at the incident.

COMMUNITY PLANNING

As an emergency responder you should be aware of the community planning mechanisms that exist in New Jersey. Through State law (The Emergency Management Act, NJSA App. A:9-30, et seq.) a statewide emergency management system has been created. Each municipality and County has an Office of Emergency Management as well as the state. This office, headed by an appointed Coordinator, is responsible for preparing an Emergency Operations Plan (EOP). This plan, utilizing standards established by the Federal Emergency Management Agency (FEMA) and New Jersey Office of Emergency Management (NJOEM), provides the operational guideline and foundation for municipal/county emergency planning and response to large scale emergencies. It outlines how a state of emergency may be declared, and under what rules the jurisdiction operates during an emergency. All 566 municipalities and 21 counties in New Jersey must by law have a completed and current EOP

The local Office of Emergency Management (OEM) is also responsible for coordinating the Local Emergency Planning Committee (LEPC). This committee, first required for community hazmat planning under SARA Title III in 1986, is responsible for preparing and reviewing the municipal EOP Its membership must include representatives of the community's emergency response organizations, public health system, elected officials, media, general public and local chemical industry. Meeting on a regular basis, this committee is intended to bring diverse perspectives to the community planning process in an effort to identify specific planning needs, ensure the coordination of resources and promote the establishment of effective communications links within the community's response network.

Emergency responders from all agencies should be aware of the OEM system in their community. They play a key role in coordination of resources, management of mutual aid requests, and support of emergency operations through the management and implementation of community wide plans.

INCIDENT COMMAND SYSTEM (ICS)

Although many systems exist throughout the nation for the command and control of resources at emergency incidents, the National Fire Academy has adopted the Incident Command System (ICS) as its base for teaching the concepts of incident command. The ICS is recognized by the Academy as a system that is documented and has been successfully used in managing available resources at emergency operations.

The system consists of procedures for controlling personnel, facilities, equipment, and communications.

It is designed to begin developing from the time an incident occurs until the requirement for management and operations no longer exists. The "Incident Commander" is a title which can apply equally to an engine company captain, or the chief of a police department, depending upon the situation. The structure of the ICS can be established and expanded depending upon the changing conditions of the incident. It is intended to be staffed and operated by qualified personnel from any emergency services agency and may involve personnel from a variety of agencies.

As such, the system can be utilized for any type or size of emergency, ranging from a minor incident involving a single unit, to major emergency involving several agencies. The ICS allows agencies to communicate using common terminology and operating procedures. It also allows for the timely combining of resources during an emergency.

The ICS is designed to be used in response to emergencies caused by fires, floods, earthquakes, hurricanes, riots, hazardous materials, or other natural or human-caused incidents.

PRIMARY FEATURES OF THE INCIDENT COMMAND SYSTEM

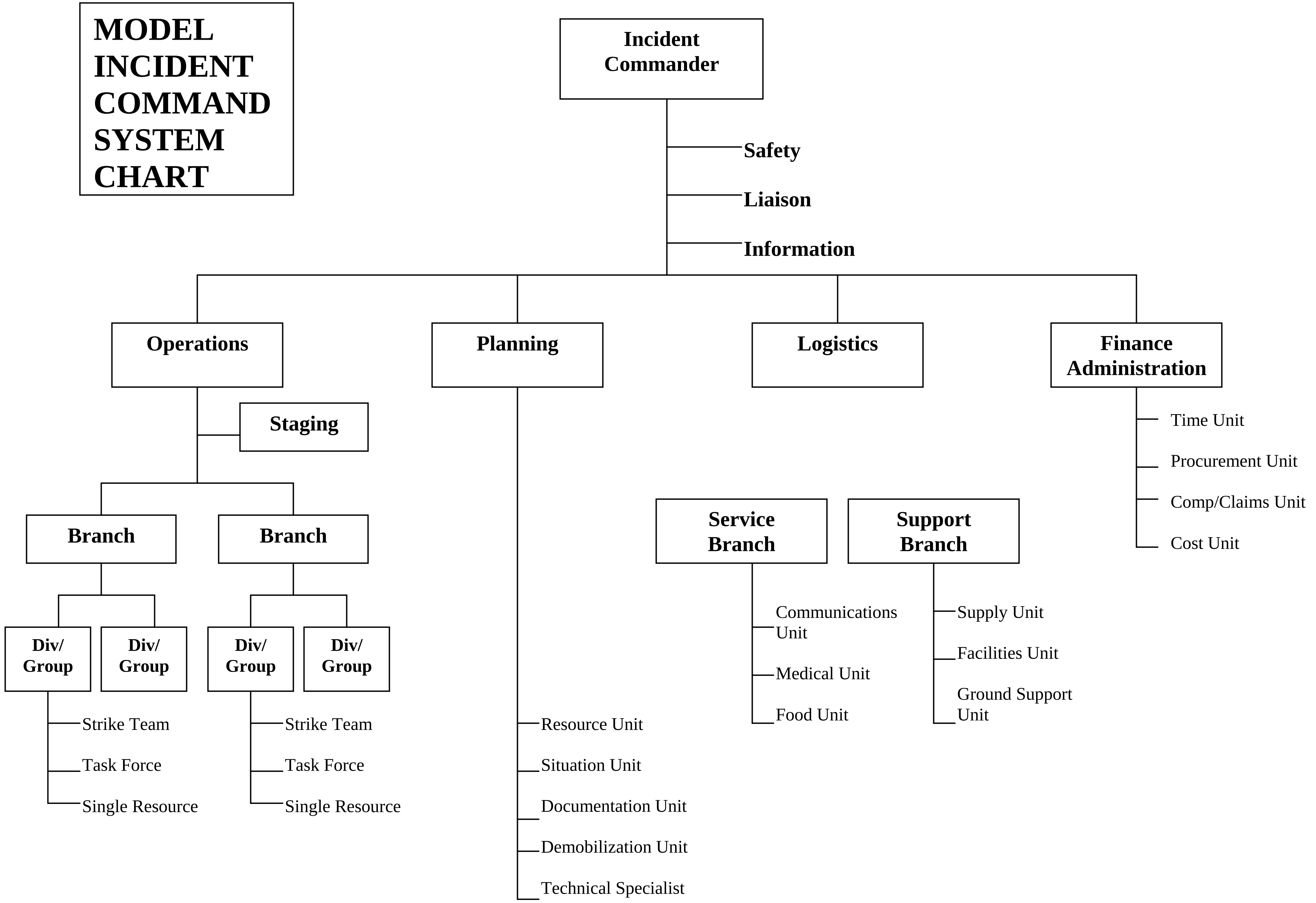
- Adaptability
- Flexibility
- Span of Control
- Unity of Command

ORGANIZATION AND OPERATION

The ICS has five major functional areas:

Command:	Command function manages the incident including establishing strategic goals, and ordering and releasing resources (personnel and equipment). Note: Command also has responsibility for the other four functions until and if they are delegated.
Operations:	Operations function directs all incident tactical resources to accomplish the goals and objectives developed by command. Operations assures that the personnel and *equipment* at the scene are used to perform effective mitigation.
Planning:	Planning is responsible for the collection and evaluation of information important to the incident. This then leads to the development of action plan. Planning is ongoing.
Logistics:	The logistics function provides the services and supplies needed to support the tactical operations. It may be a simple function such as arranging for refueling of vehicles or as complicated as feeding hundreds of people.
Finance/Admin	Purchasing, renting equipment deemed necessary on-site, keeping Administration: records on overtime on more complex larger operations.

MODEL INCIDENT COMMAND SYSTEM CHART



MODULE 2

ANALYZING THE INCIDENT

BASIC CHEMISTRY

Outline

☐ **Basic classes of hazardous substances:**

☐ **Functional classification of hazardous materials**

☐ **Physical properties (NFPA 472)**

☐ **How to read a DOH HSFS or an MSDS**

A. Finding physical properties of a substance

B. Finding the specific hazard associated with a substance

☐ **Radioactivity**

MODULE 2

ANALYZING THE INCIDENT

BASIC CHEMISTRY

Objectives

The students will be able to:

1. Define the following eight basic chemical and physical properties:
   -boiling point
   -ignition (autoignition) temp
   -vapor density
   -flash point
   -flammable (explosive) limits
   -specific gravity
   -vapor pressure -water solubility
2. Use knowledge of physical properties to determine the actions of a material in a haz mat incident given a specific incident.
3. Differentiate among alpha, beta, and gamma particles and rays on the basis of their penetration and the protection required to deal with them.
4. Define the following terms:
   -radioactive contamination
   -half-life
   -radioactive exposure
5. Describe how time, distance, and shielding can affect exposure to radioactive contaminants.

HAZARDOUS SUBSTANCES:

Functional Classification:

Effectively; hazardous materials will either blow you up, burn you, asphyxiate you, infect you, irradiate you, poison you, or freeze you.

Explosives are materials like nitrates used in the manufacture of fertilizers, TNT, or blasting caps. They are all materials that undergo a very rapid chemical transformation. This rapid reaction produces a dangerous shock wave. The terms high or low explosive do not indicate the severity of the hazard you face. These terms only indicate the speed of the flame front in the material. High or detonating explosives have detonation rates as high as four miles per second. They can be sub-divided into primary and secondary high explosives.

Primary high explosives may be detonated by shock, heat, or friction. Examples are lead azide and mercury fulminate.

Secondary high explosives usually require a booster for detonation and are relatively insensitive to shock, heat, and friction. Examples are TNT and dynamite.

Low or deflagrating explosives have slower detonation rates; 1000 feet per second or less. Examples are smokeless powder (for firearms) and magnesium.

Flammable substances include organic solvents, finely divided metals and powders, some classes of fibers, textiles, or plastics, and chemicals that evolve or absorb oxygen during storage (oxidizers) and constitute a fire hazard. Materials in which dangerous heat buildup occurs during storage. The heat buildup occurs as a result of either oxidation or microbial action. Examples are fish meal, wet waste papers, and other organic waste material.

Oxidizers (such as hydrogen peroxide) release oxygen and produce heat on contact with organic substances thus constituting a fire hazard. Organic peroxides are a combination of oxidizer and organic substance; they may burst into flame upon exposure to air or light.

Asphyxiants are materials that deprive body tissue of oxygen. Their action can be simple or chemical. Simple asphyxiants act by displacing oxygen in the air that you breathe causing oxygen starvation. This can cause headache, unconsciousness, and eventual death. Chemical asphyxiants cause death by affecting your body's ability to use the oxygen in the air you breathe. Some, like carbon monoxide prevent the transport of oxygen in the bloodstream by binding strongly with hemoglobin. Other materials act by preventing the transfer of oxygen from the bloodstream to body tissues; like hydrogen cyanide.

Toxic (poisonous) substances are drugs, chemicals, and natural or synthetic products that are in any way harmful to life or health. The effects range from skin irritations thru death. Some terms that you should be familiar with when discussing toxic materials are:

Toxicity-This is a measure of how harmful a material is. Toxicity is usually measured by the LD_{50} or LC_{50} (the amount of material required to kill half of a population of lab animals) of a substance.

Acute/chronic effects-Acute effects happen almost immediately upon exposure. Chronic effects take days, weeks, or even years to develop and are usually the result of long-term low-level exposures.

Local/systemic effects-Local effects occur at the site of exposure (if you spill lye on your hand, your hand will be burned) systemic effects occur at an organ of the body that was not directly exposed (if you inhale large amounts of benzene over time, your lungs have been directly exposed but your kidneys will develop the problem; cancer).

Carcinogens are those substances that cause cancer.

Mutagens are materials that cause genetic changes in the cells of your gonads (sperm or eggs) that can be passed on to any children you have after the exposure. Mutations can also be precursors of cancer.

Teratogens are substances that cause damage to a developing fetus (unborn child) but do not affect any future pregnancies.

Biological hazards or etiologic agents are living germs and viruses (or the toxins they produce) that can cause human disease. You are aware that you might encounter etiologic agents when dealing with incidents that involve hospital wastes but remember: the dog that lives on the site of a hazardous materials incident is also a biological hazard.

Radioactive substances are materials that emit ionizing radiation.

Corrosive substances can be either acids or bases (caustics). They are materials that burn or otherwise damage body tissue, metals, plastics or other materials as a result of contact. Examples are sodium hydroxide (lye) and sulfuric acid. The acidity or basicity of a substance is measured by pH. The pH scale runs from 0 to 14; 7 is neutral (neither acidic nor basic); numbers less than 7 are acidic; and numbers higher than 7 are basic.

Cryogenic substances are extremely cold materials like liquid oxygen or nitrogen. They have temperatures below -130 degrees F (USDOT)

PHYSICAL PROPERTIES OF HAZARDOUS SUBSTANCES:

Density-is the mass per unit volume of a substance. It is usually expressed as grams per cubic centimeter (g/cc). The density of water is 1 g/cc since 1 cc of water has a mass of 1 g.

Specific gravity-The ratio of the density of a solid or liquid to the density of water. This number tells you whether the material floats or sinks in water. A number greater than 1 indicates that the substance sinks; numbers less than 1 indicate that the substance floats. Knowing if the substance sinks or floats in water will determine your containment strategy; use booms on floating materials in a body of water and dike sinking materials.

Vapor density (VD)-The relative density of a vapor compared to air. A vapor with a VD of less than 1 is "lighter than air" and will rise. Vapors with densities greater than 1 will drop and collect in low-lying areas and pockets. Again, whether a material sinks or rises will affect your incident control strategy.

Vapor pressure-A measure of how readily a solid or liquid mixes with air at its surface. Higher VPs (approaching 760mm Hg) indicates a volatile substance and suggests that there will be high concentrations in the air at an incident involving that substance. Vapor pressures above 760mm Hg indicate a material that is normally a gas. Vapor pressure generally increases as a substance is heated.

Boiling point (BP)-The temperature at which the vapor pressure of the material being heated equals atmospheric pressure. Attaining the boiling point is just a specific case of dealing with vapor pressure.

Flammable (explosive) limits-The highest and lowest concentrations of a substance that can explode or burn. The upper explosive limit (UEL) is the richest mixture of a substance that can explode (any richer and there is not enough oxygen) while the lower explosive limit (LEL) is the most lean (any leaner and there is not enough of the substance). The LEL is measured with a Combustible Gas Indicator (CGI). Generally, an area must be evacuated if the CGI reads 10% of the LEL.

Flash point (FP)-The lowest temperature at which the vapor given off by a substance forms an ignitable mixture with air. This is only a flash, not a self-sustained fire. As a general rule of thumb, the lower the FP the more volatile the substance.

Ignition temperature-(Also called AUTOIGNITION TEMPERATURE). The minimum temperature required to initiate self-sustained combustion of a material or compound.

Water solubility-The degree to which a material or its vapors dissolve in water. Materials that readily dissolve are described as "miscible." The solubility of a substance will affect your situation control strategy; if a substance is miscible in water, all the runoff water from a hazardous materials incident site may have to be dike and retained for decontamination or proper disposal.

EXAMPLES OF PHYSICAL PROPERTIES OF CHEMICALS

FLASH POINT

KEROSENE 100 DEGREES F. GASOLINE -45 DEGREES F ACETONE 0 DEGREES F.
DIESEL FUEL 125 DEGREES F

FLAMMABLE RANGE

GASOLINE	1.3 – 7.6 FR=6.3%	CARBON DISULFIDE	1.3 – 50.0 FR = 38.7%
METHANE	5.0- 15.0 FR=10%	HYDROGEN	4.0-75.0FR=71%

AUTO IGNITION POINT

GASOLINE	536 DEGREES F.	CARBON DISULFIDE 194 DEGREES F.
ISOPROPYL ALCOHOL	750 DEG. F.	

VAPOR PRESSURE

AT 68 DEGREES F BUTYL ACETATE-10 ACETONE-220 PENTANE-426 CHLORINE-4,800

PRESSURE INCREASES AS TEMPERATURE RISES
WATER AT 52 DEGREES IS 10; AT 93 DEGREES IS 40, AT 176 DEGREES; AT 212 DEGREES IS 760

BOILIING POINT

WATER = 212 DEG F. TRICHLOROETHANE = 170 DEG LEAD= 3,183DEG. F.

VAPOR DENSITY

LOW TEMPERATURE = INCREASE VAPOR DENSITY HIGH TEMPERATURE = DECREASE VAPOR DENSITY

LOW HUMIDITY = DECREASE VAPOR DENSITY HIGH HUMIDITY = INCREASE DENSITY
GREATER THAN 1 = SETTLE IN LOWEST AVAILABLE SPACE LESS THAN 1 = MATERIAL WILL RISE
IF CLOSE TO SURROUNDING AIR DENSITY = WILL DISPERSE IN ATMOSPHERE
GASOLINE = 3.0-4.0 CHLORINE = 2.5 ETHYLENE = 1.0 METHANE =.55 HYDROGEN = 0.1

SPECIFIC GRAVITY

SOLUBILITY- DEGRESS IN WHICH A SUBSTANCE IS CAPABLE OF MIXING WITH WATER WITH NO OBSERVABLE PHASE SEPARATION. Tendency for a chemical to dissolve evenly in a liquid.
MISCIBLE = MATERIALS WHICH READILY DISSOLVE
IMMISCIBLE = MATERIALS THAT DO NOT DISSOLVE

CHEMICAL	SOLUBLE IN WATER	SPECIFIC GRAVITY	BEHAVIOR IN WATER
GASOLINE	NO	0.7	FLOATS
TRICHLOROETHANE	NO	1.3	SINKS
SULFURIC ACID	YES	1.8	DISSOLVES

pH REPRESENTS A TENFOLD INCREASE IN ACID OR BASE CONCENTRATION RELATIVE TO PURE WATER.
NEUTRALIZING IS A CHEMICAL REACTION IN WHICH WATER IS FORMED BY MUTUAL DESTRUCTION OF IONS. NEUTRALIZING DOES NOT MEAN ATTAINING A pH OF 7.0

TOXICOLOGY

LD_{50}	Dose that kills half of the test animals in 14 days (Lethal Dose)
LC_{50}	Dose that kills half of the test animals in 14 days (Lethal Dose)

EXAMPLE:

GROUP	# TESTED	ORAL DOSE (mg/kg) (1 kg = 2.2 lbs.)	# OF DEATHS
A	100	12	83
B	100	8	50
C	100	4	12
D	100	0	0

LDSO FOR THIS MATERIAL WOULD BE 8
CONCENTRATION DOSE WILL BE SHOWN IN units of ppm/time
AN EXAMPLE OF A LCso WOULD READ AS 800 ppm/4 hrs
LDLo and LCLo ARE THE LOWEST CONCENTRATIONS EXPECTED TO BE LETHAL
ESTIMATING IDLH FROM LC5o x 0.01 LD50 • 0.1
PEL = PERMISSIBLE EXPOSURE LIMITS(OSHA)
TLV = LIMIT VALUES VALUES (ACGIH)
IDLH = IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (NIOSH)
TWA = TIME WEIGHTED AVERAGE (a hour day, 40 hour week)
STELs= SHOW TERM EXPOSURE LIMIT (4x 15 minute paflods,1 hour interval)
CEILING.CONCENTRATION SHOULD;NEVER BE EXCEEDED
ALARA = LOW AS REASONABLY ACHIEVABLE

ph of SOME COMMON SUBSTANCES

	14	
lye..		
	13	
household ammonia............	12	
	11	BASIC
lime water.............................		
	10	
borax.....................................		
	9	
baking soda..........................		
	8	
blood		
milk	7	NEUTRAL
rain	6	
black coffee	5	
tomatoes	4	
soda		
	3	ACIDIC
lemon juice...........................	2	
gastric fluid	1	

RADIOACTIVITY:

${}^{12}_{6}C + {}^{1}_{1}H \quad {}^{13}_{7}N$

A nuclear equation like a chemical equation, shown to the above left of the arrow the substances that reacts to yield the products shown to the right

Radioactivity is the spontaneous disintegration of unstable atomic nuclei accompanied by the emission of ionizing radiation. Ionizing radiation can be either particles or pure energy.

There are two general types of radioactive substances; those with induced radioactivity and naturally occurring radioactive substances. In either case, the atoms of the substance emit particles and energy to attain a stable state.

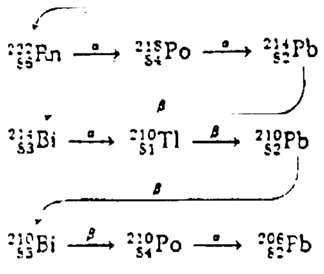
A nuclear equation, like a chemical equation, shows to the left of the arrow the substances that react to yield the products shown to the right.

Induced radioactivity occurs when a normally stable atom is bombarded by other particles. If there is enough energy in the incoming particles, they will combine with the bombarded atom's nucleus to form a new, heavier nucleus. If the new nucleus has an unstable ratio of protons and neutrons, it will undergo radioactive decay. For example, if carbon atoms are bombarded with protons, a proton is absorbed by the carbon atom nucleus. This addition changes the atom to an unstable nitrogen isotope. {Isotopes are forms of an element with different numbers of neutrons or electrons but the usual number of protons for that element.} The nucleus is unstable with too many protons and too much positive electrical charge. To attain stability, the atom emits some of this excess positive charge in the form of a positron. This, in effect, changes one of the protons into a neutron (neutral charge) and restores stability to the atom. The carbon atom is now a slightly different form of carbon {an isotope; Carbon 13} but stable.

The **rate of radioactive decay** is usually expressed as the half-life (t 1/2) of the nucleus. Half-life is the time required for half of a given amount of a radioactive substance to decay. For the nitrogen isotope that we just considered, the half-life is 10.1 minutes. This means that for any group of these nitrogen isotopes, half will have decayed at the end of 10.1 minutes; half of the remainder will decay during the 10.1 minutes after that; and so-on.

"Natural radioactivity" refers to the decay of naturally occurring unstable atoms. If we accept the geologist's estimate of the age of the earth as 5 billion years, we can see that naturally occurring radioactive isotopes must have long half-lives or they would all be gone by now. Uranium, in fact, has a half-life of 4.5 billion years, so, approximately half of the uranium that existed when the earth was formed is decayed. As uranium decays, it changes into other elements, like thorium, with a half-life of 24.1 days. As you can see, if the thorium supply were not being constantly replenished by the decay of uranium, there would soon be no thorium left. As uranium decays, it goes through a "decay series" in which it decays into radioactive (unstable) forms of: thorium, radium, radon, polonium, lead, bismuth, tellurium, lead (again), bismuth (again), polonium (again), and, after emitting enough radiation, the original uranium decays into stable lead.

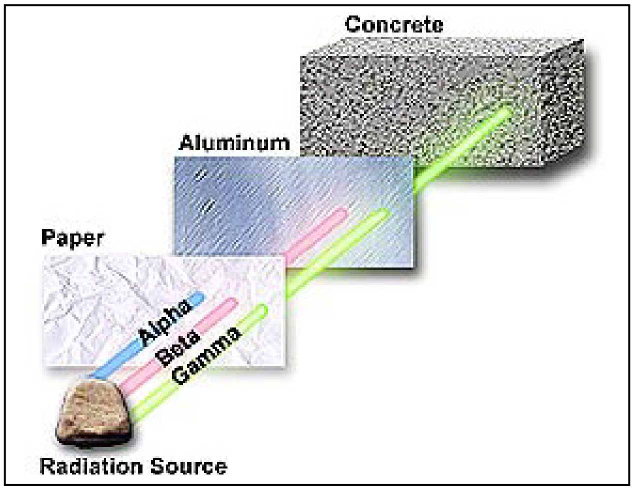
With ^{U} 232, many steps are required, involving a combination of α and Β decays, as in the following:



PARTICLES, RAYS, ROENTGENS RADS, AND REMs

Radioactive exposure usually comes in the form of exposure to particles or rays from a radioactive source. Particles and rays are, generally, emitted in three forms during radioactive decay: **alpha and beta particles, or gamma rays.**

Alpha particles are, essentially, helium nuclei (two protons and two neutrons) that have been stripped of their electrons. They are massive and travel only three or four inches from a radioactive source. Very little shielding is required to stop alpha particles; several sheets of paper are enough. Sources of alpha radiation can adhere to dust particles and be inhaled which causes lung exposure and possible cancer risks.



Beta particles are more energetic and less massive than alpha particles. They can be either electrons, carrying a negative electrical charge, or positrons, carrying a positive charge. Beta particles can travel up to one hundred feet from their source and can penetrate firefighter's turnout gear. They can be stopped by one millimeter of aluminum.

Gamma rays or photons are not particles but are a form of pure energy. They are like X-rays and can travel great distances from their source. Gamma rays can only be attenuated by massive shielding: three inches of lead. We measure the amount of these particles and rays in terms of roentgens, rads, and rems.

A **roentgen** is a measure of production. It is the amount of radiation produced by a specific size electrical discharge in a unit of dry air. Nearly all of the instruments that you encounter at an incident will be calibrated in roentgens.

A **REM** (**R**oentgen **E**quivalent in **M**an) is a measure of the amount of radiation you have received. Along with the rad, the REM is a unit of measure that is of more concern to the health physicist. Specifically, it is the receipt of one roentgen of x-rays (or the equivalent) by living tissue. Usually the REM is too large a unit to conveniently deal with so it is divided into **millirems (mrem)** each of which is 1/1000 of a REM.

Living tissue does not absorb all of the radiation that it is exposed to. A **rad** (Radiation Absorbed Dose) is a measure of the quantity of radiation absorbed by living tissue.

The biological effects of heavy particle ionizing radiation are approximately proportional to what is called Absorbed Dose (or simply dose). This is measured with instruments which detect the average energy deposited inside a small test volume.

The current unit of dose is the **gray** (abbreviated **Gy**) which represents the absorption of an average of one joule of energy per kilogram of mass in the target material. This new unit has officially replaced the **rad**, an older unit (but still seen a lot in the radiation literature). One gray equals 100 rads. Absorbed Dose was originally measured for x-rays and gamma radiation. When used in predicting biological damage, a further distinction must be made as to the "quality" of the radiation.

Although the Absorbed Dose of some radiation may be measured, another level of consideration must be made before the biological effects of this radiation can be predicted. The problem is that although two different types of heavy charged particle may deposit the same average energy in a test sample, living cells and tissues do not necessarily respond in the same way to these two radiations. This distinction is made via the concept of **Relative Biological Effectiveness (RBE)** which is a measure of how damaging a given type of particle is when compared to an equivalent dose of x-rays. The Quality Factor of a given type of radiation is determined in the following way: A group of RBE measurements are made using a variety of cells and/or tissue (these experiments aren't cheap to perform and the number that are done is driven by the overall interest in the radiation being studied). Basically, the RBE is determined by comparing the damage of the radiation to the cells/tissue of interest to that with an equal dose of gammas or x-rays. Once the RBE data are in hand, a committee of radiation experts meets and considers all the available data and then assigns a Quality Factor to the radiation.

For example, the RBE of alpha particles has been determined (by committee) to be 20 (apparently not very dependent on the energy of these particles). This means that 1 Gy of alphas is equivalent to 20 Gy of gammas/x-rays. Another way to say this is to use a new unit, the **sievert** (**Sv)** which measures Dose Equivalent (the old unit is the **rem**: 1 sievert = 100 rem). Thus 1 Gv absorbed dose of alpha particles is 20 Sv dose equivalent.

Given that, usually, only moderate doses of radiation are encountered (and thus acute effects are not seen) the long-term effects of radiation become more important to consider. The passage of an energetic charged particle through a cell produces a region of dense ionization along its track. The ionization of water and other cell components can damage DNA molecules near the particle path but a "direct" effect is breaks in DNA strands. Single strand breaks (SSB) are quite common and Double Strand Breaks (DSB) are less common but both can be repaired by built-in cell mechanisms. "Clustered" DNA damage, areas where both SSB and DSB occur can lead to cell death. For most cell types, the death of a single cell is no big deal-cells continually die and are replaced by normal processes. A more dangerous event may be the non-lethal change of DNA molecules which may lead to cell proliferation, a form of cancer.

Radioactive contamination occurs when a person or object has been exposed to a radioactive source and is made radioactive by induced radioactivity or is covered with radioactive dust. Dust can be washed off but if improper respiratory protection is worn, there is a chance that radioactive dust may be inhaled. Radioactive dust lodged in the lungs can be a serious health hazard.

Radioactive Exposure of the General Public:

ESTIMATED DOSE RATES IN THE UNITED STATES (1970)

SOURCE	AVERAGE DOSE RATE (mrem/year)
environmental	
natural	102
fallout	4
nuclear power	0.003
medical	
diagnostic	72
radiopharmaceuticals	1
occupational	0.8
miscellaneous	2
total	**182 mrem**

Time exposed, distance from a radioactive source, and shielding used all combine to limit the amount of radiation you are exposed to at a radioactive incident. It should be obvious that the shorter the time you are at a site, the less radiation your body can absorb. In this way, exposure to individuals can be controlled by work schedules.

Your exposure to radioactive particles and rays (measured in roentgens) changes with the distance from a radioactive source. The rate that radiation drops according to distance from its source is described by the "inverse square law." This "law" is a formula which states that the concentration is a function of 1 divided by the square of the distance from the source. The formula is saying that, as particles travel from their source, they spread out and so, are less concentrated. A source that is measured as releasing a dangerous concentration of radiation in its immediate proximity may pose no threat to workers outside of the incident hot zone.

Shielding is another way to limit exposure to radiation. Shielding is any material or equipment designed to limit the penetration of radioactive particles or energy. Alpha particles have a low penetration potential and workers require very little shielding to protect them from alpha particles. Beta particles are more penetrative and require a higher thicker, denser shielding to protect workers. Gamma rays are highly penetrative and require heavy lead shielding to protect workers. Shielding can be had in the form of "portable" shields that look like sections of office cubicle walls; transparent, lead impregnated plastics; and lead-lined or impregnated clothing.

MODULE 3

ANALYZING THE INCIDENT

BASIC HAZARD AND RISK ASSESSMENT TECHNIQUES

Outline

- **Introduction**
- **Assessing the Hazards & Risks Identifying Hazardous Materials Identifying Haz Mat Characteristics & Behavior**
- **The DECIDE Process**
- **The Levels of Incidents**

MODULE 3

ANALYZING THE INCIDENT

HAZARD AND RISK ASSESSMENT

Objectives

The student will be able to:

1. Describe the purpose of Hazard Risk Assessment.
2. Differentiate offensive and defensive actions, given several scenarios.
3. List and describe the six clues for detecting the presence of hazardous materials.
4. Describe the characteristics that make up the United Nations classification system.
5. List four reference publications readily available to first responders.
6. State two reasons for using 3 references to identify the properties of hazardous materials.
7. List and describe the four factors effecting behavior of hazardous materials.
8. List what each letter in the D.E.C.I.D.E. process means.
9. Determine the level of an incident, using the Planning Guide Chart, given several scenarios.
10. Use techniques outlined in this module to develop an initial defensive action plan, given a scenario.

I. Hazard and Risk Assessment

Definition: The process of: detecting and identifying hazardous materials, obtaining information on the properties of a material(s) to predict and visualize a likely outcome of an incident and using this information to formulate an initial defensive action plan.

As a first responder trained to the operational level, you should keep in mind that you are trained to act in a defensive manner. No offensive actions should be taken with this level of training. While that is easy to say, it is much more difficult to do in the field. There is an inherent feeling that as an emergency responder you need to "do something" to make the situation better. This module will help you to understand the hazards and risks associated with hazardous materials and assist you in determining what defensive actions will help you "do something" without creating additional problems. You must understand that when hazardous materials are involved, doing nothing may be the best course of action you can take and the conscious decision to do nothing is really "doing something" positive.

Basic defensive actions require that you have no intentional contact with the material involved. That does not mean that you cannot use foam, dike a spill, or even dam the material. As long as you have no contact with the material your actions are defensive. Keep in mind the physical state of the material. Gases, dusts, mist, and vapors all present the hazard of airborne contact. You must stay upwind and uphill of the material as you apply foam, dike or dam the material. Any action that places you in contact with the material is an offensive action and should only be undertaken by people who are properly trained and equipped (haz-mat technicians and specialists).

Hazard and risk assessment consists of five basic items:

1. Obtaining information on the hazardous materials, populations that might be exposed to the release, and environmentally sensitive areas.
2. Recording the collected data to be able to view the possible effects.
3. Determining the types of hazards present based on the information you have obtained and recorded.
4. Identifying vulnerable areas presented by the situation.
5. Calculating the risks associated with the situation based on the information that you have gathered.

Assessment of the Risks

The data you will collect determines the risk factors involved. Information gathered before an incident allows you to plan for future incidents and information gathered from past incidents provides valuable experience which identifies both solutions and problems associated with haz-mat response.

Minimizing the risk begins long before an incident occurs. By pre-planning a potential site of a haz-mat incident (fixed facility or transportation) you will have knowledge of the site that is as in-depth and accurate as you make it. Attempting to develop information and a plan at the time of an incident is a time consuming process, verifying the accuracy of that information is even more time consuming.

Any information developed before hand is an invaluable asset to correct decision making. Another way to minimize the risks associated with hazardous materials is through law enforcement. Fire codes, OSHA regulations, and environmental laws such as the Superfund Amendments and Reauthorization Act serve to facilitate the safe handling of hazardous materials. Prevention of the release is the best way to handle any haz-mat incident.

II. Defensive and Offensive Action

A. Defensive

The Act or actions taken during a hazardous material emergency/incident in which there is no intentional contact with the material involved.

It involves, but is not limited to:

- elimination of ignition sources vapor suppression
- and diking or diverting to keep a release to a confined area

It requires notification and possible evacuation, but *does not* involve plugging, patching or cleanup of spilled or leaking materials.

B. Offensive

The action or actions taken by a hazardous materials technician/specialist, in appropriate chemical protective clothing, to handle an emergency/incident which may result in contact with the released material.

This involves but is not limited to: patching or plugging to slow or stop a leak, containing of a material in its own container or package, and cleanup operations which may or may not require overpacking or transfer of a product to another container.

III. Six Clues for Detecting the Presence of Hazardous Materials

When a hazardous materials incident occurs, the first step in determining the hazards and risks associated with the release is to identify the material present. That means making as positive and as accurate an identification as possible. To do this you need the specific name of the material involved. In attempting to identify the material involved you should keep in mind three points:

1. You must ask for the information you need. Do not wait for outsiders to contact you. You realize the need for the information long before anyone else does. You, need to know where to get the needed information.
2. You must get some information yourself before you can use other sources for more information. You will need to make an accurate identification before you can unlock other sources for additional information.

TYPE OF ACTIVITY	HAZARDOUS MATERIALS COMMONLY FOUND AT FACILITY
AIRPORT AND MARINE FUEL DEPOTS	GASOLINES AND FUEL OILS
BREWERIES AND DISTILLERIES	ALCOHOLS
COMPRESSED GAS SUPPLIERS	MEDICAL AND INDUSTRIAL GASES
CONSTRUCTION FIRMS AND SITES	EXPLOSIVES, COMPRESSED GASES, FUELS
DRY CLEANERS	CLEANING SOLVENTS, PERCH LOROETHYLENE
ELECTRONIC CIRCUIT MAKERS	ACIDS
EMBALMING SUPPLY HOUSES	FORMALDEHYDE
FARM/GARDEN SUPPLY SHOPS	PESTICIDES, FERTILIZERS, (OXIDERS) HERBICIDES
FIREWORKS MANUFACTURERS	EXPLOSIVES, PYROTECHNICS
FOOD STORES OR WAREHOUSES	AMMONIA (REFRIGERATION SYSTEMS)
FOUNDRIES	COMBUSTIBLE DUSTS,RESINS, OTHER CHEMICALS
FUEL OIL COMPANIES	FUEL OILS
FURNITURE STRIPPING OPERATIONS	SOLVENTS
GASOLINE STATIONS	GASOLINE, AUTOMOTIVE OILS, SOLVENTS
GUN AND AMMO SHOPS	AMMUNITION, EXPLOSIVES
HAZARDOUS WASTE DISPOSAL FACILITIES	VIRTUALLY ANYTHING
HOSPITALS	COMPRESSED GASES, CRYOGENICS, MEDICINES, RADIOACTIVE MATERIALS, ETIOLOGIC AGENTS
LABORATORIES, CHEMICAL AND BIOLOGICAL	VARIOUS CHEMICALS, ETIOLOGIC AGENTS
LAWN FERTILIZER COMPANIES	PESTICIDES, HERBICIDES, FERTILIZERS
LEATHER TANNERS	VARIOUS CHEMICALS
LP GAS OR PROPANE SUPPLIERS	LIQUEFIED FLAMMABLE GASES
PAINT, VARNISH, AND LACQUER MAKERS	RESINS, SOLVENTS, CHEMICAL PIGMENTS AND ADDITIVES
PEST CONTROL COMPANIES	PESTICIDES, POISONS
PLASTIC AND RUBBER MAKERS	SOLVENTS, ADDITIVES, BULK CHEMICALS
PLATING SHOPS	ACIDS, CYANIDES
PULP AND PAPER MILLS	BLEACHES, CAUSTICS, ACIDS, SULFUR COMPOUNDS, AND OTHERS
SCHOOL/UNIVERSITY CHEMICAL LABORATORIES	VARIOUS CHEMICALS
SWIMMING POOLS (PUBLIC)	LIQUEFIED CHLORINE
SWIMMING POOL SUPPLY HOUSES	OXIDIZERS (CALCIUM HYPOCHLORITE), HYDROCHLORIC ACID, ALGAECIDES
STEEL MILLS	ACIDS, DEGREASERS
TEXTILE AND FIBER MANUFACTURERS	SOLVENTS, DYES, RESINS, VARIOUS OTHER BULK CHEMICALS
WATER TREATMENT FACILITIES	LIQUEFIED CHLORINE, ACIDS
WELDING SHOPS	COMPRESSED GASES, DISSOLVED ACETYLENE

3. When you get more information, you have to know how to use it defensively. Remember the information may confuse you if you do not know how to use it. Events analysis can help you figure out how to put that information to work as fast as you get it. To use events analysis you need to look for information that helps you estimate the likely harm without intervention.

SIX CLUES

1. OCCUPANCY AND/OR LOCATION
2. CONTAINER SHAPES
3. MARKINGS AND COLORS
4. LABELS AND PLACARDING
5. SHIPPING PAPERS/DOCUMENTATION
6. USE OF SENSES

1. OCCUPANCY AND/OR LOCATION

FIXED FACILITY

All industrial facilities are likely sites for hazardous materials because of the frequent use, manufacture, transport and storage of chemicals involved in production processes. The common causes of fixed facility accidents include:

1) human error
2) equipment failure
3) container failure
4) leak from structural stress
5) leak from valves or pipings
6) chemical reaction
7) container overflow

In the chemical industry, statistics show that up to 90% of all accidents are induced or further complicated by human error. Accidents or operation incidents appear to occur more frequently during off normal hours such as the graveyard shift, weekends, or holidays. For this reason, facility employees most expert in handling an emergency situation may not be available. Ultimately, pre-planning and training of emergency response personnel are the key ingredients in preparing for a facility emergency.

One should not exclude any location in which hazardous materials can be found such as warehouses, high school labs, town pools or water treatment facilities, pool supply outlets, hardware stores, etc. Become familiar with target areas where hazardous materials are stored before and after they are transported to the general geographic area of use.

In addition, it may be important to obtain a plot plan of a facility showing the location of where hazardous materials are stored, as well as the identity and amount of the chemicals present. Obtain aerial photographs when available.

TRANSPORTATION

Hazardous Materials are moved in great quantity throughout the country via all five modes of transportation. A hazardous material incident involving transportation will present problems based on the quantity and types of materials involved, the mode of transportation used (road, water, rail, pipeline, or air), the route, time of day, frequency of shipment, the hazards associated with the material, and the vulnerability of the container to damage.

Over 1.7 billion tons of hazardous materials are transported in the United States annually by using the various modes of transportation.

The United States Department of Transportation is the lead agency for establishing and enforcing regulations regarding safe transportation of hazardous materials (CFR Title 49). The Department's Research and Special Programs Administration has authority to issue regulations on many aspects of hazardous materials containers, except for bulk marine shipments, which are regulated by the United States Coast Guard. Other Administrations under the Department that share inspection and enforcement activities are the Federal Highway Administration, the Federal Railroad Administration, the Federal Aviation Administration, and the National Highway Traffic Safety Administration. Some of the responsibilities of the Federal Department of Transportation are:

1) to regulate the use and construction of bulk and non-bulk containers used in the transportation of hazardous materials;
2) to develop container standards and testing procedures;

3) to develop and enforce markings, including placards and labels, used in transportation of hazardous materials; and
4) to inspect and enforce multimodal shippers and container manufacturers.

Hazardous Materials incidents can occur anywhere at any time, therefore, it is vital to identify areas of potential hazards within your community. The type of incident determines the exact response of action. There are five major types of transportation modes for which an incident may occur. Let's look at each of these modes.

HIGHWAY TRANSPORTATION

Highway Transportation is the most common mode of transporting hazardous materials, therefore, it presents the most widespread public risk. It is estimated that 185 million shipments, totaling over 1.5 billion tons of hazardous materials, occur annually. Trucks ranging from cargo tank trucks, that can carry up to 9,500 gallons of certain commodities, to tractor-trailers and flatbeds, that carry non-bulk packages such as cylinders, drums, and other small containers.

Since the highway transportation of hazardous materials are so heavily regulated, the number of incidents involving truck traffic is relatively low. However, when a highway incident does occur, it can involve many complications and products. Human error and weather conditions tend to be the leading causes of highway accidents.

Many hazardous materials are transported in small packages having a capacity of less than 118.9 gallons or 1,001 pounds. Non-bulk transportation of hazardous materials represents almost 50 percent of the total tone shipped by truck and 80 percent of the total truck spills. The major causes of releases from small packages include:

1) improperly tightened or faulty fittings, valves, and closures;
2) dropping packages while loading/unloading or in transit;
3) puncturing packages;
4) improper blocking and bracing allowing packages to move, fall, or fail from impact or crushing while in a vehicle;
5) fires; and
6) freezing, getting wet, or other severe environmental exposure.

When pre-planning for a highway incident, make sure you include the following locations:

1) cargo loading and unloading facilities;
2) truck terminals; and
3) delivery areas.

RAILROAD TRANSPORTATION

Rail shipments account for about 5 percent of the tonnage of hazardous materials transported annually resulting in about 3,500 carloads shipped each day. Rail transportation of hazardous materials is regulated by the Federal government requiring all rail containers to be of the proper specification regardless of the origin, destination, or duration of the trip. We will discuss rail car container shapes later in this module.

Over the years, the increase in highway transportation reduced the need for railroads. Due to this reduction, track maintenance was often ignored resulting in track failure. Often we hear of rail incidents that have occurred due to human, signal, or mechanical errors.

The two major problems that result from rail incidents are the large quantities of product involved and the lack of emergency response information available to the responders. Become familiar with the rail line owners plans and procedures for handling rail emergencies.

WATERWAY TRANSPORTATION

A spill resulting from an incident that occurs on a waterway presents major problems to all responders. Even minor spills can have a major impact on people as well as the environment. The responders initial actions can have a tremendous impact on the outcome of this type of incident.

The largest bulk containers are self-propelled tank ships and tank barges, which together account for about 91 percent of all marine shipping of hazardous materials,. It is often difficult to determine exactly the type of cargo on board. However, more than 90 percent of the tonnage in bulk marine transport consists of petroleum products and crude oil. Chemicals make up about 7 percent of the total tonnage transported. Primarily these chemicals are basic chemicals such as sulfuric acid, fertilizers, sodium hydroxide, alcohols, benzene, and toluene.

Contamination that occurs on the water can easily spread and may be difficult to clean up. Preplanning prior to the incident can help reduce the spread of contamination. Pre-planning information should include:

1) becoming familiar with all local waterways (i.e., streams, irrigation ditches, lakes);
2) knowing the origin and destination of waterways. Tax maps or survey maps of your response area may assist;
3) determining what water areas are used for human consumption or recreation; and
4) becoming familiar with river transport vessels and seaport facilities common to your response area.

AIRCRAFT TRANSPORTATION

The transportation of hazardous materials by air is controlled by the Federal Aviation Administration's Civil Security Division.

Hazardous materials shipments by air account for less than 3 percent of total hazardous material tonnage moved nationally. Information on hazardous materials moved by military aircraft is unavailable.

Emergency response personnel must be prepared to handle the hazardous materials associated with aircraft. Aircraft fuel, oxygen, plastics, titanium and other materials that comprise the body of the aircraft can all be extremely dangerous in an emergency situation.

Aircraft transportation also applies to crop dusters applying pesticides. It is a good idea for jurisdictions in which these aircraft work to give some thought to how to respond to a crash. Knowing that these planes carry pesticides and herbicides that may be highly toxic, the crash site and surrounding areas may be highly contaminated. If a crash occurs in or near a body of water, it may affect a water supply and cause environmental damage.

Working with airport and airline officials before an accident occurs is critical. Fortunately, aircraft accidents are infrequent. However, it would be beneficial to partake in exercises and drills with airport response personnel in order to become familiar with their operations and procedures for handling such incidents. Become familiar with airport terminals and fuel storage facilities within your response jurisdiction.

PIPELINE TRANSPORTATION

Many of us fail to realize that billions of gallons of hazardous materials get transported through pipelines annually. They are used primarily to carry liquid petroleum products (crude oil, diesel fuel, fuel oil, jet fuels) and natural and manufactured gas. To a much smaller extent, pipelines also transport ethane, ethylene, anhydrous ammonia, carbon monoxide, sour (hydrogen sulfide containing) gas, and other chemicals.

Due to the potential of a release resulting from mechanical failure or human error, responders should be prepared to properly handle such incidents. There are numerous factors that may lead to pipeline failure. They include:

1) internal corrosion-especially on two-phase flow lines and those in sour service;
2) external corrosion-from defects in protective systems, in cased crossings beneath roads and railway lines;
3) external impact-due to farm or construction machinery;
4) structural failures or mechanical defects-as a result of defective seams or welds;
5) natural hazards-from seismic events, subsidence, etc.;
6) operating errors and construction defects.

Pipelines are buried only 30 to 36 inches underground, therefore, it is essential to gain an overall knowledge of the location of these pipelines within your community. Information on pipelines may be available from "***<u>digsafe</u>*"** program offices in many areas of the country that maintain records of buried pipelines and cables. Local utility companies and construction companies may know of such programs. Contact with the owner of any pipeline is likely to provide current operating conditions, specific route of the pipeline, and any emergency response information needed to handle any emergency situation. Additional information for pre-planning should include:

1) pipeline diameter;

2) flow rate (capacity) of pipeline; and

3) presence (or not) of a leak detection and emergency shutdown system.

2. CONTAINER SHAPES

FIXED FACILITY CONTAINER SHAPES

Storage containers found at fixed facilities can provide information to the responder as to what type of chemical may be present. Containers are built to meet the specific needs of the materials contained within. There are certain generalities about storage containers, such as size, shape and design, that can provide the responder with helpful information for developing an action plan based on hazard and risk assessment.

When pre-planning for a chemical emergency at a fixed facility, it is crucial to get information on the chemical storage tanks or large containers used for mixing or reacting chemicals. Additional information should include:

1) type and location of tank;
2) working capacity;
3) dimensions;
4) maximum potential pressure;
5) temperature of contents;
6) location of emergency pressure relief vents; and
7) recovery systems for flammable and toxic gases.

Let us now look at various tank descriptions and shapes for large storage containers found at fixed facilities.

VERTICAL FLAT ROOF TANKS

circular in shape with a flat roof
wider than they are tall
usually contain large quantities of
flammable or combustible materials
tanks often grouped together in diked areas
designed to withstand pressures from only 0 to 0.5 psig (pounds per square inch gauge)

VERTICAL CONE-ROOF TANKS

slightly pointed, cone shaped roofs
many have break away roofs in case internal pressure gets too high (these roofs may not be able to support any weight)
usually contain flammable, combustible, and corrosive liquids
can hold from 20,000 gallons to over 10 million gallons of product
designed to withstand pressures from only 0 to 0.5 psig (pounds per square inch gauge)

OPEN FLOATING-ROOF TANKS

roofs float on top of material contained within • floating roof eliminates build up of vapors
hold large quantities of flammable and combustible liquids that may readily vaporize
heavy rainfall or snow can cause roof to sink exposing contents of tank
pouring large streams of water on this type of tank during a fire can cause the roof to sink

COVERED FLOATING-ROOF TANKS

fixed cone shape roof with floating roof underneath
large vents found around top of tank allowing vapors to be released usually store flammable and combustible liquids

DOME-ROOF TANKS

generally taller than they are wide roofs are
dome shape
usually store flammable and combustible liquids

HORIZONTAL TANKS

much larger than ton containers

usually set on legs or blocks pressure horizontal tanks have rounded ends

pressure horizontal tanks may contain butane, propane, anhydrous ammonia, chlorine, sulfur dioxide, and hydrogen chloride

Non-pressure horizontal tanks have flat ends

may contain flammable and combustible liquids, corrosives, poisons, and solvents

SPHERICAL TANKS

- ball-like shape; rounded surface can withstand higher pressure for the same thickness of material
- usually painted white or another highly reflective color
- may be storing pressurized commodities such as methane, propane, LPG, or other gases if relief valves are present at the top of tank
- may be storing cryogenic liquids such as hydrogen, nitrogen, or oxygen when pressure relief valves are not present and the tank appears to be insulated
- can withstand pressures up to 25 psig (pounds per square inch gauge)

COVERED SPHERICAL TANKS

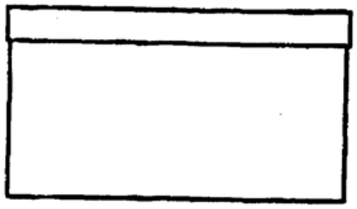
- resemble vertical tanks with rounded roofs much like water towers
- it is a spherical tank with sheet metal placed around the bottom which serves no functional purpose
- often store LPG or cryogenic liquids

CRYOGENIC LIQUID TANKS

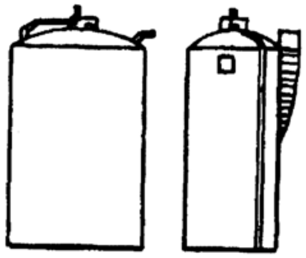
- these tanks are taller than they are wide and have rounded roofs
- heavily insulated and tank rests on legs
- there are actually two tanks present; the inner tank holds the material and the outer tank holds the insulation
- the inner tank may be half the size of the outer tank usually stores liquefied oxygen and liquefied nitrogen

UNDERGROUND STORAGE TANKS

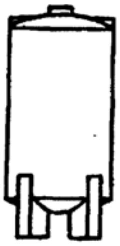
- can store both liquids and gases
- gauges, controls, and vents can be seen above ground
- the most commonly stored materials are liquefied petroleum gas, gasoline, and fuel oil



Vertical Flat-Roof Tank

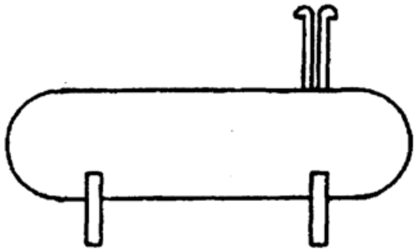


Dome-Roof Tanks

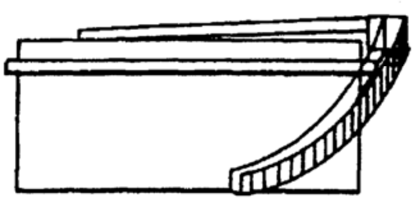


Cryogenic Liquid Tank

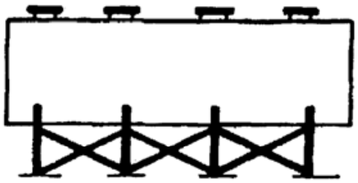
Vertical Cone-Roof Tank



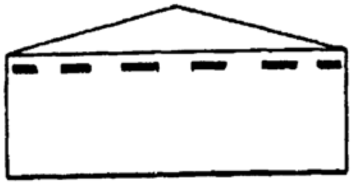
Pressurized Horizontal Tank



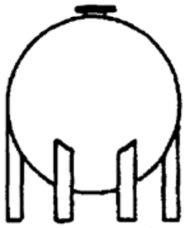
Open Floating-Roof Tank



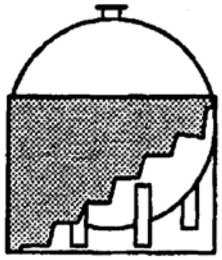
Non-Pressurized Horizontal Tank



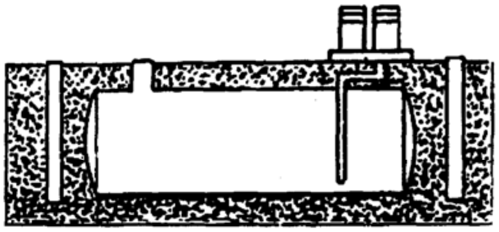
Covered Floating-Roof Tank



Spherical Tank



Covered Spherical Tank



Underground Storage Tank

As part of your basic hazard and risk assessment, it will be important to know what defensive actions can be taken at the site of a fixed storage tank incident. Your actions will be limited based on the training you have received and the equipment and resources you have available. Some defensive actions that may be used include the following:

1) evacuate the downwind area of the vapor cloud keeping in mind the isolation and protective action distances found for certain chemicals in the NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK (green border section),

2) responding personnel, as well as the command post, should approach and remain upwind. The safety officer should make sure that all of the emergency responders are equipped with the appropriate personal protective equipment (i.e., SCBA),

3) determine how weather conditions (wind direction, rain, temperature) and topography might affect your action plan,

4) try to identify the product from facility personnel. Determine the hazards of the product and determine what areas (exposures) may also be vulnerable as a result of this incident,

5) gather information from facility personnel on the type of storage tank, their safety features, shutoff valves, and dike and containment dimensions,

6) try to determine the amount of product in the storage tank. There are several ways to determine the volume. Among the methods are:

   a) remote digital readout
   b) gauging rods
   c) float-operated gauge
   d) pressure-operated gauge
   e) infrared scanning device that shows differences in temperature of the metal

REMEMBER, do not come in contact with the material in order to determine how much product remains within the tank. You must always remain in a defensive mode.

7) vapor suppression in the form of hose streams can be used to disperse the release of a gas that is not on fire. It may then be possible to shut off the control valves to stop the release. The water used for the vapor suppression may now become contaminated with the product, therefore it may need to be contained within a dike,

8) if there is a gas leak or release with the fire, the release must be stopped first prior to extinguishing the fire. A trained, well-equipped hazardous materials response team may be needed to stop the release. Water must be applied to keep the exposures cool and to disperse the radiant heat. NEVER approach any tank that is under pressure from the ends, but rather from the side, as pressure tanks build up pressure within, there will be a release of this pressure through the relief valve. As the pitch of the pressure increases, the pitch of the noise also increases; and

9) since many of these storage tanks are found within containment areas, it will be important to make sure these containment areas do not overflow due to the large amounts of water being used at the scene.

In many cases, the dikes built around the tanks are capable of holding only the quantity of that which the tank can hold. The water and foam applied to the tank during an emergency will add to the liquid volume and may cause the containment area to overflow.

SMALL STORAGE TANKS

Non-bulk or small storage containers and packages are also used to store hazardous materials. These containers are in wide use for a variety of products to meet the different needs of the user. Small containers holding hazardous materials can be extremely harmful and dangerous to the emergency responder, therefore, they should be handled in a cautious manner.

These smaller containers can take on the same potentially hazardous characteristics as the larger storage tanks. The smaller containers can build-up internal pressure, can BLEVE, and can even violently rupture. Recognition of these containers and knowledge of their possible contents may provide the information needed to mitigate a hazardous materials incident.

CYLINDERS

- may contain compressed gases, flammable or combustible liquids, poisons, radioactive materials, or corrosives
- short, broad cylinders are generally used for low pressure
- tall, thin cylinders are usually used for high pressure materials
- cylinders with a seam up the side are not used for high pressure
- cylinders without frangible disks or fusible plugs are used to store poison gases
- the COMPRESSED GAS ASSOCIATION recommends a coloring code system for compressed gas cylinders. THIS IS ONLY A RECOMMENDATION AND NOT A REQUIREMENT.

TANK CARDS AND TRUCKS

In the case of many tank cars, examination of the ends can indicate the presence of a pressurized gas. Due to the inherent strength of this construction, these vessels generally have hemispherical ends. In contrast, a low pressure vehicle is not required to have this great mechanical strength; it will generally have flattened ends.

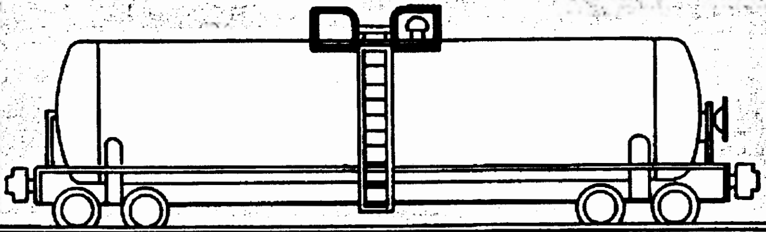
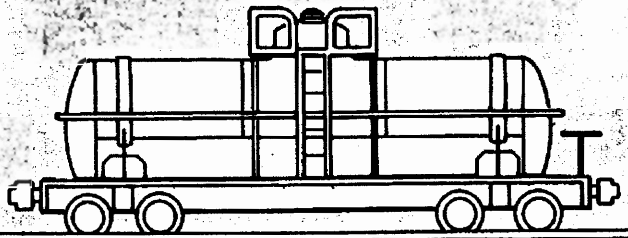
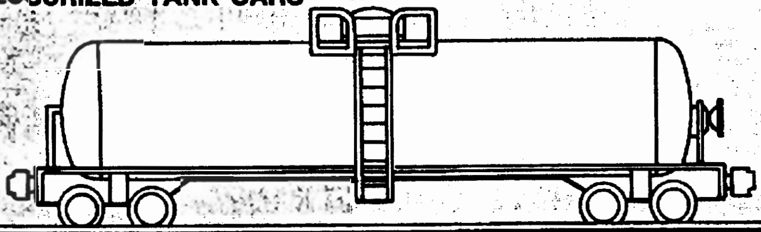
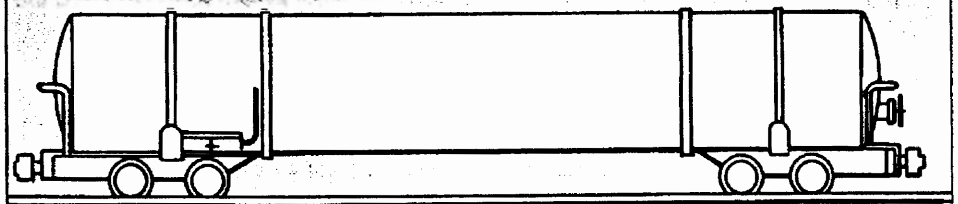
However, it should be noted that due to the increasing use of highly insulated and double wall construction, the tank structure that we can see may be merely the outside jacket; not the true containment vessel.

As a further complication, some tank cars have multiple compartments, which can contain different materials with varying types and degrees of hazards.

On rail tank cars, the presence of a protective man way housing on top of the car indicates a pressurized gas; the protective housing contains the valves, appliances for loading and unloading product, and relief devices. The presence of valving on the bottom of the car usually indicates a liquid bearing car.

On cargo tank trucks, in contrast, most pressure vessels have their valving on the bottom and relief valves on the top. This can create problems during a roll over.

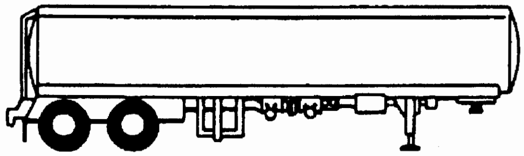
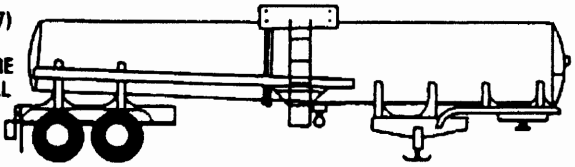
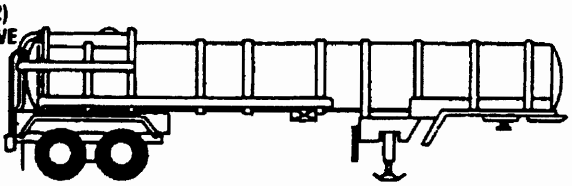
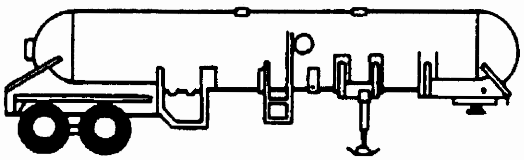
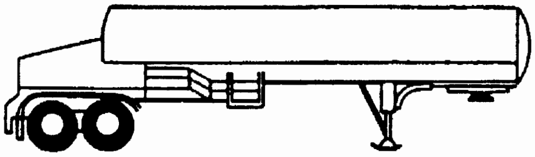
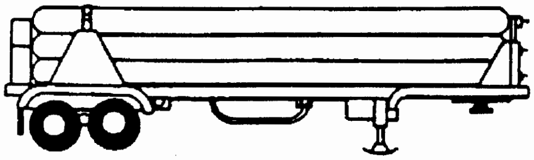
RAILROAD TANK CARS

CONTAINER SHAPE	DESCRIPTION	CONTENTS
NON-PRESSURIZED TANK CARS  	• HORIZONTAL TANK WITH FLAT, OR NEARLY FLAT ENDS. • FITTINGS AND VALVING VISIBLE ON TOP OF CAR. • OLDER CARS WILL HAVE AN EXPANSION DOME WITH VISIBLE FITTINGS. • TANK PRESSURES LESS THAN 100 psi. • OFTEN HAS BOTTOM UNLOADING VALVES.	• TRANSPORTS WIDE VARIETY OF LIQUIDS, MOLTEN SOLIDS AND SOME LIQUEFIED GASES.
PRESSURIZED TANK CARS 	• HORIZONTAL TANK WITH ROUNDED ENDS. • FITTINGS AND VALVES ENCLOSED IN DOME. • OFF-WHITE PAINT INDICATES SPRAYED-ON THERMAL INSULATION. • BLACK PAINT USUALLY WILL INDICATE A JACKETED TANK CAR.	• TRANSPORTS FLAMMABLE AND NON-FLAMMABLE COMPRESSED GASES AND CLASS A POISONS.
CRYOGENIC LIQUID TANK CARS 	• WELL-INSULATED "THERMOS BOTTLE" DESIGN. • DOUBLE SHELL TANK SIMILAR TO FIXED STORAGE TANKS. • TRANSPORT LOW-PRESSURE REFRIGERATED LIQUIDS (PRESSURES 25psig OR LOWER). • ABSENCE OF ANY TOP FITTINGS. • LOADING/UNLOADING FITTINGS AND SAFETY RELIEF DEVICE OFTEN FOUND IN CABINETS AT DIAGONAL CORNERS OR ON ONE END AT GROUND LEVEL.	• TRANSPORTS LIQUID OXYGEN, LIQUID HYDROGEN, LIQUID NITROGEN.

MC = MOTOR CARRIER
DOT = DEPARTMENT OF TRANSPORTATION

306/406—NONPRESSURE LIQUID CARRIER, FLAT ENDS (GASOLINE OR FUEL OIL)
307/407—LOW PRESSURE CHEMICAL CARRIER, ROUND ENDS
307/407—FLAT BOTTOM—A ROUND CONTAINER SURROUNDED WITH INSULATION AND AN OUTER JACKET TO KEEP THE CONTENTS WARM
312/412—SMALLER DIAMETER—CORROSIVE LIQUID CARRIER (HEAVIER THAN WATER)
331—HIGH PRESSURE GAS CARGO TANK TRUCK
338—CRYOGENIC (COLD)

CARGO TANK TRUCKS

CONTAINER SHAPE	DESCRIPTION	CONTENTS
MC 306 (DOT 406) ATMOSPHERIC PRESSURE CARGO TANK TRUCKS 	• OVAL CROSS SECTION INDICATES NON-PRESSURIZED TANK (LESS THAN 3 psi). • USUALLY SINGLE-SHELL, ALUMINUM CONSTRUCTION, OLDER STEEL CONSTRUCTED TANKS MAY BE FOUND. • GENERALLY 9,000 GALLONS MAXIMUM CAPACITY.	• TRANSPORTS PETROLEUM PRODUCTS (GASOLINE, FUEL OIL), CLASS B POISONS.
MC 307 (DOT 407) LOW-PRESSURE CHEMICAL CARGO TANK TRUCKS 	• CIRCULAR CROSS SECTION WITH PRESSURES UP TO 25 psi. • DOUBLE SHELL CONSTRUCTION WITH INSULATION THE MOST COMMON. • INSULATED TANKS MAY NOT APPEAR CIRCULAR IN CROSS SECTION. • ONE OR TWO COMPARTMENTS WITH OVERTURN PROTECTION. • GENERALLY 6,000 TO 7,000 GALLONS MAXIMUM CAPACITY.	• TRANSPORTS FLAMMABLE AND COMBUSTIBLE LIQUIDS, MILD CORROSIVES, MOST CHEMICALS, ETC.
MC 312 (DOT 412) CORROSIVE CARGO TANK TRUCKS 	• CIRCULAR CROSS SECTION, SMALLER DIAMETER WITH EXTERNAL REINFORCING RIBS OFTEN VISIBLE. • MAY ALSO BE FOUND IN DOUBLE SHELL CONFIGURATION. • INSULATED TANKS MAY NOT APPEAR CIRCULAR IN CROSS SECTION. • OVERTURN AND SPLASH PROTECTION AT DOME COVER/VALVE LOCATIONS. • GENERALLY 5,000 TO 6,000 MAXIMUM CAPACITY.	• TRANSPORTS STRONG CORROSIVES.
MC-331 HIGH PRESSURE GAS CARGO TANK TRUCKS 	• CIRCULAR CROSS SECTION WITH ROUNDED ENDS OR HEADS. • SINGLE SHELL, NON-INSULATED TANK. • UPPER TWO-THIRDS PAINTED WHITE OR HIGHLY REFLECTIVE COLOR. • CAPACITY RANGES FROM 2,500 ("BOBTAIL" DELIVERY TRUCK) TO 11,500 GALLONS (CARGO TANK TRUCK).	• TRANSPORTS LP GASES AND ANHYDROUS AMMONIA (PARTICULARLY IN THE SPRING).
MC-338 CRYOGENIC LIQUID TANK TRUCKS 	• WELL-INSULATED "THERMOS BOTTLE" DESIGN WITH FLAT TANK ENDS. • DOUBLE SHELL TANK WITH RELIEF PROTECTION. • OFTEN HAVE VAPORS DISCHARGING NORMALLY FROM RELIEF VALVES.	• TRANSPORTS CRYOGENIC LIQUIDS (E.G. LOX, LIQUID NITROGEN, LIQUID ARGON AND LIQUID CARBON DIOXIDE).
COMPRESSED GAS TRAILER 	• OFTEN REFERRED TO AS A "TUBE TRAILER". • CYLINDERS ARE STACKED AND MANIFOLDED TOGETHER. • MANIFOLD AT REAR. • PRESSURES RANGE FROM 3,000 TO 5,000 psi. • OFTEN FOUND AT CONSTRUCTION AND INDUSTRIAL SITES.	• TRANSPORTS COMPRESSED GASES (E.G. OXYGEN, NITROGEN, HYDROGEN).

It should be apparent that there are a great number of rules, exceptions to rules, and exceptions to exceptions in this area, and at best it is complicated and confusing.

Without appearing to be overly cautious, any accident involving a transport vehicle, should be approached with the attitude that it is carrying hazardous materials. Tank cars, box vans, box trailers, gondolas, and bulk cargo carriers are of special concern.

There are a number of marking systems in use to indicate the possible presence of hazardous materials. Some are generally used in transportation, others primarily used at fixed facilities. We will discuss the more widely used systems. It is incumbent upon us to use aids to vision, such as binoculars, to be able to obtain this information at the greatest possible distance.

3. MARKINGS AND COLORS

Names may be stenciled on tanks, vats, or other containers of hazardous materials or the facility may use the NFPA 704 marking systems. The NFPA 704 system was originally designed to be placed on the outside of a building or tank to warn firefighters of the hazards within a building, the system has now been adapted to include container labels and a variation of the 704 system, the Hazardous Materials Identification System (HMIS), has been designed exclusively for container labels.

The 704 system uses a four colored diamond (blue for health, red for flammability, yellow for reactivity, and white for special information) which contains one of the five numbers (0-4) to indicate the degree of hazard for health, flammability, and reactivity. Zero represents no hazard and a four represents a severe and immediate hazard. The numbers between 0 and 4 represent an increasing degree of reactivity. The white area of the marking systems are reserved for special information such as water reactive, radioactive, etc. The NFPA system does not provide for the specific identity of the material itself,

HMIS does provide a space for the chemical or common name of the material.

The New Jersey Right to Know Law provides that certain fixed facilities must label all containers within the facility and send a chemical inventory of hazardous materials to the local police and fire departments. This chemical inventory is known as the Community Right to Know Survey and while it might be useful at a haz mat incident, it is much more useful for pre-planning purposes.

SARA Title III provides for emergency planning and notification of the local fire department as to the identity of hazardous material kept on a site that is covered by the law. As part of the notification of the fire department, industry must send Material Safety Data Sheets (MSDS) and a chemical inventory to the fire department.

MARKINGS YOU ARE LIKELY TO ENCOUNTER IN THE FIELD:

1) NJRTK "Universal Labeling":

A) Every container at a site should be labeled with the five major ingredients (with CAS #) of the material in the container plus any additional hazardous substances:

NAME:	CAS #:
Hydroquinone	123-31-9
Paraformaldehyde	30525-89-4
Sodium Methanal Bisulfate	870-72-4
Triethylene Glycol	112-27-6
Water	7732-18-5
Sodium Sulfite	7757-83-7

B) Any container with more than 1 % of its contents unknown must include in its label "Contents Unknown" or "Contents Partially Unknown" in addition to other required labeling.

NAME:	CAS #:
Hydroquinone	123-31-9
Paraformaldehyde	30525-89-4

CONTENTS PARTIALLY UNKNOWN

C) All pipelines must be labeled (name and CAS #) near valves, outlets, drains, and junctions with the contents.

D) Process vessels will have a placard or other label posted nearby with the chemical names and CAS # of their contents.

E) Small containers (2 ounces or less) will have code labels that are explained on in-house charts or books.

PIPELINE MARKINGS

Pipeline can be defined as the pipe, fittings, pumping apparatus, measuring techniques, storage facilities, and maintenance requirements to transport a commodity from one point to another. Pipelines transport numerous materials in either a liquid or gas state. The liquids range from heavy crude oils to liquefied petroleum gases, to refined petroleum products, to anhydrous ammonia. However, technology is now being enhanced that will allow the movement of very thick liquids and some solids through pipelines.

Pipeline markers are placed over the buried line at road crossings, railroad crossings, and along the route the line travels. However, when the pipeline enters urban areas, the placement of markers at every road intersection would be impractical. In general, pipeline markers or warning signs should be located:

a. at each public road crossing, railroad crossing, and in sufficient number along the remainder of each buried line. The latter may be found at fence lines, property lines, and right-of-way boundaries;
b. where the pipeline is above ground and is accessible to the public, and;
c. on each side of all crossings of navigable waterways.

It is important to remember that markings for gas pipelines have not yet been standardized. They may come in many variations and can be found in different locations. For example, it is not uncommon for a marker to be buried in the ground or to be shown as painted circles on asphalt.

PETROLEUM PRODUCTS PIPELINE

Possible Signs of A Pipeline Leak

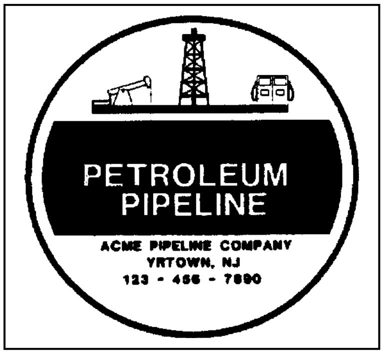
- A blowing or hissing sound
- Dust blowing from a hole in the ground
- Continuous bubbling in one spot in wet or flooded areas
- A gaseous or hydrocarbon odor
- A spot of dead or discolored vegetation in an otherwise green location • Abnormally dry or hardened soil
- Flames occurring if the leak has ignited

What To Do If You Suspect A Leak

- Shut down and abandon any equipment being used in or near the area
- Avoid open flame or other sources of ignition. Do not start any motor vehicles or electrical equipment
- Evacuate the area and prevent the public from entering the area
- Call Pipeline Company and give location of the problem Remain upwind
- Do not attempt to extinguish a fully involved fire on the pipeline right-of-way
- Fire department should protect adjacent property and protect exposures near fire
- Do not attempt to operate any pipeline valves

The Pipeline Company Will

- Shutdown the pipeline
- Dispatch personnel to investigate
- Close valves to isolate the problem
- Identify hazardous areas
- Protect the environment
- Excavate and repair the damaged line



Underground Utilities

Uniform Color Code as recommended by the American Public Works Association

- **RED-Electric**
- **YELLOW-Gas, Oil, Petroleum Products**
- **ORANGE-Telephone, Cable TV, Communications**
- **BLUE-Water**
- **GREEN-Sewer**
- **PINK-Temporary Survey Markings**
- **WHITE-Proposed Excavation**

RED	🟥
YELLOW	🟨
ORANGE	🟧
BLUE	🟦
GREEN	🟩
PINK	▨
WHITE	⬜

3) HMIS AND NFPA LABELS:

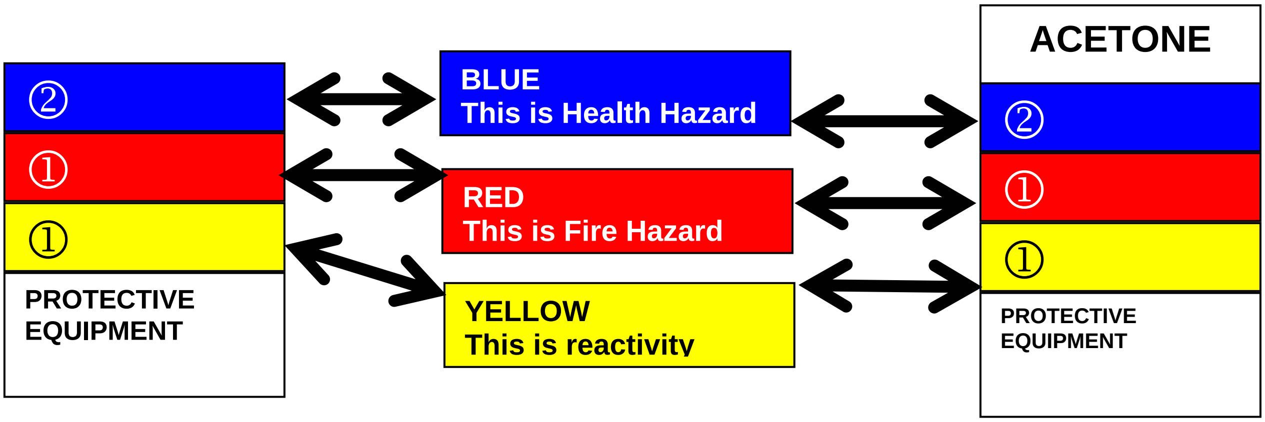
Colors specify the type of hazard:

RED-Fire Hazard YELLOW-Reactivity Hazard BLUE-Health Hazard WHITE-Special Information

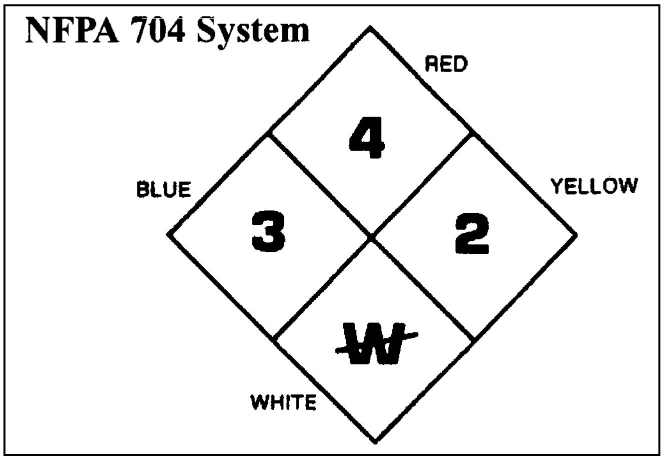
Numbers specify the degree of hazard:

0 = Minimal Hazard
1 = light Hazard
2 = Moderate Hazard
3 = Serious Hazard
4 = Severe Hazard

On HMIS (Hazardous Material Information System) labels, the upper white bar identifies the material in the container. The lower white bar identifies personal protective equipment required.

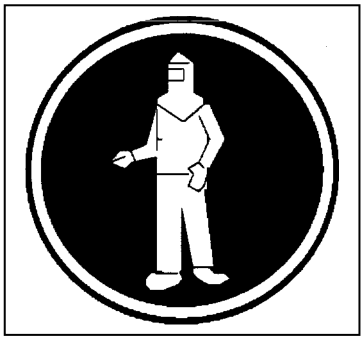


On NFPA (National Fire Protection Association) labels, the lower diamond (white) identifies specific hazards:

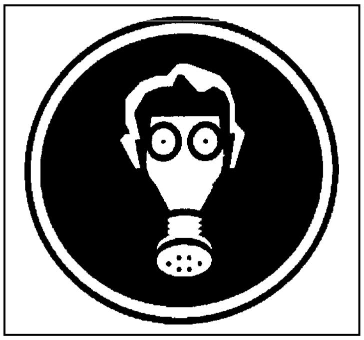


OXY = oxidizer
ACID = acid
ALK = alkali
COR = corrosive
~~W~~ = use no water
=radioactive
P= POLYMERMIZES

4) MILITARY MARKINGS

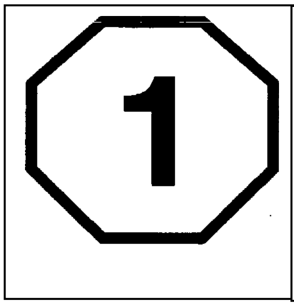


WEAR FULL PROTECTIVE CLOTHING

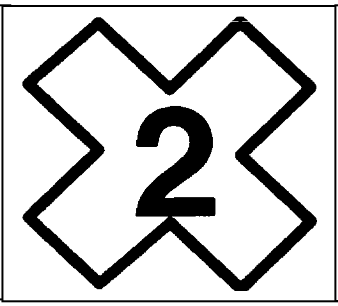


WEAR APR OR BREATHING APPARATUS

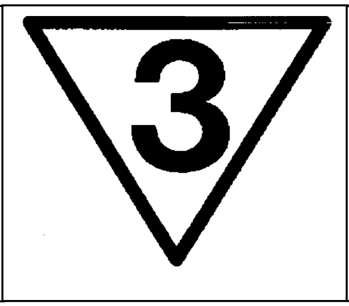
APPLY NO WATER



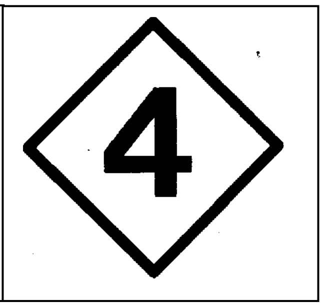
MASS DETONATION



EXPLOSIVE with FRAGMENTATION HAZARD



MASS FIRE HAZARD



MODERATE FIRE AZARD

Military marker are ORANGE IN COLOR

5) TRANSPORTATION MARKINGS

Large Quantities of HM in Non-Bulk Packages

A transport vehicle or freight container with 4,000 kg (8,820 lbs.) aggregate gross weight of a HM having a single identification number must be marked with the ID #.

D.O.T. sets the requirement of how the ID # must be displayed (orange panel, in the placard, or white square on point).

Infectious Substance Packaging

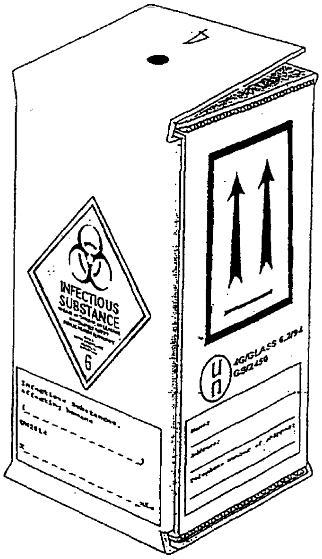
Infectious substances/agents or clinical specimens that have a high probability of containing an infectious agent must be packaged as infectious substances. This label should contain the telephone number of the Center for Disease Control and Prevention in Atlanta. Damaged or leaking packages should be reported to this number. 800 232 0124

Poisonous Hazardous Materials PIH

A transport vehicle or freight container with more than 1,000 kg (2,205 lbs.) aggregate gross weight of a material poisonous by inhalation (PIH) shall be marked with the ID # for the material on each side and each end. D.O.T. sets the display requirement (orange panels, within placards, or white square on point).

Other Bulk Packages

A bulk package (IBC) contained in or on a transport vehicle or freight container and the ID #'s are not visible, the transport vehicle or freight container must be marked on each side and each end with the ID #. D.O.T. sets the display requirements.

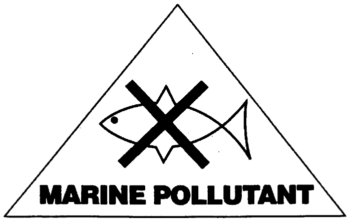


This is the same as the "old" Portable tank requirement.

Marine Pollutants

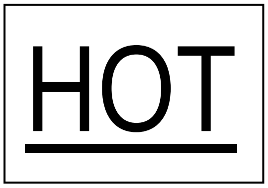
Non-bulk packaging of marine pollutants, transported in modes other than water, are not subject to the requirements for marine pollutants, therefore, will not be marked.

The MARINE POLLUTANT mark, except for size must appear as follows:



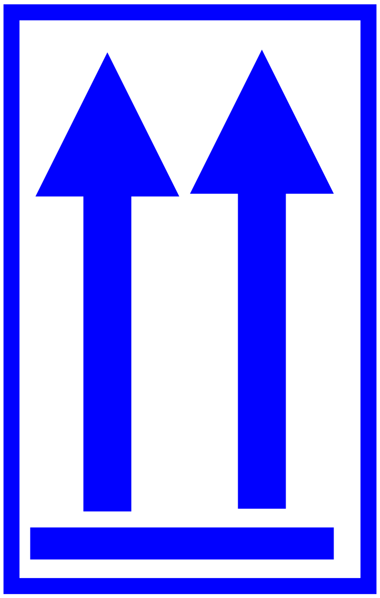
Elevated Temperature

A material, when in bulk packaging, is a liquid at or above 212°F; or, is a liquid with a flashpoint at or above 100°F that is intentionally heated and offered for transportation or transported at or above its flashpoint; or, in a solid phase and at a temperature at or above 464°F



Package Orientation

Non bulk combination packaging containing liquid hazardous materials must be marked with package orientation arrows. Does not apply to "limited quantity" or ORM-D shipments of Class 3 flammable liquids.



Caution

Contains

PCBs

(Polychlorinated Biphenyls)
A toxic environmental contaminant requiring special handling and disposal in accordance with U.S. Environmental Protection Agency Regulations: 40 CFR 761 – For Disposal information contact the nearest U.S. E.P.A Office

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In case of accident or spill, call toll free the U.S. Coast Guard National Response Center:
800-424-8802

Also Contact
Tel #

DISPLAY OF FUMIGATION MARKINGS

DANGER

THIS UNIT IS UNDER FUMIGATION

WITH,___________________________APPLIED ON

Date ______________________________

Time ______________________________

DO NOT ENTER

A freight container, truck body, or trailer in which the lading has been fumigated or is undergoing fumigation must be marked. The marking must be red letters on a white background and must be prominently displayed to be seen by person(s) attempting to enter the interior. The marking must remain until the lading is unloaded or the unit has been sufficiently aerated.

4. LABELS AND PLACARDS

Both government and industry have acknowledged that the most vital information immediately needed to properly handle a hazardous materials incident is some method of quickly identifying what material is involved. To achieve this, an identification system has been implemented which is affixed to containers of hazardous material.

The "label" is attached to individual drums, cylinders, boxes, bags and packages of hazardous materials.

The "placard" is a 10'/4-inch square on point sign which is displayed on four sides of large shipping containers, rail cars, trucks and other vehicles used to transport cargo and on bulk storage tanks.

Labels and placards were created to be simple in design yet still present needed information. The following information may be found on either a label or a placard:

1. a color 2. a symbol 3. a class or division number, or 4. one or two words.

The above characteristics make up the UN classification system. Independently, each of them can give the observer or emergency responder a solid clue to what the basic hazards are of the material involved.

A word of caution. The absence of a placard from a vehicle or rail car does not mean that there is no hazardous material aboard. DOT regulations do not require placards on highway shipments of less than 1,001 pounds of some hazardous materials and 1,000 pounds of some of these commodities can cause a great deal of damage.

Furthermore, it must be acknowledged that there are numerous cases where regulated shipments were not labeled or placarded. Regardless of why the material is unlabeled or placarded, these omissions are illegal. While in many cases the placement of the appropriate placards was just forgotten or overlooked, investigators say that truckers have removed placards completely or posted placards indicating lesser hazards so the vehicles can use routes and tunnels where hazardous materials are prohibited.

**SPECIAL RAIL PLACARDS FOR EXTREMELY DANGEROUS MATERIALS

Because of the great quantity of materials normally transported by a single rail car, special placards are required when transporting these classes of hazardous materials by rail.

- **Explosives-Division 1.1**
- **Explosives-Division 1.2**
- **Poison Gas-Division 6.1**

These placards are displayed upon a white, rectangular background.

PLACARDING FOR HIGHWAY TRANSPORTATION

TABLE 1 MATERIALS PLACARD FOR ANY QANITITY

CLASS OR DIVISION		PLACARD NAME
DIVISION	1.1	EXPLOSIVES 1.1
DIVISION	1.2	EXPLOSIVES 1.2
DIVISION	1.3	EXPLOSIVES 1.3
DIVISION	2.3	POISON GAS
DIVISION	4.3	DANGEROUS WHEN WET
DIVISION 5.2	ORGANIC PEROXIDE, TYPE B, TEMPERATURE CONTROLLED	ORGANIC PEROXIDE
DIVISION ONLY)	6.1 (PG I, INHALATION HAZARD	INHALATION HAZARD (CLASS 6)
DIVISION	7 (YELLOW III LABEL ONLY)	RADIOACTIVE

TABLE 2 MATERIALS

CLASS OR DIVISION		PLACARD NAME
DIVISION	1.4	EXPLOSIVES 1.4
DIVISION	1.5	EXPLOSIVES 1.5
DIVISION	1.6	EXPLOSIVES 1.6
DIVISION	2.1	FLAMMABLE GAS
DIVISION	2.2	NON-FLAMMABLE GAS
CLASS 3		FLAMMABLE
COMBUSTIBLE LIQUID		COMBUSTIBLE
DIVISION	4.1	FLAMMABLE SOLID
DIVISION	4.2	SPONTANEOUSLY COMBUSTIBLE
DIVISION	5.1	OXIDIZER
DIVISION 5.2 (OTHER THAN TYPE B, TEMPERATURE CONTROLLED)		ORGANIC PEROXIDE
DIVISION 6.1 (PG I OR II, OTHER THAN PG I INHALAZATION HAZARD)		POISON
DIVISION	6.1 (PG III)	KEEP AWAY FROM FOOD
DIVISION	6.2	(NONE)
CLASS 8		CORROSIVE
CLASS 9		CLASS 9
ORM-D		(NONE)

There is one placard that is used that has caused problems for emergency responders. It is the "DANGEROUS" placard. It would indicate different classes of Table 2 hazardous materials in one vehicle each being over 1,001 lbs. However, when 2,205 lbs. or more of one hazard class was loaded at one loading facility the specific placard for that class must be displayed.

5. SHIPPING PAPERS/DOCUMENTATION

The best information that emergency personnel can get at a hazardous materials incident may come from the shipping papers, which accompany the cargo regardless of which mode of transportation is involved. These papers can tell exactly how much of each material is on board, the type of packaging, the hazard class, the proper shipping name, the U.N. number, the destination and who shipped it.

SHIPPING DOCUMENTS

Any shipment of materials, whether hazardous or not, must be accompanied by sufficient documentation to prove that the transport of the material is legal; that is, not stolen.

HIGHWAY TRANSPORTATION

- The "Bill of Lading" is the primary highway shipping document. It specifies each commodity being transported.
- The Bill of Lading is the responsibility of the truck's driver, and it should be within his reach, while driving. If the driver leaves the vehicle unattended, the documents are supposed to be left on the driver's seat or in a pouch on the driver's side door.

SHIPING PAPER LOCATION CHART

MODE OF TRANSPORTATION	TITLE OF SHIPPING PAPER	LOCATION OF SHIPING PAPER	RESPPONIBLE PERSON
Highway	Bill of Lading	Cab of Vehicle	Driver
Rail	Waybill/Consist	With Conductor or	Conductor or Engineer
Water	Dangerous Cargo Manifest on Barge	Wheelhouse or Pipe like Container	Captain or Master
Air	Air Bill with Shippers Certification for Restricted Articles		

EXAMPLES OF MATERIAL DESCRIPTION FOUND ON SHIPPING PAPERS:

GASOLINE, 3, UN1203, PG II
PROPER SHIPPING NAME = GASOLINE
DIVISION NUMBER = 3
IDENTIFICATION NO. = UN1203
PACKING GROUP = PG II

SODIUM PHOSPHIDE, 4.3, UN1432, PG I, DANGEROUS WHEN WET

SULFURIC ACID, 8, UN1830, PG II

CALCIUM CYANIDE, 6.1, UN1575, PG I, RQ, (MARINE POLLUTANT)
Since this material is listed as a Marine Pollutant under U.S. D.O.T. Title 49 (HM-211) the words "Marine Pollutant" must be entered on the shipping paper in association with the basic description.

PACKING GROUP I = VERY DANGEROUS MATERIALS
PACKING GROUP II = MODERATE DANGER
PACKING GROUP III = MINOR DANGER

NO PACKING GROUPS FOR CLASS 2, CLASS 7, DIVISION 6.2 (OTHER THAN REGULATED MEDICAL WASTES) AND ORM-D MATERIALS

CHLORINE PENTAFLUORIDE, 2.3, UN2548, POISON-INHALATION HAZARD, ZONE A
PROPER SHIPPING NAME = CHLORINE PENTAFLUORIDE
DIVISION NUMBER = 2.3
IDENTIFICATION NO. = UN2548 HAZARD
ZONE = ZONE A

HAZARD ZONES A & B = EXTREME DANGER-SMALL CONCENTRATIONS
HAZARD ZONES C = VERY DANGEROUS--LARGER CONCENTRATIONS
HAZARD ZONES D = DANGEROUS-LARGER CONCENTRATIONS
HAZARD ZONES ARE FOR 2.3 (POISON GAS) AND CERTAIN 6.1 (LIQUID) DIVISION MATERIALS ONLY

RQ'S ARE REPORTABLE QUANTITIES LISTED FOR MATERIALS DESIGNATED AS HAZARDOUS SUBSTANCES UNDER THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT.

EXAMPLES OF SHIPPING PAPERS

CHEMTREC 1-800-424-9300

NO. PACKAGES	DESCRIPTION OF ARTICLES AND SPECIFICATIONS	WEIGHT
2 drums	ALLYL ALCOHOL, 6.1, UN 1098, PG I,	
	POISON-INHALATION HAZARD, ZONE B	714 LBS
25 pkg	SODIUM PHOSPHIDE, 4.3, UN 1432, PG I,	
	DANGEROUS WHEN WET	2,000 LBS
20 pkg	SULFURIC ACID, 8, UN 1830, PG II	304 LBS.

SHIPPING NAME
Div. No.
DOT ID #
Packing Gp

Hazardous materials have additional requirements for documentation to assist emergency response personnel in gaining information about the shipment. All of the following types of shipping papers will have at least the following information:

- Proper shipping name.
- Hazard class or division number.
- Number of packages.
- Types of packages.
- Correct weight.
- A 24 hour emergency response telephone number.

Emergency response information must accompany the shipping papers. As a minimum, the emergency response information must contain:

1. The description of the hazard material.
2. Immediate hazards to health.
3. Risk of fire or explosion.
4. Immediate precaution to be taken in the event of an accident or incident.
5. Immediate methods for handling small or large fires.
6. Initial methods for handling spills or leaks in the absence of fire.
7. Preliminary first aid measures.

The information can be presented in a shipping paper or in a document, other than a shipping paper, i.e., ERG, MSDS.

There are some differences among the documents used in each mode of transport. Each mode's shipping papers will be discussed.

STRAIGHT BILL OF LADING
ORIGINAL - NOT NEGOTIABLE

PAGE 1 OF 1

CARRIER NAME ACE TRUCKING CARRIER ADDRESS 123 MAIN STREET KEARNY, NJ 07035	**NEW JERSEY STATE POLICE** **Homeland Security Branch, Spec. Ops.** **HAZ MAT EMERGENCY RESPONSE UNIT**
TO: AERIAL BENDER INC. CONSIGNEE 45 KELLY STREET FLANDERS, NJ 07104	
FROM: SHIPPER STREET ORIGIN KBA INDUSTRIES 3 LONG STREET JERSEY CITY, NJ 07032	SPECIAL INSTRUCTIONS 24 HR. EMERGENCY CONTACT JUSTIN CASE 1 800 123-4567

NO. SHIPPING UNITS	H/	DESCRIPTION OF ARTICLES	WEIGHT	RATE
20 CASES	X	PAINT, 3, UN 1263, I	800 LBS.	
15 CASES	X	SODIUM ALUMINUM HYDRIDE, 4.3, UN2835, II		
		DANGEROUS WHEN WET	275 LBS.	
6 DRUMS	X	MOTOR FUEL ANTIKNOCK MIXTURES		
		(TETRAETHYL LEAD), 6.1, UN1649, 1,		
		(MARINE POLLUTANT)	800 LBS.	
5 CYL.	X	BORON TRICHLORIDE, 2.3, UN1741,		
		HAZARD ZONE A, POISON INHALATION HAZARD I	900 LBS.	

RAIL TRANSPORTATION

e A "freight waybill" specifies the contents of a specific car of a train.

9 A "train consist" lists all of the cars in a train by its identifying number and contents.

9 The waybill, consist, and other related information is the responsibility of the conductor, although it may be held by any train crew member.

9 The rail industry uses a 7-digit code number for each commodity it transports. It is known as the STCC (Standard Transportation Commodity Code) and is found on all rail documents.

"*Hazardous Material STCC numbers always begin with 49. That is to say, if the STCC number's first two digits are 49, the commodity is a hazardous material.

AIR TRANSPORTATION

- The "Airbill" is the shipping document associated with air transport.

- The Airbill is the responsibility of the aircraft's pilot, and should be retained in a suitcase in the cockpit.

WATER TRANSPORTATION

e The Dangerous Cargo Manifest specifies the quantity and types of commodities being transported by the vessel.

0 The DCM is the responsibility of the Master of the vessel and will be found in the wheel house, along with other information about its location.

9 On barges, manifests are placed in mailbox-type containers.

OTHER DOCUMENTATION

FIXED FACILITIES, INCLUDING STORAGE FACILITIES

Unlike transportation incidents where the identity of the material can be anything depending on the vehicle involved, fixed facilities generally have hazards that are common to that facility. Fixed facilities can be more thoroughly planned for and the identification of the material might be known upon receipt of the alarm. However, just because you know the facility involved does not mean that you automatically know the identity of the material involved. You still must identify the material. To do that you can use markings and colors, labels and inventory lists generated in compliance with the New Jersey Right to Know Law and SARA Title III, and pre-emergency planning.

SOURCES OF INFORMATION

Once you have correctly identified the hazardous material involved, you need to develop more information about the hazards and risks presented by the material. This information falls into two categories: printed and verbal.

Regardless of the means that you use to identify the hazardous material involved in the incident, it is critical that you spell the name of the material correctly. Most of the information resources you use list materials alphabetically and misspelling by even a single letter could be disastrous.

- Ethanol is a clear, colorless liquid with an aromatic aroma. It has a flashpoint of 55°F (CAS #64-17-5)
- Ethanal is a clear colorless liquid with a pungent choking odor and has a flashpoint of -36°F (CAS #75-07-0)
- The vapors of ethanol are irritating to the eyes and mucous membranes and it may polymerize spontaneously, additionally it forms unstable oxides in air.

Printed sources of information include the DOT Emergency Response *Guidebook* (ERG), Materials Safety Data Sheets, and other published references for hazardous materials. Some books are a compilation of other books such as the NFPA's Fire Protection Guide on Hazardous Materials, others are published by chemical manufacturers such as Shell's Safety *Manual,* Agricultural Chemicals, and still others are published for industry and have gained widespread use by haz-mat responders. No one book can do it all, there are over 60,000 hazardous materials out there. The DOT ERG references only 2,400 materials that can be transported and the Coast Guard's CHRIS Manual covers 900 materials. You must have the reference sources available before the incident and know how to use them.

One important source of information for haz-mat response is the MSDS's. These data sheets should be available for use at fixed facilities. MSDS's are required to contain the following information:

- Identification of the manufacturer.
- Description of the hazardous components.
- Physical data.
- Fire and explosion data.
- Health hazards.
- Reactivity data.
- Spill or leak procedure.
- Special protection information.
- Special precautions.
-

Warning: not all MSDS's are created equally! While MSDS's are required to contain certain information, not all of the suppliers of MSDS's pay close attention to the accuracy of information on the sheet. Look on the sheet for a telephone number to call in emergencies.

Department of Health (D.O.H.) Hazardous Substance Fact Sheets are an excellent source of information for hazardous materials. Every county lead agency has a library of the reference documents. Emergency Response Teams can obtain complete sets of Fact Sheets from the DOH.

The fact sheets discuss means of exposure, acute and chronic health effects, medical testing, workplace controls and practices, PPE, handling and storage, common questions and answers, definitions, and emergency information for individual hazardous substances.

Verbal sources of information refer to valid sources of information such as CHEMTREC. CHEMTREC is located in Washington, D.C. and was established in 1971 by the Chemical Manufacturer's Association. It is available 24 hours a day, seven days a week, 365 days a year. Most of us think of CHEMTREC for transportation incidents but it can also assist at fixed facilities. The telephone number is 800-424-9300. When you call CHEMTREC you must provide your name, location, and telephone number for call back. Other information you will be asked for will include the name of the material or if unknown, any information you might have, shipper and/or manufacturer, carrier, consignee, container type, identifying numbers, location of the emergency, and local conditions. CHEMTREC may also be able to connect you directly to transportation or industry experts.

Provide communicator with:

- **Your name, location, and telephone number**
- **Name of material**
- **If name of the material is not known, provide any information you might have:**
- **Shipper/Manufacturer**
- **Carrier Consignee Container Type**

  Identifying container numbers

  Location of the emergency Local

  conditions

(See Appendix 1)

6. USE OF THE SENSES TO DETECT THE PRESENCE OF HAZARDOUS MATERIALS

If you smell a strange odor, if you feel a strange sensation on your skin or even if you get a strange taste in your mouth, you are probably in the wrong place and should use those signs as an indication to leave.

The sense of smell is also extremely dangerous as a means of detection, as many deadly poisonous materials have little or no odor associated with their vapor. In others, the threshold (concentration of vapor in air) required to be identified is far over the level where injury will occur. It is unfortunate that many references state `pungent' or other reference to odor in their description of the physical properties of hazardous materials. This might lead untrained and unsuspecting individuals to use odors as a primary method of detection.

In any case, do not use the sense of smell as a method of hazardous materials detection. It is an extremely dangerous practice.

The sense of hearing may be of value in detecting the escape of gas from a relief valve, or a (hopefully distant) explosion. It is generally of limited use.

The effective use of one's vision, especially when aided by binoculars and telescopes, may provide the best indication of hazardous materials presence.

Placards & DOT Classes

Classification of Hazardous Materials

The DOT has broad authority to regulate hazardous materials that are in transport, including the discretion to determine which materials shall be classified as "hazardous". These materials are placed in one of nine categories, based on their chemical and physical properties. Based on the classification of the material, the DOT is also responsible for determining the appropriate packaging materials for shipping or transport. Finally, also based on the material classification, strict guidelines are furnished for proper labeling/marking of packages of hazardous materials offered for transport, and for placarding of transport vehicles.

- Class 1: Explosives
  - Division 1.1 Explosives with a mass explosion hazard
  - Division 1.2 Explosives with a projection hazard
  - Division 1.3 Explosives with predominantly a fire hazard
  - Division 1.4 Explosives with no significant blast hazard
  - Division 1.5 Very insensitive explosives
  - Division 1.6 Extremely insensitive explosive articles
- Class 2: Gases
  - Division 2.1 Flammable gases
  - Division 2.2 Nonflammable gases
  - Division 2.3 Poison gas
  - Division 2.4 Corrosive gases
- Class 3: Flammable liquids.
  - Division 3.1 Flashpoint below -18^{o}C (0^{o}F)
  - Division 3.2 Flashpoint -18^{o}C and above, but less than 23^{o}C (73^{o}F)
  - Division 3.3 Flashpoint 23^{o}C and up to 61^{o}C (141^{o}F)
- Class 4: Flammable solids; spontaneously combustible materials; and materials that are dangerous when wet
  - Division 4.1 Flammable solids
  - Division 4.2 Spontaneously combustible materials
  - Division 4.3 Materials that are dangerous when wet

- Class 5: Oxidizers and organic peroxides
  - Division 5.1 Oxidizers
  - Division 5.2 Organic peroxides
- Class 6: Poisons and etiologic materials
  - Division 6.1 Poisonous materials
  - Division 6.2 Etiologic (infectious) materials
- Class 7: Radioactive materials
  - Any material, or combination of materials, that spontaneously gives off ionizing radiation. It has a specific activity greater than 0.002 microcuries per gram.
- Class 8: Corrosives
  - A material, liquid or solid, that causes visible destruction or irreversible alteration to human skin or a liquid that has a severe corrosion rate on steel or aluminum.
- Class 9: Miscellaneous
  - A material which presents a hazard during transport, but which is not included in any other hazard class (such as a hazardous substance or a hazardous waste).
- ORM-D: Other regulated material
  - A material which, although otherwise subjected to regulations, presents a limited hazard during transportation due to its form, quantity and packaging.

INHALATION HAZARD PLACARD

DANGEROUS PLACARD

The dangerous placard has always been an exception to TABLE 2 requirements when two or more TABLE 2 items in non bulk packages were loaded. However, when 5,000 pounds or more of one hazard class was loaded at on loading facility the specific placard for that class must be displayed. The 5,000 pounds amount has been reduced to 2, 250 pounds. This rule becomes effective October 1, 1997 and has always been permissive.

Classes of Hazards

The chemical industry has said that more than 38,000 substances meet the criteria of being hazardous. These materials are broken into several unique classes *of hazards.* However, for the most part they are classified by a single primary hazard. Many hazardous substances present multiple dangers. The following is a brief description with examples of major classes of hazards.

CLASSES OF HAZARDOUS MATERIALS

These definitions and descriptions are paraphrased from those found in the U.S. Code of Federal Regulations, Title 49, which are promulgated by the Department of Transportation.

They should not be considered as the legal parameters which govern the transport of these materials, but rather an abstract of those definitions.

Examples of each class of materials are presented at the end of each section.

1) Explosives: Class 1

Any mixture, compound or chemical or mechanical device designed to function by explosion, thus generating the instantaneous release of heat and gas.

The Department of Transportation divides explosives into 6 divisions. Some examples are:

1. Division 1.1, which is the most dangerous of the three and is very sensitive to heat, impact and shock. Examples include dynamite and nitroglycerin.
2. Division 1.2, which includes very fast burning material such as flares and solid rocket motors.
3. Division 1.3, materials in which the major hazard is the release of radiant heat or violent burning, or both, but there is no projection or blast hazard.
4. Division 1.4, contains small amounts of Class A and/or Class B explosives such as fireworks and ammunition. While this class of material usually presents little danger piece by piece, a large quantity, such as a full boxcar or truck load, can be very hazardous.
5. Division 1.5, this material is used for blasting and is the most insensitive of the explosive class to shock and offers minimal threat of accidental detonation.
6. Division 1.6, these materials are found to be extremely insensitive detonating substances.

2) Gases: Class 2

1. Division 2.1, Flammable gases are any compressed gas which meets the technical requirements such as low flammability limits and flame projection and often ignite immediately when leaks or punctures occur.
   Examples: LPG, propane, acetylene, hydrogen.
2. Division 2.2, Nonflammable gases are those other gases which do not fall under the flammable gas limits. However, it is important to note that several of the gases which carry the green "nonflammable gas" label or placard can burn or cause fires and have, in several cases, led to death and injury. Furthermore, nonflammable gases often present other serious health hazards which should be considered.

Examples: anhydrous ammonia, oxygen, compressed nitrogen, hydrogen chloride.

3. Division 2.3, Poisonous gases are materials known to be so toxic to humans as to pose a hazard to health during transportation.

3) Flammable Liquids: Class 3

This hazard category deals with liquids which produce vapors which can be easily ignited. They are broken into two groups.

1. Flammable liquids are any liquid which have a flash point of 141 °F or below.
   Examples: gasoline, acetone, toluene.
2. Combustible liquids are those which have a flash point between 141°F and 200°F
   Examples: fuel, oil, kerosene, asphalt, creosote.

Flammable Liquids-(NFPA definition). Any liquid having a flash point (FP) below 100°F and having a vapor pressure not exceeding 40 psi absolute at 100°F shall be known as Class 1 liquids.

Class 1 -as above

Class 1A -FP below 73°F and BP below 100°F

Class 1 B -FP below 73°F and BP at or above 100°F

Class 1 C -FP at or above 73°F and below 100°F

Combustible Liquids-any liquid having a flash point (FP) at or above 100°F

Class II -FP at or above 100°F and below 140°F

Class 111A -FP at or above 140°F and below 200°F

Class 111B -FP at or above 200°F

Specific Gravity-a measure of a substance in relation to water which is rated 1.0.

4) Flammable Solids: Class 4

Divisions 4.1 Flammable Solids; 4.2 Spontaneously Combustible; 4.3 Dangerous When Wet. These are solids, other than explosives, which are likely to cause fire through spontaneous chemical changes, friction, absorption of moisture or exposure to moisture. This group also includes material that is water reactive or spontaneously combustible. Once these materials begin burning they often generate toxic vapors and are sometimes very difficult to extinguish.
Examples: sodium, calcium carbide, phosphorus, lithium.

5) Oxidizers and Organic Peroxide: Class 5

That material which readily produces or yields oxygen to stimulate the combustion of other material. Should this class of material be allowed to mix with flammable liquids or other combustibles rapid burning could result.
Examples: oxygen, ammonium nitrate, magnesium perchlorate.

Division 5.2 Organic Peroxide, Type B, liquid or solid, temperature controlled. Any amount of this material must be placarded.

6) Poisons and Etiologic: Class 6

1. Division 6.1 poisons are those very toxic substances where a very small amount of the gas, or vapor of the liquid are *dangerous* to life and can cause immediate illness or death.
   Examples: hydrogen cyanide, chlorine, aniline.
2. Poisons (also called Poison B) are those substances that are known or presumed to be toxic to man.
   Examples: parathion, arsenic, sodium cyanide.
3. Irritants are substances which cause severe discomfort but usually not death nor extremely serious injuries.
4. Substances, such as micro-organisms or toxins, either natural or manmade, which may cause or transmit disease.
   Examples: anthrax, botulism, rabies, tetanus.

7) Radioactive Material: Class 7

Those products which spontaneously emit ionizing radiation, which could be capable of damaging living tissue.

8) Corrosives: Class 8

Materials that cause visible destruction or irreversible damage to human tissue or that has a severe rate of corrosion on steel.

9) Miscellaneous Hazardous Materials: Class 9

May include any hazardous material that does not meet the criteria of another hazard class.

OTHER TERMS USED TO DESCRIBE HAZARDOUS PROPERTIES AND MATERIALS IN TRANSPORTATION

The following list of terms are not "classes" of hazardous materials, but rather used to describe the properties and effects of hazardous materials.

Cryogenics

Materials, such as some highly compressed and liquefied gases, which have temperatures below -130°F (-101^{0}C).

Examples: Liquid oxygen, Liquid hydrogen, LNG

Limited Quantity

The maximum amount of a hazardous material that may be transported for which there is a specific labeling or packaging exception.
Spontaneously Combustible Material (solid)

A solid substance (including sludge's and pastes) which may undergo spontaneous heating or self-ignition under conditions normally incident to transportation or which may, upon contact with the atmosphere, undergo an increase in temperature and ignite.

NOS, Not Otherwise Specified

This term, appearing along with a general class description, indicates that the subject material conforms to a hazardous material definition, but is not listed by generic name in the regulations.
Examples: Flammable liquid NOS, Combustible liquid NOS

Gas in Solution

This special form of storing some gases is useful when the physical properties of the material make it impractical to use high storage pressures.
Examples: Acetylene undergoes autoignition at pressures over 1-20 psi. It is therefore stored as a gas in solution (in acetone).

Pyrophoric Material

Any material that ignites within 5 minutes after coming in contact with air without an external ignition source.
Examples: Diborane, some silanes

Forbidden

A material which must not be offered or accepted for transportation.

V. Reference Publication

A. Earlier in this module we discussed sources of information. These sources were broken down into two categories: printed and verbal. Printed reference material should be used by the first responder to identify a possible hazardous material. These publications should be readily available. The following are a list of four publications that will assist the first responder in gathering together and verifying the identifications of a hazardous material.

1. DOT Guide Book for response to Hazardous Materials Incidents.
2. Emergency Action Guide Book Association of American Railroads, Bureau of Explosives.
3. Emergency Handling of Haz Mat in surface transportation. Bureau of Explosives Association of American Railroads, Washington, D.C.
4. Fire Protection Guide for Haz Mat.

B. Using reference materials to ID hazardous material.
First responders should use at least three reference sources to identify the properties of a possible hazardous material. The first reason is obvious, to identify the chemical. Secondly, at least two additional reference sources should be used to cross reference its properties. This is very important to the first responder so that verification can be made and additional information can be obtained.

1. Reasons for using three references
   a. to ID chemical
   b. cross reference its priorities
   c. avoid mistakes
   d. get better picture of properties

VI. Factors Effecting the Behavior of Hazardous Material

There are four basic factors that affect the behavior of hazardous materials at an emergency.

1. The inherent properties and quantity of the material involved including:
   Physical state (solid, liquid, or gas).
   Reactivity.
   Flammability.
   Health Hazards.

2. The built-in characteristics of the container including the five basic forms of stress to the container. Those forms of stress are:

"Thermal stress" caused by fire, sparks, friction, electricity, ambient temperatures, and extreme or intense cold.

"Mechanical stress" caused by an object physically contacting the container and the effects caused such as punctures, gouges, bending breaks, or tears.

"Chemical stress" caused by chemical actions such as acids corroding the container, pressure generated by decomposition, polymerization, or corrosion.

While less common, "Irradiation" and "Etiologic stresses" can occur and allow the release of the material.

Container can be stressed in one or more ways as occurred in Waverly, Tenn. when a train derailed, caught fire, was extinguished. Two days later as a propane car was being moved, a mechanical BLEVE occurred. They had both thermal and mechanical stress applied to it.

3. The natural laws of physics and chemistry will affect the incident based on the material and forces present.

4. The environment including the exposures, physical surrounding (terrain), and the conditions (weather) will all affect the incident.

Determining the interrelationship between these factors can help considerably in visualizing what is likely to happen in the emergency.

VII. THE D.E.C.I.D.E. PROCESS

The D.E.C.I.D.E. process is a guide to your intervention during an emergency. It is meant to minimize personal risk and in order to do so certain basic decisions must be made.

To use the process you will.

- Detect the presence of hazardous materials.
- Estimate the likely harm without intervention.
- Choose the response objectives.
- Identify the action options.
- Do the best option.
- Evaluate your progress.

In an emergency you must detect and identify the hazardous materials present. Know the size of your problem!

Estimate the likely harm without intervention. You are in a defensive mode and want to be part of the solution not a part of the problem.

Choose objectives based on your knowledge of the problem. What is the overall goal-the harm you want to prevent? This is a most critical step.

Identify your action options, with your objectives in mind. Take the time to consider all practical options before you act. You are defining your tactics in this step.

Do the best possible option, the one with the most gain and the least loss.

Evaluate your progress to see if what you expected to happen is happening. You may have to change your actions based on your evaluation.

Remember that you are trained to take defensive actions. Basic hazard and risk assessment should be considered in both the pre-plans and the incident analysis. It is the initial safe step to hazardous materials response. The correct and as complete as possible identification of the hazardous material present will allow you to access information about the hazards and risks posed by the material. Do not come in contact with the material in attempting to identify it. Stay part of the solution not part of the problem.

CHEMICAL/BIOLOGICAL AGENTS

The probability of a major chemical/biological (C/B) incident occurring in the United States is difficult to quantify. However, the inevitability of a significant C/B incident is heightened by a number of factors including:

1. Chemical/Biological agents are relatively inexpensive to produce.
2. Basic chemical precursors and biological production processes are relatively easy to acquire.
3. The basic knowledge required to manufacture such substances is readily available.
4. The impact to the public is intensified by the inability to quickly identify and/or contain the affects of such substances (particularly biological agents).
5. Media coverage has increased the visibility and public knowledge of the use of chemical/biological weapons, thus creating a more likely scenario for their use.
6. The portability of small amounts of C/B agents, (especially biological agents), make them especially useful for clandestine purposes.
7. The proliferation of C/B agent technology and development efforts worldwide have increased the stockpile of such weapons, thus elevating the potential for the acquisition or theft of the C/B weapons by terrorist groups.

The public safety community must be prepared to address a chemical/biological event with regard to evacuation, containment, neutralization, removal, cleanup and disposal. Some possible scenarios may include:

1. The sabotage of a hazardous chemical production or storage facility.
2. The hijacking or premeditated destruction of a tractor-trailer or railroad tanker containing hazardous materials.
3. Discovering an individual or a group of individuals involved in the manufacturing or possession of a chemical/biological weapon.
4. The dispersal of a chemical/biological agent among the civilian population, livestock or agricultural industry.
5. The contamination of a municipal water or public food supply with a chemical/biological agent.
6. The credible threat to accomplish one of the above.

V. Reference Publication

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1. Reasons for using three references a. to ID

chemical

b. cross reference its priorities c. avoid

mistakes

d. get better picture of properties

VI. Factors Effecting the Behavior of Hazardous Material

There are four basic factors that affect the behavior of hazardous materials at an emergency.

1. The inherent properties and quantity of the material involved including:

Physical state (solid, liquid, or gas).
Reactivity.
Flammability. Health
Hazards.

2. The built-in characteristics of the container including the five basic forms of stress to the container. Those forms of stress are:

"Thermal stress" caused by fire, sparks, friction, electricity, ambient temperatures, and extreme or intense cold.

"Mechanical stress" caused by an object physically contacting the container and the effects caused such as punctures, gouges, bending breaks, or tears.

VIII. Determining the Levels of Incidents

A student activity

Scenario One

You respond to a call at a large isolated railroad yard in an unpopulated area. The call was for a reported train accident. Upon arrival, you are directed to the yardmaster who informs you that there is a small leak in a tank car of hydrogen cyanide which is UN#1051.

Using the chart you determine this incident to be level ____

Your first actions would be to:

1. ____

2. ____

Scenario Two

You respond to an accident involving a pickup truck carrying gas cylinders. The truck has a green placard on the side and you are able to get the shipping papers from the driver. One cylinder is releasing gas from its valve that was somehow opened in the accident. From the shipping papers you are able to identify the cylinder contents as nitrogen. It looks to you as if the release can be stopped by turning the shut off valve.

Using the chart you determine this incident to be level ____

Your first actions would be to:

1. ____

2. ____

Scenario Three

You are a fire lieutenant with an engine company that has responded to an overturned tank truck. The truck's contents are leaking out of a dome cover. The truck is placarded with ID #1203. The leaking material is a liquid that is running towards the curb. About 60 ft. down the curb is a sewer drain opening. The area is an industrial park with most buildings at one story, bordering the park are residential townhouses.

Using the chart you determine this incident to be level ____

Your first actions would be to:

1. ____

2. ____

Scenario Four

In the previous incident you have decided to build an earthen dike ahead of the running spill and apply foam. After you have secured all ignition sources you notice that the liquid is continuing to spill out of the dome cover and at some point will exceed the capacity of your dike. The only way to stop the leak is to apply a dome clamp to the leaking cover.

Following the DECIDE process, you evaluate the results of your actions and determine that it is a new situation that you need to reapply the DECIDE process to. The best option appears to be to stop the leak.

Using the chart you determine this incident to be level ____________________________________

Your first actions would be to:

1. ____

2. ____

PLANNING GUIDE FOR DETERMINING HAZARDOUS MATERIALS INCIDENT LEVELS, RESPONSE, & TRAINING

		FIRST RESPONDER	HAZ MAT TECHNICIAN AND/OR SPECIALIST	
		DEFENSIVE OPERATIONS	OFFENSIVE OR DEFENSIVE OPERATIONS	
		LEVEL ONE	LEVEL TWO	LEVEL THREE
DECIDING	PRODUCT HAZARD (1)	CAN REQUIRE UP TO FULL STRUCTURAL FIRFIGHTING PPE	CAN REQUIRE UP TO LEVEL B CHEMICAL PPE AND /OR SPECIALIZEDHIGH TEMPERATURE PPE	REQUIRES LEVEL A CHEMICAL PPE OR BOTH LEVEL A & SPECIALIZED HIGH TEMPERATURE PPE
CONDITIONS	LIFE SAFETY (2)	NO LIFE THREAENING SITUATION FROM MATERIALSINVOLVED	LOCALIZED AREALIMITE EVACUATION AREA	LARGE AREA. MASS EVACUATION AREA.
CONTRIBUTING FACTORS	ENVIRONMENTAL IMPACT (POTENTIAL)	MINIMAL	MODERATE	SEVERE
	LEAK SEVERITY	NO RELEASES OR SMALL RLEASE CONTAINED OR CONFINED WITH READILY AVAILABLE RESOURCES	RELEASES MAY NOT BE CONTROLLABLE WITHOUT SPECIAL RESOURCES	RELEASE MAY NOT BE CONTROLLABLE EVEN WITH SPECIAL RESOURCS
	NONPRESSURIZED CONTAINER INTEGRITY	STRESSED OR MINOR DAMAGE	DAMAGED BUT ABLE TO CONTAN THE CONTENTS TO ALLOW HANDLING OR TRANSFER OF PRODUCTS	DAMAGED TOSUCH AN EXTENT THAT CATASTROPHIC RUPTURE IS POSSIBLE
	PRESSURIZED CONTAINER INTEGRITY	STRESSED BUT NOT DAMAGED	DAMAGED BUT ABLE TO CONTAN THE CONTENTS TO ALLOW HANDLING OR TRANSFER OF PRODUCTS	DAMAGED TO SUCH AN EXTENT THAT CATASTROPHIC RUPTURE IS POSSIBLE
	LIFE THREATENING EXPLOSION POTENTIAL	LOW	MEDIUM	HIGH

POTENTIAL HAZARDS

HEALTH

- **TOXIC; Extremely Hazardous.**
- May be fatal if inhaled or absorbed through skin.
- Initial odor may be irritating or foul and may deaden your sense of smell.
- Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite.
- Fire will produce irritating, corrosive and/or toxic gases.
- Runoff from fire control may cause pollution.

FIRE OR EXPLOSION

- These materials are extremely flammable.
- May form explosive mixtures with air.
- May be ignited by heat, sparks or flames.
- Vapors from liquefied gas are initially heavier than air and spread along ground.
- Vapors may travel to source of ignition and flash back.
- Runoff may create fire or explosion hazard.
- Containers may explode when heated.
- Ruptured cylinders may rocket.

PUBLIC SAFETY

- **CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- Isolate spill or leak area immediately for at least 100 to 200 meters (330 to 660 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Keep out of low areas.
- Ventilate closed spaces before entering.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing which is specifically recommended by the manufacturer. It may provide little or no thermal protection.
- Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations.

EVACUATION

Spill

- See the Table of Initial Isolation and Protective Action Distances for highlighted substances. For non-highlighted substances, increase, in the downwind direction, as necessary, the isolation distance shown under "PUBLIC SAFETY".

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions.

EMERGENCY RESPONSE

FIRE

- **DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED.**

Small Fires

- Dry chemical, CO_2, water spray or regular foam.

Large Fires

- Water spray, fog or regular foam.
- Move containers from fire area if you can do it without risk.
- Damaged cylinders should be handled only by specialists.

Fire involving Tanks

- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Do not direct water at source of leak or safety devices; icing may occur.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from tanks engulfed in fire.

SPILL OR LEAK

- ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
- All equipment used when handling the product must be grounded.
- Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire.
- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material.
- Do not direct water at spill or source of leak.
- If possible, turn leaking containers so that gas escapes rather than liquid.
- Prevent entry into waterways, sewers, basements or confined areas.
- Isolate area until gas has dispersed.
- Consider igniting spill or leak to eliminate toxic gas concerns.

FIRST AID

- Move victim to fresh air. • Call 911 or emergency medical service.
- Apply artificial respiration if victim is not breathing.
- **Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device.**
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- In case of contact with liquefied gas, thaw frosted parts with lukewarm water.
- Keep victim warm and quiet. • Keep victim under observation.
- Effects of contact or inhalation may be delayed.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

Name of Material	Guide No.	ID No.
Hazardous substance, liquid, n.o.s.	**171**	9188
Hazardous substance, solid, n.o.s.	**171**	9188
Hazardous waste, liquid, n.o.s.	**171**	3082
Hazardous waste, liquid, n.o.s.	**171**	9189
Hazardous waste, solid, n.o.s.	**171**	3077
Hazardous waste, solid, n.o.s.	**171**	9189
HD	**153**	**2810**
Heater for refrigerator car, liquid fuel type	**128**	1993
Heating oil, light	**128**	1202
Heat producing article	**171**	8038
Helium	**121**	1046
Helium, compressed	**121**	1046
Helium, refrigerated liquid (cryogenic liquid)	**120**	1963
Helium-Oxygen mixture	**122**	1980
Heptafluoropropane	**126**	3296
n-Heptaldehyde	**129**	3056
Heptanes	**128**	1206
n-Heptene	**128**	2278
Hexachloroacetone	**153**	2661
Hexachlorobenzene	**152**	2729
Hexachlorobutadiene	**151**	2279
Hexachlorocyclopentadiene	**151**	**2646**
Hexachloroethane	**151**	9037
Hexachlorophene	**151**	2875
Hexadecyltrichlorosilane	**156**	1781
Hexadiene	**130**	2458
Hexaethyl tetraphosphate	**151**	1611
Hexaethyl tetraphosphate, liquid	**151**	1611
Hexaethyl tetraphosphate, solid	**151**	1611
Hexaethyl tetraphosphate and compressed gas mixture	**123**	**1612**
Hexaethyl tetraphosphate mixture, liquid	**152**	2783
Hexafluoroacetone	**125**	**2420**
Hexafluoroacetone hydrate	**151**	2552
Hexafluoroethane	**126**	2193
Hexafluoroethane, compressed	**126**	2193
Hexafluorophosphoric acid	**154**	1782
Hexafluoropropylene	**126**	1858
Hexafluoropropylene oxide	**126**	1956
Hexaldehyde	**129**	1207
Hexamethylenediamine, solid	**153**	2280
Hexamethylenediamine, solution	**153**	1783
Hexamethylene diisocyanate	**156**	2281
Hexamethyleneimine	**132**	2493
Hexamethylenetetramine	**133**	1328
3,3,6,6,9,9-Hexamethyl-1,2,4,5-tetraoxacyclononane	**146**	2165
3,3,6,6,9,9-Hexamethyl-1,2,4,5-tetraoxacyclononane	**145**	2166
3,3,6,6,9,9-Hexamethyl-1,2,4,5-tetraoxacyclononane	**145**	2167
Hexamine	**133**	1328
Hexanes	**128**	1208
Hexanoic acid	**154**	1760
Hexanoic acid	**153**	2829
Hexanols	**129**	2282
1-Hexene	**128**	2370
Hexyltrichlorosilane	**156**	1784
HL	**153**	**2810**
HN-1 (nitrogen mustard)	**153**	**2810**
HN-2	**153**	**2810**
HN-3	**153**	**2810**
Hydrazine, anhydrous	**132**	2029
Hydrazine, aqueous solution, with not less than 37% but not more than 64% Hydrazine	**153**	2030
Hydrazine, aqueous solution, with not more than 37% Hydrazine	**152**	3293
Hydrazine, aqueous solutions, with more than 64% Hydrazine	**132**	2029
Hydrazine, aqueous solutions, with not more than 64% Hydrazine	**153**	2030
Hydrazine hydrate	**153**	2030
Hydrides, metal, n.o.s.	**138**	1409
Hydriodic acid	**154**	1787
Hydriodic acid, solution	**154**	1787
Hydrobromic acid	**154**	1788
Hydrobromic acid, solution	**154**	1788
Hydrocarbon gas, compressed, n.o.s.	**115**	1964
Hydrocarbon gas, liquefied, n.o.s.	**115**	1965
Hydrocarbon gas mixture, compressed, n.o.s.	**115**	1964
Hydrocarbon gas mixture, liquefied, n.o.s.	**115**	1965
Hydrocarbon gas refills for small devices, with release device	**115**	3150
Hydrocarbons, liquid, n.o.s.	**128**	3295
Hydrochloric acid	**157**	1789
Hydrochloric acid, mixture	**157**	1789
Hydrochloric acid, solution	**157**	1789
Hydrocyanic acid, aqueous solution, with less than 5% Hydrogen cyanide	**154**	1613
Hydrocyanic acid, aqueous solution, with not more than 20% Hydrogen cyanide	**154**	**1613**
Hydrocyanic acid, aqueous solutions, with more than 20% Hydrogen cyanide	**117**	**1051**
Hydrocyanic acid, liquefied	**117**	1051
Hydrofluoric acid	**157**	1790
Hydrofluoric acid, solution	**157**	1790
Hydrofluoric acid and Sulfuric acid mixture	**157**	1786
Hydrofluoric acid and Sulphuric acid mixture	**157**	1786
Hydrofluorosilicic acid	**154**	1778
Hydrofluosilicic acid	**154**	1778
Hydrogen	**115**	1049
Hydrogen, compressed	**115**	1049
Hydrogen, refrigerated liquid (cryogenic liquid)	**115**	1966
Hydrogen and Carbon monoxide mixture	**119**	**2600**
Hydrogen and Carbon monoxide mixture, compressed	**119**	**2600**
Hydrogen and Methane mixture, compressed	**115**	2034
Hydrogen bromide, anhydrous	**125**	**1048**
Hydrogen chloride, anhydrous	**125**	**1050**
Hydrogen chloride, refrigerated liquid	**125**	**2186**
Hydrogen cyanide, anhydrous, stabilized	**117**	**1051**
Hydrogen cyanide, anhydrous, stabilized (absorbed)	**131**	**1614**
Hydrogen cyanide, aqueous solution, with not more than 20% Hydrogen cyanide	**154**	**1613**

TABLE OF INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES

		SMALL SPILLS (From a small package or small leak from a large package)						LARGE SPILLS (From a large package or from many small packages)					
		First **ISOLATE** in all Directions		Then **PROTECT** persons Downwind during-				First **ISOLATE** in all Directions		Then **PROTECT** persons Downwind during-			
				DAY		**NIGHT**				**DAY**		**NIGHT**	
ID No.	**NAME OF MATERIAL**	Meters	(Feet)	Kilometers	(Miles)	Kilometers	(Miles)	Meters	(Feet)	Kilometers	(Miles)	Kilometers	(Miles)
1005	Ammonia, anhydrous	30 m	(100 ft)	0.2 km	(0.1 mi)	0.2 km	(0.1 mi)	60 m	(200 ft)	0.5 km	(0.3 mi)	1.1 km	(0.7 mi)
1005	Ammonia, anhydrous, liquefied												
1005	Ammonia, solution, with more than 50% Ammonia												
1005	Anhydrous ammonia												
1005	Anhydrous ammonia, liquefied												
1008	Boron trifluoride	30 m	(100 ft)	0.2 km	(0.1 mi)	0.6 km	(0.4 mi)	215 m	(700 ft)	1.6.5 km	(1.0 mi)	5.1 km	(3.2 mi)
1008	Boron trifluoride, compressed												
1016	Carbon monoxide	30 m	(100 ft)	0.2 km	(0.1 mi)	0.2 km	(0.1 mi)	125 m	(400 ft)	0.6 km	(0.4 mi)	1.8 km	(1.1 mi)
1016	Carbon monoxide, compressed												
1017	Chlorine	30 m	(100 ft)	0.3 km	(0.2 mi)	1.1 km	(0.7 mi)	275 m	(900 ft)	2.7 km	(1.7 mi)	6.8 km	(4.2 mi)
1023	Coal gas	30 m	(100 ft)	0.2 km	(0.1 mi)	0.2 km	(0.1 mi)	60 m	(200 ft)	0.3 km	(0.2 mi)	0.5 km	(0.3 mi)
1023	Coal gas, compressed												
1026	Cyanogen	30 m	(100 ft)	0.3 km	(0.2 mi)	1.1 km	(0.7 mi)	305 m	(1000 ft)	3.1 km	(1.9 mi)	7.7 km	(4.8 mi)
1026	Cyanogen, liquefied												
1026	Cyanogen gas												
1040	Ethylene oxide	30 m	(100 ft)	0.2 km	(0.1 mi)	0.2 km	(0.1 mi)	60 m	(200 ft)	0.5 km	(0.3 mi)	1.8 km	(1.1 mi)
1040	Ethylene oxide with Nitrogen												
1004	Fluorine	30 m	(100 ft)	0.2 km	(0.1 mi)	0.5 km	(0.3 mi)	185 m	(600 ft)	1.4 km	(0.9 mi)	4.0 km	(2.5 mi)
1045	Fluorine, compressed												
1048	Hydrogen bromide, anhydrous	30 m	(100 ft)	0.2 km	(0.1 mi)	0.5 km	(0.3 mi)	125 m	(400 ft)	1.1 km	(0.7 mi)	3.4 km	(2.1 mi)
1050	Hydrogen chloride, anhydrous	30 m	(100 ft)	0.2 km	(0.1 mi)	0.6 km	(0.4 mi)	185 m	(600 ft)	1.6 km	(1.0 mi)	4.3 km	(2.7 mi)
1051	AC **(when used as a weapon)**	60 m	(200 ft)	0.2 km	(0.1 mi)	0.5 km	(0.3 mi)	460 m	(1500 ft)	1.6 km	(1.0 mi)	3.9 km	(2.4 mi)
1051	Hydrocyanic acid, aqueous solutions, with more than 20% Hydrogen cyanide	60 m	(200 ft)	0.2 km	(0.1 mi)	0.5 km	(0.3 mi)	400 m	(1300 ft)	1.3 km	(0.8 mi)	3.4 km	(2.1 mi)
1051	Hydrocyanic acid, liquefied												
1051	Hydrogen cyanide, anhydrous, stabilized												
1051	Hydrogen cyanide, stabilized												
1052	Hydrogen fluoride, anhydrous	30 m	(100 ft)	0.2 km	(0.1 mi)	0.6 km	(0.4 mi)	125 m	(400 ft)	1.1 km	(0.7 mi)	2.9 km	(1.8 mi)
1053	Hydrogen sulfide	30 m	(100 ft)	0.2 km	(0.1 mi)	0.3 km	(0.2 mi)	215 m	(700 ft)	1.4 km	(0.9 mi)	4.3 km	(2.7 mi)
1053	Hydrogen sulfide, liquefied												
1053	Hydrogen sulphide												
1053	Hydrogen sulphide, liquefied												
1062	Methylbromide	30 m	(100 ft)	0.2 km	(0.1 mi)	0.3 km	(0.2 mi)	95 m	(300 ft)	0.5 km	(0.3 mi)	1.4 km	(0.9 mi)
1064	Methylmercaptan	30 m	(100 ft)	0.2 km	(0.1 mi)	0.3 km	(0.2 mi)	95 m	(300 ft)	0.8 km	(0.5 mi)	2.7 km	(1.7 mi)
1067	Dinitrogen tetroxide	30 m	(100 ft)	0.2 km	(0.1 mi)	0.5 km	(0.3 mi)	305 m	(1000 ft)	1.3 km	(0.8 mi)	3.9 km	(2.4 mi)
1067	Dinitrogen tetroxide, liquefied												
1067	Nitrogen dioxide												
1067	Nitrogen dioxide, liquefied												
1067	Nitrogen peroxide, liquid												
1067	Nitrogen tetroxide, liquid												
1069	Nitrosyl chloride	30 m	(100 ft)	0.3 km	(0.2 mi)	1.4 km	(0.9 mi)	365 m	(1200 ft)	3.5 km	(2.2 mi)	9.8 km	(6.1 mi)
1071	Oil gas	30 m	(100 ft)	0.2 km	(0.1 mi)	0.2 km	(0.1 mi)	30 m	(100 ft)	0.3 km	(0.2 mi)	0.5 km	(0.3 mi)
1071	Oil gas, compressed												
1076	CG **(when used as a weapon)**	155 m	(500 ft)	1.3 km	(0.8 mi)	3.2 km	(2.0 mi)	765 m	(2500 ft)	7.2 km	(4.5 mi)	11.0$^+$ km	(7.0$^+$ mi)
1076	Diphosgene	60 m	(200 ft)	0.2 km	(0.1 mi)	0.5 km	(0.3 mi)	95 m	(300 ft)	1.0 km	(0.6 mi)	1.9 km	(1.2 mi)
1076	DP **(when used as a weapon)**	60 m	(200 ft)	0.3 km	(0.2 mi)	1.0 km	(0.6 mi)	185 m	(600 ft)	1.6 km	(1.0 mi)	4.5 km	(2.8 mi)
1076	Phosgene	95 m	(300 ft)	0.8 km	(0.5 mi)	2.7 km	(1.7 mi)	765 m	(2500 ft)	6.6 km	(4.1 mi)	11.0 km	(6.9 mi)
1079	Sulfur dioxide	30 m	(100 ft)	0.3 km	(0.2 mi)	1.1 km	(0.7 mi)	185 m	(600 ft)	3.1 km	(1.9 mi)	7.2 km	(4.5 mi)
1079	Sulfur dioxide, liquefied												
1079	Sulphur dioxide												
1079	Sulphur dioxide, liquefied												

means distance can be larger in certain atmospheric conditions

Name of Material	Guide No.	ID No.
Nickel sulphate	**154**	9141
Nicotine	**151**	1654
Nicotine compound, liquid, n.o.s.	**151**	3144
Nicotine compound, solid, n.o.s.	**151**	1655
Nicotine hydrochloride	**151**	1656
Nicotine hydrochloride, solution	**151**	1656
Nicotine preparation, liquid, n.o.s.	**151**	3144
Nicotine preparation, solid, n.o.s.	**151**	1655
Nicotine salicylate	**151**	1657
Nicotine sulfate, solid	**151**	1658
Nicotine sulfate, solution	**151**	1658
Nicotine sulphate, solid	**151**	1658
Nicotine sulphate, solution	**151**	1658
Nicotine tartrate	**151**	1659
Nitrate, n.o.s.	**140**	1477
Nitrates, inorganic, aqueous solution, n.o.s.	**140**	3218
Nitrates, inorganic, n.o.s.	**140**	1477
Nitrating acid, spent	**157**	1826
Nitrating acid mixture	**157**	1796
Nitrating acid mixture, spent	**157**	1826
Nitric acid, 40% or less	**154**	1760
Nitric acid, fuming	**157**	2032
Nitric acid, other than red fuming	**157**	2031
Nitric acid, red fuming	**157**	2032
Nitric oxide	**124**	1660
Nitric oxide, compressed	**124**	1660
Nitric oxide and Dinitrogen tetroxide mixture	**124**	1975
Nitric oxide and Nitrogen dioxide mixture	**124**	1975
Nitric oxide and Nitrogen tetroxide mixture	**124**	1975
Nitriles, flammable, poisonous, n.o.s.	**131**	3273
Nitriles, flammable, toxic, n.o.s.	**131**	3273
Nitriles, poisonous, flammable, n.o.s.	**131**	3275
Nitriles, poisonous, n.o.s.	**151**	3276
Nitriles, toxic, flammable, n.o.s.	**131**	3275
Nitriles, toxic, n.o.s.	**151**	3276
Nitrites, inorganic, aqueous solution, n.o.s.	**140**	3219
Nitrites, inorganic, n.o.s.	**140**	2627
Nitroanilines	**153**	1661
Nitroanisole	**152**	2730
Nitroanisole, liquid	**152**	2730
Nitroanisole, solid	**152**	2730
Nitrobenzene	**152**	1662
Nitrobenzenesulfonic acid	**153**	2305
Nitrobenzenesulphonic acid	**153**	2305
Nitrobenzotrifluorides	**152**	2306
Nitrobromobenzene	**152**	2732
Nitrobromobenzene, liquid	**152**	2732
Nitrobromobenzene, solid	**152**	2732
Nitrocellulose, block, wet, with not less than 25% alcohol	**127**	2059
Nitrocellulose, colloided, granular or flake, wet, with not less than 20% alcohol or solvent	**127**	2059
Nitrocellulose, colloided, granular or flake, wet, with not less than 20% water	**113**	2555
Nitrocellulose, solution, flammable	**127**	2059
Nitrocellulose, solution, in a flammable liquid	**127**	2059
Nitrocellulose, wet, with not less than 30% alcohol or solvent	**113**	2556
Nitrocellulose membrane filters	**133**	3270
Nitrocellulose mixture, without plasticizer, without pigment	**133**	2557
Nitrocellulose mixture, without plasticizer, with pigment	**133**	2557
Nitrocellulose mixture, with plasticizer, without pigment	**133**	2557
Nitrocellulose mixture, with plasticizer, with pigment	**133**	2557
Nitrocellulose with alcohol	**113**	2556
Nitrocellulose with not less than 25% alcohol	**113**	2556
Nitrocellulose with plasticizing substance	**133**	2557
Nitrocellulose with water, not less than 25% water	**113**	2555
Nitrochlorobenzenes, liquid	**152**	1578
Nitrochlorobenzenes, solid	**152**	1578
3-Nitro-4-chlorobenzotrifluoride	**152**	2307
Nitrocresols	**153**	2446
Nitroethane	**129**	2842
Nitrogen	**121**	1066
Nitrogen, compressed	**121**	1066
Nitrogen, refrigerated liquid (cryogenic liquid)	**120**	1977
Nitrogen and Rare gases mixture	**121**	1981
Nitrogen and Rare gases mixture, compressed	**121**	1981
Nitrogen dioxide	**124**	1067
Nitrogen dioxide, liquefied	**124**	1067
Nitrogen dioxide and Nitrix oxide mixture	**124**	1975
Nitrogen peroxide, liquid	**124**	1067
Nitrogen tetroxide, liquid	**124**	1067
Nitrogen tetroxide and Nitric oxide mixture	**124**	1975
Nitrogen trifluoride	**122**	2451
Nitrogen trifluoride, compressed	**122**	2451
Nitrogen trioxide	**124**	2421
Nitroglycerin, solution in alcohol, with more than 1% but not more than 5% Nitroglycerin	**127**	3064
Nitroglycerin, solution in alcohol, with not more than 1% Nitroglycerin	**127**	1204
Nitroglycerin mixture, desensitized, liquid, flammable, n.o.s., with not more than 30% Nitroglycerin	**113**	3343
Nitroglycerin mixture, desensitized, liquid, n.o.s., with not more than 30% Nitroglycerin	**113**	3357
Nitroglycerin mixture, desensitized, solid, n.o.s., with more than 2% but not more than 10% Nitroglycerin	**113**	3319
Nitroglycerin mixture with more than 2% but not more than 10% Nitroglycerin, desensitized	**113**	3319
Nitroguanidine (Picrite), wetted with not less than 20% water	**113**	1336
Nitroguanidine, wetted with not less than 20% water	**113**	1336
Nitrohydrochloric acid	**157**	1798
Nitromethane	**129**	1261
Nitronaphthalene	**133**	2538
Nitrophenols	**153**	1663
Nitropropanes	**129**	2608

POTENTIAL HAZARDS

HEALTH

- **Vapors may cause dizziness or asphyxiation without warning.**
- Vapors from liquefied gas are initially heavier than air and spread along ground.
- Contact with liquefied gas may cause frostbite.

FIRE OR EXPLOSION

- **Non-flammable gases.**
- Containers may explode when heated.
- Ruptured cylinders may rocket.

PUBLIC SAFETY

- **CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- Isolate spill or leak area immediately for at least 10 to 25 meters (30 to 80 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Keep out of low areas.
- Ventilate closed spaces before entering.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing will only provide limited protection.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

EMERGENCY RESPONSE

FIRE

- Use extinguishing agent suitable for type of surrounding fire.
- Move containers from fire area if you can do it without risk.
- Damaged cylinders should be handled only by specialists.

Fire involving Tanks

- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Do not direct water at source of leak or safety devices; icing may occur.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from tanks engulfed in fire.

SPILL OR LEAK

- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material.
- Do not direct water at spill or source of leak.
- If possible, turn leaking containers so that gas escapes rather than liquid.
- Prevent entry into waterways, sewers, basements or confined areas.
- Allow substance to evaporate.
- Ventilate the area.

FIRST AID

- Move victim to fresh air. • Call 911 or emergency medical service.
- Apply artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Clothing frozen to the skin should be thawed before being removed.
- In case of contact with liquefied gas, thaw frosted parts with lukewarm water.
- Keep victim warm and quiet.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

Name of Material	Guide No.	ID No.
Fish meal, unstabilized	133	1374
Fish meal containing 6% to 12% water	171	2216
Fish meal containing less than 6% or more than 12% water	133	1374
Fish scrap, stabilized	171	2216
Fish scrap, unstabilized	133	1374
Fish scrap containing 6% to 12% water	171	2216
Fish scrap containing less than 6% or more than 12% water	133	1374
Flame retardant compound, liquid (corrosive)	154	1760
Flammable gas in lighter for cigars, cigarettes, etc.	115	1057
Flammable liquid, corrosive, n.o.s.	132	2924
Flammable liquid, n.o.s.	128	1993
Flammable liquid, poisonous, corrosive, n.o.s.	131	3286
Flammable liquid, poisonous, n.o.s.	131	1992
Flammable liquid, toxic, corrosive, n.o.s.	131	3286
Flammable liquid, toxic, n.o.s.	131	1992
Flammable liquid preparations, n.o.s.	127	1142
Flammable liquids, elevated temperature material, n.o.s.	128	9276
Flammable solid, corrosive, inorganic, n.o.s.	134	3180
Flammable solid, corrosive, n.o.s.	134	2925
Flammable solid, corrosive, organic, n.o.s.	134	2925
Flammable solid, inorganic, corrosive, n.o.s.	134	3180
Flammable solid, inorganic, n.o.s.	133	3178
Flammable solid, n.o.s.	133	1325
Flammable solid, organic, molten, n.o.s.	133	3176
Flammable solid, organic, n.o.s.	133	1325
Flammable solid, oxidizing, n.o.s.	140	3097
Flammable solid, poisonous, inorganic, n.o.s.	134	3179
Flammable solid, poisonous, n.o.s.	134	2926
Flammable solid, poisonous, organic, n.o.s.	134	2926
Flammable solid, toxic, inorganic, n.o.s.	134	3179
Flammable solid, toxic, organic, n.o.s.	134	2926
Flue dust, poisonous	154	2811
Fluoboric acid	154	1775
Fluorine	124	1045
Fluorine, compressed	124	1045
Fluorine, refrigerated liquid (cryogenic liquid)	167	9192
Fluoroacetic acid	154	2642
Fluoroanilines	153	2941
Fluorobenzene	130	2387
Fluoroboric acid	154	1775
Fluorophosphoric acid, anhydrous	154	1776
Fluorosilicates, n.o.s.	151	2856
Fluorosilicic acid	154	1778
Fluorosulfonic acid	137	1777
Fluorosulphonic acid	137	1777
Fluorotoluenes	130	2388
Fluosilicic acid	154	1778
Formaldehyde, solution, flammable	132	1198
Formaldehyde, solutions (Formalin)	132	1198
Formaldehyde, solutions (Formalin) (corrosive)	132	2209
Formic acid	153	1779
Fuel, aviation, turbine engine	128	1863
Fuel oil	128	1202
Fuel oil	128	1993
Fuel oil, no. 1,2,4,5,6	128	1202
Fumaric acid	171	9126
Fumaryl chloride	156	1780
Furaldehydes	132P	1199
Furan	127	2389
Furfural	132P	1199
Furfuraldehydes	132P	1199
Furfuryl alcohol	153	2874
Furfurylamine	132	2526
Fusee (rail or highway)	133	1325
Fusel oil	127	1201
GA	153	2810
Gallium	172	2803
Gas, refrigerated liquid, flammable, n.o.s.	115	3312
Gas, refrigerated liquid, n.o.s.	120	3158
Gas, refrigerated liquid, oxidizing, n.o.s.	122	3311
Gas cartridges	115	2037
Gas drips, hydrocarbon	128	1864
Gas generator assemblies	171	8013
Gas identification set	123	9035
Gasohol	128	1203
Gas oil	128	1202
Gasoline	128	1203
Gas sample, non-pressurized, flammable, n.o.s., not refrigerated liquid	115	3167
Gas sample, non-pressurized, poisonous, flammable, n.o.s., not refrigerated liquid	119	3168
Gas sample, non-pressurized, poisonous, n.o.s., not refrigerated liquid	123	3169
Gas sample, non-pressurized, toxic, flammable, n.o.s., not refrigerated liquid	119	3168
Gas sample, non-pressurized, toxic, n.o.s., not refrigerated liquid	123	3169
GB	153	2810
GD	153	2810
Genetically modified micro-organisms	171	3245
Genetically modified organisms	171	9278
Germane	119	2192
GF	153	2810
Glycerol alpha-monochlorohydrin	153	2689
Glycidaldehyde	131P	2622
Grenade, tear gas	159	2017
Guanidine nitrate	143	1467
H	153	2810
Hafnium powder, dry	135	2545
Hafnium powder, wetted with not less than 25% water	170	1326
Halogenated irritating liquid, n.o.s.	159	1610
Hay, wet, damp or contaminated with oil	133	1327

POTENTIAL HAZARDS

FIRE OR EXPLOSION

- **HIGHLY FLAMMABLE: Will be easily ignited by heat, sparks or flames.**
- Vapors may form explosive mixtures with air.
- Vapors may travel to source of ignition and flash back.
- Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Vapor explosion hazard indoors, outdoors or in sewers.
- Those substances designated with a **"P"** may polymerize explosively when heated or involved in a fire.
- Runoff to sewer may create fire or explosion hazard.
- Containers may explode when heated.
- Many liquids are lighter than water.
- Substance may be transported hot.

HEALTH

- Inhalation or contact with material may irritate or burn skin and eyes.
- Fire may produce irritating, corrosive and/or toxic gases.
- Vapors may cause dizziness or suffocation.
- Runoff from fire control or dilution water may cause pollution.

PUBLIC SAFETY

- **CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Keep out of low areas.
- Ventilate closed spaces before entering.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing will only provide limited protection.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 300 meters (1000 feet).

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions

EMERGENCY RESPONSE

FIRE

CAUTION: All these products have a very low flash point: Use of water spray when fighting fire may be inefficient.

Small Fires

- Dry chemical, CO_2, water spray or regular foam.

Large Fires

- Water spray, fog or regular foam.
- Use water spray or fog; do not use straight streams.
- Move containers from fire area if you can do it without risk.

Fire involving Tanks or Cars/Trailer Loads

- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from tanks engulfed in fire.
- For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

SPILL OR LEAK

- ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
- All equipment used when handling the product must be grounded.
- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Prevent entry into waterways, sewers, basements or confined areas.
- A vapor suppressing foam may be used to reduce vapors.
- Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.
- Use clean non-sparking tools to collect absorbed material.

Large Spills

- Dike far ahead of liquid spill for later disposal.
- Water spray may reduce vapor; but may not prevent ignition in closed spaces.

FIRST AID

- Move victim to fresh air. • Call 911 or emergency medical service.
- Apply artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Wash skin with soap and water.
- Keep victim warm and quiet.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

If material involved in fire
Extinguish fire using agent suitable for type of surrounding fire (Material itself does not burn or burns with difficulty.)
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 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
Personnel protection
Avoid breathing vapors
Keep upwind
Avoid bodily contact with the material
Wear boots, protective gloves, and goggles
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
If contact with the material anticipated, wear full protective clothing
Environmental considerations—land spill
Dig a pit, pond, lagoon, holding area to contain liquid or solid material
Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete
Absorb bulk liquid with fly ash or cement powder
Neutralize with agricultural lime (slaked lime), crushed limestone, or sodium bicarbonate
Environmental considerations—water spill
Neutralize with agricultural lime (slaked lime), crushed limestone, or sodium bicarbonate
Environmental considerations—air spill
Apply water spray or mist to knock down vapors
Vapor knockdown water is corrosive or toxic and should be diked for containment

HYDROCHLORIC ACID, ANHYDROUS (See HYDROGEN CHLORIDE 4904270)

HYDROCYANIC ACID, LIQUEFIED 4920125
POISON A, FLAMMABLE NA1051
ENVIRONMENTALLY HAZARDOUS SUBSTANCE (RQ-10/4.54)

Hydrocyanic acid, liquefied is a colorless gas with a faint aromatic odor. It is shipped as a liquefied gas under its vapor pressure and it must be stabilized to avoid polymerization. It is easily ignited. The vapor is just lighter than air but a flame can travel back to the source of leak very easily. It can polymerize from contact with alkali. Lethal amounts may be absorbed through the skin, as well as by inhalation. It may be shipped in cylinders or tank cars. Prolonged exposure to fire or heat may cause the cylinder or tank car to violently rupture and rocket.

It weighs 5.7 pounds per gallon.

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
Solid streams of water may be ineffective
Use "alcohol" foam, carbon dioxide or dry chemical
If material not on fire and not involved in fire
Keep sparks, flames, and other sources of ignition away
Keep material out of water sources and sewers
Build dikes to contain flow as necessary
Attempt to stop leak if without hazard
Use water spray to knock-down vapors
Personnel protection
Avoid breathing vapors
Keep upwind
Wear self-contained breathing apparatus
Avoid bodily contact with the material
Wear full protective clothing
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
Evacuation
If fire becomes uncontrollable or container is exposed to direct flame—evacuate for a radius of 2500 feet
If material leaking (not on fire) evacuate for a radius of 2500 feet
Environmental considerations—land spill
Dig a pit, pond, lagoon, holding area to contain liquid or solid material
Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete
Absorb bulk liquid with fly ash or cement powder
Environmental considerations—water spill
Use natural barriers or oil spill control booms to limit spill motion
Neutralize with agricultural lime (slaked lime), crushed limestone, or sodium bicarbonate
Environmental considerations—air spill
Apply water spray or mist to knock down vapors
Vapor knockdown water is corrosive or toxic and should be diked for containment

HYDROCYANIC ACID, SOLUTION 4920130
POISON A, FLAMMABLE UN1613
ENVIRONMENTALLY HAZARDOUS SUBSTANCE (RQ-10/4.54)

Hydrocyanic acid, solution is hydrocyanic acid, a gas dissolved in water. It is a clear colorless liquid with a faint aromatic odor. It is flammable though the lower concentrations may require some effort to ignite. The vapor is lighter than air, but a flame can flash back to the source of the leak very easily. Lethal amounts may be absorbed through the skin as well as by inhalation.

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
Solid streams of water may be ineffective
Use "alcohol" foam, carbon dioxide or dry chemical
If material not on fire and not involved in fire
Keep sparks, flames, and other sources of ignition away
Keep material out of water sources and sewers
Build dikes to contain flow as necessary
Attempt to stop leak if without hazard
Use water spray to knock-down vapors
Personnel protection
Avoid breathing vapors
Keep upwind
Wear self-contained breathing apparatus
Avoid bodily contact with the material
Wear full protective clothing
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
Evacuation
If fire becomes uncontrollable or container is exposed to direct flame—evacuate for a radius of 2500 feet
If material leaking (not on fire) evacuate for a radius of 2500 feet

Continued on next page

Personnel protection
- Avoid breathing dusts, and fumes from burning material
- Keep upwind
- Avoid bodily contact with the material
- Wear full protective clothing
- 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

NITROCHLOROBENZENE, ORTHO, LIQUID **4921457**
POISON B **UN1578**

Nitrochlorobenzene, ortho, liquid is a clear yellow liquid. It will burn though it may require some effort to ignite. It is heavier than water and insoluble in water. It is toxic by inhalation and skin absorption. Toxic oxides of nitrogen are produced during combustion of this material.

If material on fire or involved in fire
- Do not extinguish fire unless flow can be stopped
- Use water in flooding quantities as fog
- Solid streams of water may be ineffective
- Cool all affected containers with flooding quantities of water
- Apply water from as far a distance as possible
- Use foam, carbon dioxide or dry chemical

If material not on fire and not involved in fire
- Keep sparks, flames, and other sources of ignition away
- Keep material out of water sources and sewers
- Build dikes to contain flow as necessary
- Attempt to stop leak if without hazard
- Use water spray to knock-down vapors

Personnel protection
- Avoid breathing vapors
- Keep upwind
- Wear self-contained breathing apparatus
- Avoid bodily contact with the material
- Wear full protective clothing
- 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

Evacuation
- If material leaking (not on fire), downwind evacuation must be considered

NITROCHLOROBENZENE, PARA, SOLID (PARA-NITROCHLOROBENZENE) **4921459**
POISON B **UN1578**

Nitrochlorobenzene, para, solid is a yellow crystalline solid. It is used in the manufacture of chemicals, dyes and agricultural chemicals. It is toxic by inhalation (dust etc.) and may be toxic by skin absorption. Toxic oxides of nitrogen are produced during combustion of this material.

If material on fire or involved in fire
- Extinguish fire using agent suitable for type of surrounding fire (Material itself does not burn or burns with difficulty.)
- Use water in flooding quantities as fog
- Use foam, carbon dioxide or dry chemical

If material not on fire and not involved in fire
- Keep sparks, flames, and other sources of ignition away
- Keep material out of water sources and sewers

Personnel protection
- Avoid breathing dusts, and fumes from burning material
- Keep upwind
- Avoid bodily contact with the material
- Wear full protective clothing
- 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

NITROGEN **4904565**
NONFLAMMABLE GAS **UN1066**

Nitrogen is a colorless odorless gas. It is noncombustible, it can cause asphyxiation by displacement of air. It can be shipped in cylinders, cargo tanks, or tank cars.

If material involved in fire
- Extinguish fire using agent suitable for type of surrounding fire (Material itself does not burn or burns with difficulty.)
- Cool all affected containers with flooding quantities of water
- Apply water from as far a distance as possible

If material not involved in fire
- Attempt to stop leak if without hazard

Personnel protection
- Wear protective gloves and goggles
- Do not handle broken packages without protective equipment

NITROGEN DIOXIDE, LIQUID **4920340**
POISON A, OXIDIZING **UN1067**
ENVIRONMENTALLY HAZARDOUS SUBSTANCE (RQ-1000/454)

Nitrogen dioxide, liquid is a reddish brown colored gas which becomes a yellowish brown liquid on cooling or compressing. It is shipped as a liquefied gas under its vapor pressure. Its vapor is heavier than air. It dissolves in water forming nitric acid, a corrosive material. It is toxic by inhalation (vapor) and skin absorption. It is noncombustible but it will accelerate the burning of combustible materials. The cylinders and "ton container" tank cars may not be equipped with a safety relief device. Prolonged exposure to fire or heat can cause the violent rupturing and rocketing of the cylinders and tank cars.

It weighs 12.1 pounds per gallon.

If material involved in fire
- Extinguish fire using agent suitable for type of surrounding fire (Material itself does not burn or burns with difficulty.)
- 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
- Use foam, carbon dioxide or dry chemical

If material not involved in fire
- Keep sparks, flames, and other sources of ignition away
- Keep material out of water sources and sewers
- Attempt to stop leak if without hazard
- Use water spray to knock-down vapors

Personnel protection
- Avoid breathing vapors
- Keep upwind
- Wear self-contained breathing apparatus
- Avoid bodily contact with the material
- Wear full protective clothing
- 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

Evacuation
- If material leaking (not on fire) evacuate for a radius of 2500 feet

Environmental considerations—land spill
- Dig a pit, pond, lagoon, holding area to contain liquid or solid material
- Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete
- Absorb bulk liquid with fly ash or cement powder
- Neutralize with agricultural lime (slaked lime), crushed limestone, or sodium bicarbonate

Environmental considerations—water spill
- Neutralize with agricultural lime (slaked lime), crushed limestone, or sodium bicarbonate
- Use mechanical dredges or lifts to remove immobilized masses of pollutants and precipitates

Environmental considerations—air spill
- Apply water spray or mist to knock down vapors
- Vapor knockdown water is corrosive or toxic and should be diked for containment

If material not on fire and not involved in fire
Keep sparks, flames, and other sources of ignition away
Keep material out of water sources and sewers
Build dikes to contain flow as necessary
Use water spray to knock-down vapors
Personnel protection
Avoid breathing vapors
Keep upwind
Wear boots, protective gloves, and goggles
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

GAS ODORANTS, NOT COMPRESSED GAS (FLAMMABLE LIQUID, N.O.S.) 4910474
FLAMMABLE LIQUID UN1993

Gas odorants, not compressed gas are materials containing a solvent having a closed cup flash point of less than 100 deg. F. The hazard of these materials is flammability.

If material on fire or involved in fire
Do not extinguish fire unless flow can be stopped
Use water in flooding quantities as fog
Solid streams of water may be ineffective
Cool all affected containers with flooding quantities of water
Apply water from as far a distance as possible
Use "alcohol" foam, carbon dioxide or dry chemical
If material not on fire and not involved in fire
Keep sparks, flames, and other sources of ignition away
Keep material out of water sources and sewers
Build dikes to contain flow as necessary
Use water spray to knock-down vapors
Personnel protection
Avoid breathing vapors
Keep upwind
Wear boots, protective gloves, and goggles
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

GASOHOL 4907827
FLAMMABLE LIQUID NA1257

Gasohol is a blend of gasoline and ethyl alcohol having an odor more of alcohol than gasoline. It is used as a motor fuel. It has a flash point of less than 0 deg. F. It is lighter than water and insoluble in water. Its vapors are heavier than air.

If material on fire or involved in fire
Do not extinguish fire unless flow can be stopped
Use water in flooding quantities as fog
Solid streams of water may spread fire
Cool all affected containers with flooding quantities of water
Apply water from as far a distance as possible
Use "alcohol" foam, carbon dioxide or dry chemical
If material not on fire and not involved in fire
Keep sparks, flames, and other sources of ignition away
Keep material out of water sources and sewers
Build dikes to contain flow as necessary
Attempt to stop leak if without hazard
Use water spray to knock-down vapors
Personnel protection
Avoid breathing vapors
Keep upwind
Wear boots, protective gloves, and goggles
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
Evacuation
If fire becomes uncontrollable or container is exposed to direct flame—evacuate for a radius of 1500 feet
If material leaking (not on fire), downwind evacuation must be considered

GASOLINE 4908178
FLAMMABLE LIQUID UN1203

Gasoline is a clear colorless to amber colored volatile liquid with a petroleum like odor. It has a flash point of less than 0 deg. F. It is lighter than water and insoluble in water. The vapors are heavier than air.

If material on fire or involved in fire
Do not extinguish fire unless flow can be stopped
Use water in flooding quantities as fog
Solid streams of water may spread fire
Cool all affected containers with flooding quantities of water
Apply water from as far a distance as possible
Use foam, carbon dioxide or dry chemical
If material not on fire and not involved in fire
Keep sparks, flames, and other sources of ignition away
Keep material out of water sources and sewers
Build dikes to contain flow as necessary
Attempt to stop leak if without hazard
Use water spray to knock-down vapors
Personnel protection
Avoid breathing vapors
Keep upwind
Wear boots, protective gloves, and goggles
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
Evacuation
If fire becomes uncontrollable or container is exposed to direct flame—evacuate for a radius of 1500 feet
If material leaking (not on fire), downwind evacuation must be considered

GASOLINE (GASOLINE NATURAL (CASING HEAD)) 4908176
FLAMMABLE LIQUID UN1203

Gasoline is a clear colorless to amber colored volatile liquid with a petroleum like odor. It has a flash point of less than 0 deg. F. It is lighter than water and insoluble in water. The vapors are heavier than air.

If material on fire or involved in fire
Do not extinguish fire unless flow can be stopped
Use water in flooding quantities as fog
Solid streams of water may spread fire
Cool all affected containers with flooding quantities of water
Apply water from as far a distance as possible
Use foam, carbon dioxide or dry chemical
If material not on fire and not involved in fire
Keep sparks, flames, and other sources of ignition away
Keep material out of water sources and sewers
Build dikes to contain flow as necessary
Attempt to stop leak if without hazard
Use water spray to knock-down vapors
Personnel protection
Avoid breathing vapors
Keep upwind
Wear boots, protective gloves, and goggles
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
Evacuation
If fire becomes uncontrollable or container is exposed to direct flame—evacuate for a radius of 1500 feet
If material leaking (not on fire), downwind evacuation must be considered

HYDROGEN CYANIDE

HCN

Common Synonyms

Hydrocyanic acid
Prussic acid

Watery liquid, or gas Colorless Bitter almond odor

Sinks and mixes with water. Poisonous, flammable vapor is produced and rises. Boiling point is 78°F.

AVOID CONTACT WITH LIQUID AND VAPOR. EVACUATE AREA.
WEAR CHEMICAL PROTECTIVE SUIT WITH SELF-CONTAINED BREATHING APPARATUS.
Stop discharge if possible. Call fire department.
Shut off ignition sources.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
WEAR CHEMICAL PROTECTIVE SUIT WITH SELF-CONTAINED BREATHING APPARATUS.
Stop discharge if possible.
Cool exposed containers and protect men effecting shutoff with water.
Let fire burn.

Exposure

CALL FOR MEDICAL AID.

VAPOR
POISONOUS IF INHALED OR IF SKIN IS EXPOSED.
Irritating to eyes.
Move to fresh air.
If breathing has stopped, give artificial respiration (but NOT mouth to mouth).
If breathing is difficult, give oxygen.

LIQUID
POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.
Irritating to eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability, water contaminant
Restrict access
Evacuate area

2. LABEL

2.1 **Category:** Poison
2.2 **Class:** 6

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** HCN
3.3 **IMO/UN Designation:** 2.0/1051
3.4 **DOT ID No.:** 1051
3.5 **CAS Registry No.:** 74-90-8

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless to bluish white
4.3 **Odor:** Characteristic sweetish, like almond

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** CAUTION-Class A poison; asphyxiation can be caused by ingestion, inhalation, or absorption of liquid or vapor through skin (particularly eyes, mucous membranes, and feet). Escape purposes only-air escape mask with 5-minute air cylinder. Work purposes-vapor-proof emergency suit or vinyl-coated coverall, plus air mask with clear-view facepiece, speaking diaphragm, demand regulator, and 30-minute air cylinder. Rubber gloves; chemical safety goggles; quick-opening safety shower.

5.2 **Symptoms Following Exposure:** Irritation of throat, palpitation, difficult breathing, reddening of eyes, salivation, nausea, headache, weakness of arms and legs, giddiness-followed by collapse and convulsions.

5.3 **Treatment of Exposure:** Call a doctor. If breathing has stopped, give artificial respiration until doctor arrives. INHALATION: remove patient to fresh air. SKIN CONTACT: remove contaminated clothing and wash skin thoroughly with copious quantities of water and soap. EYE CONTACT: hold eyelids apart and wash eye with continuous gentle stream of water for at least 15 min. If patient is unconscious, administer amyl nitrite by crushing a pearl (ampule) in a cloth and holding this under patient's nose for 15 seconds in every minute. Do not interrupt artificial respiration. Replace amyl nitrite pearl when its strength is spent. Continue treatment until patient's condition improves or doctor arrives.

5.4 **Threshold Limit Value:** 10 ppm
5.5 **Short Term Inhalation Limits:** 20 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 4; LD_{50} less than 50 mg/kg
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapor is not very irritating but is extremely poisonous.
5.9 **Liquid or Solid Irritant Characteristics:** Liquid is not irritating but is extremely poisonous if absorbed through skin or eyes.
5.10 **Odor Threshold:** 1 mg/m³
5.11 **IDLH Value:** 50 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 0°F C.C.
6.2 **Flammable Limits in Air:** 5.6%-40.0%
6.3 **Fire Extinguishing Agents:** Stop flow of gas
6.4 **Fire Extinguishing Agents Not to be Used:** None
6.5 **Special Hazards of Combustion Products:** Extremely toxic vapors are generated even at ordinary temperatures.
6.6 **Behavior in Fire:** Containers may explode with ignition of contents.
6.7 **Ignition Temperature:** 1004°F
6.8 **Electrical Hazard:** Data not available
6.9 **Burning Rate:** 1.8 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** 6.350 (Est.)
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** Dissolves with a moderate reaction.
7.2 **Reactivity with Common Materials:** None
7.3 **Stability During Transport:** May become unstable and subject to explosion if stored for extended time or exposed to high temp. and pressure.
7.4 **Neutralizing Agents for Acids and Caustics:** The weak acidity can be neutralized by slaked lime, but this does not destroy the poisonous property.
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:**
0.16 ppm/72 hr/young bass/TL_m/fresh water
0.069 ppm/24 hr/pin perch/TL_m/salt water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** 96%; sometimes shipped as a water solution, or absorbed on an inert solid. All forms are extremely toxic.
9.2 **Storage Temperature:** Data not available
9.3 **Inert Atmosphere:** May be padded
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-B-C-K-L-M-N

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Poison, A
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	4
Health	
Vapor Irritant	2
Liquid or Solid Irritant	1
Poisons	4
Water Pollution	
Human Toxicity	4
Aquatic Toxicity	4
Aesthetic Effect	1
Reactivity	
Other Chemicals	3
Water	0
Self Reaction	3

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	4
Flammability (Red)	4
Reactivity (Yellow)	2

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 27.03
12.3 **Boiling Point at 1 atm:** 78.3°F = 25.7°C = 298.9°K
12.4 **Freezing Point:** 8.1°F = −13.3°C = 259.9°K
12.5 **Critical Temperature:** 362.3°F = 183.5°C = 456.7°K
12.6 **Critical Pressure:** 735 psia = 50 atm = 5.07 MN/m²
12.7 **Specific Gravity:** 0.689 at 20°C (liquid)
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** 0.9
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.303
12.12 **Latent Heat of Vaporization:** 444 Btu/lb = 247 cal/g = 10.3×10^5 J/kg
12.13 **Heat of Combustion:** −10,560 Btu/lb = −5864 cal/g = -245.3×10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 74.38
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

NITROGEN

NXX

Common Synonyms
Liquid nitrogen

Gas Colorless Odorless

Floats and boils on water.

Avoid contact with liquid.

Fire

Not flammable.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Not harmful.
In high concentrations may cause dizziness, difficult breathing, or loss of consciousness.

LIQUID
Will cause frostbite.
Flush affected areas with plenty of water.
DO NOT RUB AFFECTED AREAS.

Water Pollution

Not harmful to aquatic life.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Restrict access

2. LABEL

2.1 Category: Nonflammable gas
2.2 Class: 2

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: N_2
3.3 IMO/UN Designation: 2/1977
3.4 DOT ID No.: 1977
3.5 CAS Registry No.: 7727-37-9

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquefied gas
4.2 Color: Colorless to faint yellow
4.3 Odor: None

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Safety glasses or face shield; insulated gloves; long sleeves; trousers worn outside boots or over high-top shoes to shed spilled liquid; self-contained breathing apparatus where insufficient air is present.
5.2 Symptoms Following Exposure: Inhalation can cause asphyxiation, if atmosphere does not contain oxygen; dizziness, unconsciousness, or even death can result. Contact of liquid with skin or eyes causes frostbite burns.
5.3 Treatment of Exposure: INHALATION: remove to fresh air; apply artificial respiration if breathing has stopped; call physician. EYES: treat for frostbite burns caused by liquid. SKIN: treat for frostbite; soak in lukewarm water.
5.4 Threshold Limit Value: Non-toxic
5.5 Short Term Inhalation Limits: Not pertinent
5.6 Toxicity by Ingestion: Not pertinent
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: None
5.9 Liquid or Solid Irritant Characteristics: Frostbite
5.10 Odor Threshold: Not pertinent
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: Not pertinent (nonflammable compressed gas)
6.2 Flammable Limits in Air: Not pertinent
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Containers may explode when heated.
6.7 Ignition Temperature: Not pertinent
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not pertinent
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: Heat of water will vigorously vaporize liquid nitrogen.
7.2 Reactivity with Common Materials: No chemical reaction. Low temperature may cause brittleness in rubber and plastics.
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: None
8.2 Waterfowl Toxicity: None
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: 99.5+%
9.2 Storage Temperature: −320°F
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-C-D-F-G

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Nonflammable gas
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	0
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Gas
12.2 Molecular Weight: 28.0
12.3 Boiling Point at 1 atm: −320.1°F = −195.8°C = 77.4°K
12.4 Freezing Point: −354°F = −215°C = 58°K
12.5 Critical Temperature: −232.6°F = −147.0°C = 126.2°K
12.6 Critical Pressure: 493 psia = 33.5 atm = 3.40 MN/m²
12.7 Specific Gravity: 0.807 at −195.5°C (liquid)
12.8 Liquid Surface Tension: 8.3 dynes/cm = 0.083 N/m at −193°C
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: 0.966
12.11 Ratio of Specific Heats of Vapor (Gas): 1.3962
12.12 Latent Heat of Vaporization: 95 Btu/lb = 53 cal/g = 2.2 X 10^5 J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 6.15 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

GASOLINES: AUTOMOTIVE (<4.23g lead/gal)

GAT

Common Synonyms

Motor spirit
Petrol

Watery liquid — Colorless to pale brown or pink — Gasoline odor

Floats on water. Flammable, irritating vapor is produced.

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness, headache, difficult breathing or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea or vomiting.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Disperse and flush

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: (Mixture of hydrocarbons)
3.3 IMO/UN Designation: 3.1/1203
3.4 DOT ID No.: 1203
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless to brown
4.3 Odor: Gasoline

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective goggles, gloves.
5.2 Symptoms Following Exposure: Irritation of mucous membranes and stimulation followed by depression of central nervous system. Breathing of vapor may also cause dizziness, headache, and incoordination or, in more severe cases, anesthesia, coma, and respiratory arrest. If liquid enters lungs, it will cause severe irritation, coughing, gagging, pulmonary edema, and, later, signs of bronchopneumonia and pneumonitis. Swallowing may cause irregular heartbeat.
5.3 Treatment of Exposure: INHALATION: maintain respiration and administer oxygen; enforce bed rest if liquid is in lungs. INGESTION: do NOT induce vomiting; stomach should be lavaged (by doctor) if appreciable quantity is swallowed. EYES: wash with copious quantity of water. SKIN: wipe off and wash with soap and water.
5.4 Threshold Limit Value: 300 ppm
5.5 Short Term Inhalation Limits: 500 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg.
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.25 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: −36°F C.C.
6.2 Flammable Limits in Air: 1.4%-7.4%
6.3 Fire Extinguishing Agents: Foam, carbon dioxide, dry chemical
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: None
6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 853°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity:
90 ppm/24 hr/juvenile American shad/TL_m/fresh water
91 mg/1/24 hr/juvenile American shad/TL_m/salt water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 8%, 5 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Various octane ratings; military specifications
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U-V-W

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	2
Aesthetic Effect	2
Reactivity	
Other Chemicals	0
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	1
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm:
140—390°F
= 60—199°C = 333—472°K
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.7321 at 20°C (liquid)
12.8 Liquid Surface Tension:
19-23 dynes/cm
= 0.019—0.023 N/m at 20°C
12.9 Liquid Water Interfacial Tension:
49-51 dynes/cm
= 0.049—0.051 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 3.4
12.11 Ratio of Specific Heats of Vapor (Gas): (est.) 1.054
12.12 Latent Heat of Vaporization:
130—150 Btu/lb = 71—81 cal/g
= 3.0 — 3.4 X 10^5 J/kg
12.13 Heat of Combustion: −18,720 Btu/lb
= −10,400 cal/g = 435.1 X 10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 7.4 psia

NOTES

MODULE 4

ANALYZING THE INCIDENT

HEALTH AND SAFETY

Outline

- **Health and Safety Hazards**
- **Exposure vs. Dose**
- **Guidelines for Assessment**

MODULE 4

ANALYZING THE INCIDENT

HEALTH AND SAFETY

Objectives

The student will be able to:

1. Define exposure, doses and warning properties.
2. Identify (5) five common symptoms of chemical exposure.
3. Differentiate between chronic and acute effects of chemical exposure and give an example of each.
4. Identify (6) six safety and health hazards other than chemical contamination that may be encountered at a hazardous materials incident.
5. Define a confined space and list (4) four hazards commonly found there.
6. List (4) four precautions to be taken when attempting a rescue of a Haz Mat victim.

I. Exposure to Toxic Chemicals

Exposure to toxic chemicals is frequently the primary concern at HazMat incidents. Many scenes contain a variety of chemicals in solid, liquid or gaseous form.

Contaminants can enter the body through the four pathways consisting of inhalation, injection, ingestion and absorption. Inhalation and absorption are considered to be the most common routes of entry and protective equipment is available to minimize the risk. Remember, that the first responder with operational training will be limited in both operation and types of protective equipment.

We must always be aware of the ingestion route and how contaminants enter the body in this manner. The act of smoking, drinking, eating or rubbing ones face with the hands may introduce contaminants to the body through ingestion. For this reason, one must always be aware of the presence of contaminants at a scene and the need for safety proper protection, and effective decontamination.

Exposure and Dose

Exposure is the act of coming in contact with a contaminant.

Dose-is the amount of contaminant taken into the body.

Warning Properties-are the physical characteristics of a chemical which enable it to be identified by the senses.

Carcinogen-substance that causes cancer.

Mutagen-a substance that causes mutations. A mutation is a change in the genetic material in a body cell. Mutations can lead to birth defects, or miscarriages.

Teratogen-a substance that causes birth defects by damaging a fetus.

A contaminant could cause damage at the point of contact or at another point in the body. Effects may be immediate (acute), in the case of a large concentrated dose, or more commonly, delayed (chronic) and will not be detected for over a period of time. These are known as acute and chronic doses.

Signs and Symptoms

Symptoms from a chemical dose are not usually immediate except when the dose is very highly concentrated. In most cases, however, effects are from small chronic doses or a single large dose with delayed effects. Unless the contaminant has "warning properties" the victim may not even be aware of his exposure and dose. Dermatitis, an inflammation of the skin including which it becomes red and swollen and often appears as a rash. Dermatitis is the most common symptom of exterior exposure to chemicals.

***MANY SUBSTANCES PRESENT HAZARDS TO SAFETY; MANY PRESENT HAZARDS TO HEALTH. THE FOLLOWING INFORMATION FOCUSES ON HEALTH EFFECTS**

Type of Hazard	**Signs and Symptoms**
General Chemical	Behavioral changes
Hazards	Breathing difficulties Changes in complexion or skin color Coordination difficulties Coughing Dizziness Drooling Diarrhea Fatigue and/or weakness Irritability Irritation of eyes, nose, respiratory tract, skin or throat Headache Lightheadedness Nausea Sneezing Sweating Tearing Tightness in the chest
Explosives and Blasting Agents:	Many explosives contain nitrates that can cause: Dilation of blood vessels resulting in headache, nausea, cramping, low blood pressure, and eye and skin irritation Severe exposures can cause dysrhythmia, shortness of breath, and formation of methemoglobin Explosives can cause toxic fumes that cause lung injury
Poison Gases and Poisons:	Most poison gases and poisons are extremely toxic The primary route of exposure is inhalation, although solids and liquids can be ingested and absorbed Poisons (which are liquids) are considered less dangerous than poison gases because they are not inhaled as readily Fire can liberate poison gas from liquid and solid poisons Some, like cyanides, can cause rapid death by asphyxiation
Flammable Gases:	Methane is a simple asphyxiant Acetylene is a simple asphyxiant and a narcotic in high concentrations Ethylene oxide causes cancer and possible birth defects, and is irritating to skin, eyes, and mucous membranes
Type of Hazard	Signs and Symptoms

Non-Flammable Gases, Oxygen, and Chlorine:	* Oxygen-rich environments are non-toxic but are extremely hazardous in cases of fire Carbon dioxide and inert gases are simple asphyxiants * Ammonia is extremely irritating Halogens and their acids, such as hydrogen fluoride and hydrogen chloride, are highly irritating to skin and mucous membranes Halogens react with water and can easily react with water in body tissues Halogenated hydrocarbons can be toxic to the liver and kidneys and may be carcinogenic Hydrocarbons can increase absorption of other hydrocarbons
Flammable/Water Reactive Solids	Lithium compounds are irritating to skin, eyes, mucous membranes, and lungs When burned, some nitro compounds liberate oxides of nitrogen which may affect the liver, kidney, heart, or CNS
Oxidizers and Organic Peroxides	Oxidizers may include nitrate compounds or ammoniumcompounds that create possible carcinogenic toxic fumes when they decompose 0 Halogens are irritating to eyes and mucous membranes; fluorine and chlorine are especially powerful caustic irritants Peroxides can cause skin or mucous membrane irritation or pulmonary or laryngeal edem
Radioactive Materials:	Radioactive exposure usually causes long-term, or chronic, problems Acute exposure to high radiation may cause neurologic problems, nausea, skin and mucous membrane irritation Long-term effects include cancer and birth defects
Corrosives:	*Corrosives include acids and bases that cause severe injury to skin and mucous membranes, lung damage (if inhaled), or gastrointestinal damage,(if ingested)
Chemical Warfare Agents:	Chemical warfare agents are defined as compounds which through their chemical properties produce lethal or damaging effects in man, animal, plants or materials. They exist as solids, liquids or gas and are classified by their physiological effects: nerve, blood, choking or blister agents.
Type of Hazard	Signs and Symptoms
	Nerve agents are the most lethal. They are comparable to pesticides (organophosphates), but are much more toxic than pesticides and other standard industrial chemicals. These agents interfere with the central nervous system by disrupting nerve impulse transmissions. Nerve agents can be fatal in very small quantities. The most well-known nerve agents are tabun (also referred to by its military designation, "GA"), sarin (GB), soman (GD), and VX. Although they are liquids at room temperature, they evaporate quickly enough to create toxic vapor. Sarin is the most volatile, evaporating at about the same rate as water. Exposure occurs when the liquid form of the agent comes in contact with skin or eyes or the vapor is inhaled. Symptoms include pinpoint pupils, severe headache, and extreme tightness in the chest.

	Nerve agents, according to the World Health Organization, such as Tabun, Sarin or VX, may be absorbed through the skin or respiratory tract. Exposure to nerve agents causes a disruption of nerve impulse transmissions and in sufficient quantities may cause almost instant death. Therefore, full protective clothing and a protective breathing mask are required to ensure safety. The substances are stored as liquids and are usually disseminated as aerosols by means of an explosive charge. They also may be circulated by aerosol dispensers.
	Blister agents, such as mustard (HD) and lewisite (L), cause severe burns to the skin, eyes, and respiratory tissues. Exposure occurs when the liquid form of the agent comes in contact with skin or eyes or the vapor is inhaled. Symptoms may be delayed for hours, making detection and response more difficult. Although much less lethal than nerve agents, blister agents easily penetrate clothing and are readily absorbed through the skin. These agents are also systemic poisons and potent carcinogens.
	Blood agents interfere with the blood's ability to transfer oxygen to the cells. High concentrations can cause rapid death by asphyxiation. Lower concentrations cause breathing problems, gastrointestinal distress, dizziness, and headaches. Most of these agents are derivatives of cyanide compounds and are liquids under pressure. Examples include the common industrial chemicals hydrogen cyanide (AC) and cyanogen chloride (CK).
	Choking agents injure the respiratory system causing the lungs to fill with fluid. High concentrations result in death by asphyxiation. Lower concentrations of these agents cause severe coughing. Examples of choking agents include chlorine and phosgene, which are common industrial chemicals. These agents are liquids under pressure, but injury occurs when the vapor is inhaled.
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Type of Hazard	**Signs and Symptoms**
	Irritants fall into two categories: vomiting agents and riot gases. *Vomiting agents* can cause nausea, vomiting, coughing, sneezing, nose/throat pain, nasal discharge, and tears. They have been used in tandem with other chemical warfare agents-soldiers would be overcome by the vomiting agent, remove their masks, and be exposed to the second (and more lethal) agent. Riot *gases,* such as tear gas (CS), cause copious tearing and coughing. They are non-lethal chemicals that cause short-term incapacitation. High doses can be lethal, however.
Biological Warfare Agents	Biological agents are generally divided into either replicating (infectious) agents, or non-replicating (non-infecting or intoxicating) agents. Replicating agents are pathogenic bacteria, viruses or fungus. Non-replicating agents are produced from replicating agents, other living organisms and plants and are called "toxins."

	Biological weapons are regarded as infectious agents or toxins which are pathogenetic to man. These may include numerous naturally occurring viruses, bacteria or fungi previously known to science as well as genetically engineered organisms previously unknown to man. These substances possess the common ability to kill or incapacitate large numbers of people. Biological weapons are defined as any micro-organism, virus, infectious substance or toxin, capable of causing death, disease or other biological malfunction in a human, animal, plant or other living organism. Toxins are a poisonous substance produced by a living organism, but in some cases can also be man-made. The danger of biological weapons is amplified by the fact that exposure to the agents would probably not be diagnosed until symptoms appeared. Comprehensive quick field detection and identification methods do not currently exist for these agents. Not only may an accurate diagnosis be difficult to quickly accomplish, but the value of medical treatment for some agents may be diminished once symptoms have developed. Personal protection generally consists of immunization or the application of some other post-incident medical treatment, such as the use of antibiotics. A chemical protective mask also protects personnel from biological agents.
	Viruses primarily cause diseases in man. Transmission of these viruses in a weapon system would most likely be accomplished by aerosol dissemination, or the use of a vector (a living organism capable of delivering a biological weapon to a victim, such as fever, headache, nausea and vomiting, following an incubation period of a matter of days). These illnesses can be fatal if untreated.
Type of Hazard	Signs and Symptoms
	Bacterial agents can be produced in the laboratory or purchased from a number of medical research firms. Dissemination would probably be accomplished by aerosol or natural dispersal such as food contamination. Infections are introduced through the respiratory tract. An incubation period may last from one day to several weeks and the fatality rate for untreated cases may exceed 80 percent. Water supplies are particularly susceptible to contamination by strains of certain bacteria. It is important to note, however, that it is extremely difficult to contaminate most municipal waste systems. The number of purification and filtering procedures and treatments built into municipal water systems would rid the water of any contamination. Private water supplies or water supplies that are not subjected to a rigorous purification process are at risk.
	Fungal infections usually are induced through the respiratory system by breathing infected spores. Fungal infections can be spread through the civilian or agricultural population, and would be extremely difficult to detect prior to the first casualty. At this time, there are no known applications of fungal infections which would lend themselves to being used as a biological agent for a weapon. Toxins are defined as poisonous substances made by living organisms, and can cause incapacitation or death quickly. Toxins can now be reproduced through new advances in biotechnology and pose a new problem for new generations of CIB weapons.

	Biological warfare agents are living organisms (or their derivatives) that cause disease in humans. Examples include anthrax, tularemia, cholera, and encephalitis. These agents can cause more damage than chemical agents because some are contagious diseases that can spread far past the incident site, infecting unlimited numbers of people. The presence of a biological warfare agent can be difficult to recognize, identify, and treat. Many of the initial symptoms of these diseases are common to other diseases. There may be a delay between the time of exposure and the appearance of symptoms. The symptoms may also be mistaken for a naturally occurring outbreak of a disease. Responding to a biological warfare incident includes identifying the event as a biological warfare incident, controlling access to and from the site, and imposing quarantines.

Personnel experiencing any of the above symptoms should stop working and seek immediate medical attention.

Initial Treatment of Overexposure

This discussion of initial treatment is not intended to be a first aid course. It will point out ways of preventing further injury when overexposure occurs. In any case of overexposure, medical care should be obtained as soon as possible.

Chemical overexposure

Initial treatment of chemical overexposure depends on the route of exposure and the particular hazardous material.

Prior to the initiation of medical treatment, as much information as possible should be obtained about the contaminant so proper treatment can begin.

If material is on the skin, washing with large quantities of water is the most common method of removing the substance. Warm water should be used to minimize opening the pores of the skin preventing further absorption.

If there is irritation of the eyes, large amounts of water should be used for flushing. This procedure should continue for a minimum of 15 minutes.

When inhalation of toxic material has occurred, oxygen should be administered if available. A high concentration mask should be used rather than nasal prongs to maximize the effectiveness of the oxygen given.

Toxicology:

- The toxicity of a substance is its ability to cause harmful effects. These effects can strike a single cell, a group of cells, an organ system, or the entire body. A toxic effect may be visible damage, or a decrease in performance or function measurable only by a test. All chemicals can cause harm. When only a very large amount of the chemical can cause damage, the chemical is considered to be relatively non-toxic. When a small amount can be harmful, the chemical is considered toxic.

- The toxicity of a substance depends on three factors:
  (1) its chemical structure,
  (2) the extent to which the substance is absorbed by the body,
  (3) and the body's ability to detoxify the substance (change it into less toxic substances) and eliminate it from the body.

- The toxicity of a substance is the potential of that substance to cause harm, and is only one factoring determining whether a hazard exists. The hazard of a chemical is the practical likelihood that the chemical will cause harm. A chemical is determined to be a hazard depending on the following factors:

(1) toxicity: how much of the substance is required to cause harm,
(2) route of exposure: how the substance enters your body,
(3) dose: how much enters your body,
(4) duration: the length of time you are exposed,
(5) reaction and interaction: other substances you are exposed to,
(6) sensitivity: how your body reacts to the substance compared to others.

- Some chemicals are hazardous because of the risk of fire or explosion. These are important dangers, but are considered to be safety rather than toxic hazards. The factors of a toxic hazard are more fully explained below.

- The longer you are exposed to a chemical, the more likely you are to be affected by it. The dose is still important-at very low levels you may not experience any effects no matter how long you are exposed. At higher concentrations you may not be affected following a short term exposure, but repeated exposure over time may cause harm. Chemical exposure which continues over a long period of time is often particularly hazardous because some chemicals can accumulate in the body or because the damage does not have a chance to be repaired. The combination of dose and duration is called the rate of exposure.

- The body has several systems, most importantly the liver, kidneys and lungs, that change chemicals to a less toxic form (detoxify) and eliminate them. If your rate of exposure to a chemical exceeds the rate at which you can eliminate it some of the chemical will accumulate in your body. For example, if you work with a chemical for eight hours each day, you have the rest of the day (16 hours) to eliminate it from your body before you are exposed again the next day. If your body can't eliminate all the chemical in 16 hours and you continue to be exposed, the amount in the body will accumulate each day you are exposed. Illness that affects the organs for detoxification and elimination, such as hepatitis (inflammation of the liver), can also decrease their ability to eliminate chemicals from the body.

- Accumulation does not continue indefinitely. There is a point where the amount in the body reaches a maximum and remains the same as long as your exposure remains the same. This point will be different for each chemical. Some chemicals, such as ammonia and formaldehyde, leave the body quickly and do not accumulate at all. Other chemicals are stored in the body for long periods. For instance, lead is stored in the bone, calcium is stored in the liver and kidneys. There are a few substances, such as asbestos fibers, that, once deposited, remain in the body forever.

- The effects of toxic substances may appear immediately or soon after exposure, or they may take many years to appear. Acute exposure is a single exposure or a few exposures. Acute effects are those which occur following acute exposures. Acute effects can occur immediately, or be delayed and occur days or weeks after exposure.

Prevention & Control

- Prevention and control measures include, but are not limited to, the following:
  - Elimination/substitution and process modification;
  - Engineering controls;
  - Administrative controls; and
  - Use of personal protective equipment.
- In certain circumstances, personal protection of the individual employee is necessary. Personal protective devices should be regarded as being supplementary to substitution and engineering control and should not be used in preference to the latter because they do nothing to eliminate the hazard.
- Personal protective equipment must be appropriately selected, individually fitted and workers trained in their correct use and maintenance. The equipment must be regularly checked and maintained to ensure that the worker is being protected.
- Monitoring may be used for the evaluation of a hazard and for assessing the effectiveness of control measures. The design and implementation of a monitoring program should be carried out by, or in consultation with, a properly qualified person. Monitoring of the work environment involves the measurement of atmospheric contaminants at selected locations in the workplace (static, positional monitoring).
- Biological monitoring involves measurement of the concentration of a contaminant, its metabolites or other indicators in the tissues or body fluids of the worker. In some cases, biological monitoring may be required to supplement static or personal monitoring.
- f. In the control of health hazards due to a specific contaminant, where it has been demonstrated that the exposure of the employee to the contaminant is approaching the relevant exposure standard, or where biological monitoring indicates that an unacceptable exposure is occurring, immediate action must be taken to reduce the health hazard and intensive monitoring should continue.

Routes of Entry

- Injury can be caused by chemicals only if they reach sensitive parts of a person or other living organism at a sufficiently high concentration and for a sufficient length of time. Thus, injury depends upon the physicochemical properties of the potentially toxic substances, the exact nature of the exposure circumstances, and the health and developmental state of the person or organism at risk.
- Major routes of exposure are through the skin (topical), through the lungs (inhalation), or through the gastrointestinal tract (ingestion). In general, for exposure to any given concentration of a substance for a given time, inhalation is likely to cause more harm than ingestion which, in turn, will be more harmful than topical exposure faster.

a. Inhalation Route

Inhalation is the most significant route of entry by which harmful substances enter the human body at work. Toxic atmospheric contaminants may have local or systematic effects. Local effects harm only the part of the body they come in contact with, for example, inhalation of silica dusts causing pneumoconiosis. Systemic effects, cause changes to the function of other organs, as in the case of inhaled particles that are soluble in the fluid of the tissues that line the lung, for example, lead and mercury fumes. Inhalation results in the introduction of toxic compounds into the respiratory system. Most of the compounds that are commonly inhaled are gases or vapors of volatile liquids; however, solids and liquids can be inhaled as dusts or aerosols. Inhalation of toxic agents generally results in a rapid and effective absorption of the compound.

When you inhale a toxic chemical, the dose you receive depends on four factors:

(1) The level (concentration) of chemical in the air;
(2) How hard (fast and deep) you are breathing, which depends on your degree of physical exertion;
(3) How much of the chemical that is inhaled stays in your lungs and is absorbed into your bloodstream; and
(4) How long the exposure lasts.

b. Absorption Route

Some atmospheric contaminants may be absorbed through the skin without any noticeable change to the skin, while others may cause serious damage to the skin itself. Ingestion is of relatively minor significance in occupational exposure to toxic materials.

(1). Skin contact exposure does not typically result in as rapid systemic dosage as Inhalation, although some chemicals are readily absorbed through the skin. Many organic compounds are lipid (fat) soluble and can therefore be rapidly absorbed through the skin. Some materials that come in contact with the eyes can also be absorbed. Ingestion is a less common route of exposure for emergency personnel. However, incidental hand-to-mouth contact, smoking, and swallowing of saliva and mucus containing trapped airborne contaminants can cause exposure by this route. In addition, emergency medical personnel in both hospital or prehospital settings will see chemical exposures in patients who have ingested toxic substances as a result of accidental poisonings or suicide attempts.
(2) Many people do not realize that some chemicals can penetrate healthy intact skin and so this fact should be emphasized.

c. Ingestion

Airborne particles breathed through the mouth or cleared by the cilia of the lungs will be ingested. Otherwise, ingestion of potentially toxic substances in the work, domestic, or natural environment is likely to be accidental and commonsense precautions should minimize this. The nature of the absorption processes following ingestion is discussed elsewhere. The importance of concentration and time of exposure has already been pointed out. It should be remembered that exposure may be continuous or repeated at intervals over a period of time; the consequences of different patterns of exposure to the same amount of a potentially toxic substance may vary considerably in their seriousness.

d. Injection

The injection of hazardous materials into the body can occur by stepping on a sharp object, or being cut by a sharp object while working at an incident site. The best precaution is to have protective clothing on, including steel shank and toed foot protection, and by strictly instituting and observing safe work habits.

Exposure Limit

These limits are established by health and safety authorities to control exposure to hazardous substances. Exposure limits usually represent the maximum amount (concentration) of a chemical which can be present in the air without presenting a health hazard. However, exposure limits may not always be completely protective, for the following reasons:

> Although exposure limits are usually based on the best available information, this information, particularly for chronic (long-term) health effects, may be incomplete. Often we learn about chronic health effects only after workers have been exposed to a chemical for many years, and then as new information is learned, the exposure limits are changed.

Exposure limits are set to protect most workers. However, there may be a few workers who will be affected by a chemical at levels below these limits (see "Sensitivity"). Employees performing extremely heavy physical exertion breathe in more air and more of a chemical, and so may absorb an excessive amount.

☐ Exposure limits do not take into account chemical interactions. When two or more chemicals in the workplace have the same health effects, industrial hygienists use a mathematical formula to adjust the exposure limits for those substances in that workplace.

☐ When toxic chemicals are present in the workplace, your exposure can be estimated by measuring the concentration of a given chemical in the air and the duration of exposure. This measurement is called air or environmental monitoring or sampling and is usually done by industrial hygienists, using various types of instruments. The air is collected from your breathing zone (the air around your nose and mouth) so that the concentrations measured will accurately reflect the concentration you are inhaling. The exposure levels calculated from this monitoring can then be compared to the Permissible Exposure Level for that chemical.

☐ Environmental monitoring is the most accurate way to determine your exposure to most chemicals. However, for chemicals that are absorbed by routes other than inhalation, such as through the skin and by ingestion, air monitoring may underestimate the amount of chemical you absorb. For these and some other chemicals, the levels of the chemical (or its breakdown products) in the body can sometimes be measured in the blood, urine or exhaled air. Such testing is called biological monitoring, and the results may give an estimate of the actual dose absorbed into the body. For one substance, lead, biological monitoring is required by law when air monitoring results are above a certain level. The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended the exposure limits for biological monitoring for a small number of chemicals. These are called Biological Exposure Indices (BEIs) and are published together with TLVs.

☐ If you smell a chemical, you are inhaling it. However, some chemicals can be smelled at levels well below those that are harmful, so that detecting an odor does not mean that you are inhaling harmful amounts. On the other hand, if you cannot smell a chemical, it may still be present. Some chemicals cannot be smelled even at levels that are harmful. The odor threshold is the lowest level of a chemical that can be smelled by most people. If a chemical's odor threshold is lower than the amount that is hazardous, the chemical is said to have good warning properties.

☐ If you or your co-workers experience symptoms known to be caused by a chemical during or its use, you may have been overexposed. Symptoms might include tears in your eyes; a burning sensation of skin, nose, or throat; a cough; dizziness or a headache.

☐ If toxic substances have entered the body by injection, the wound should be washed thoroughly. A sterile dressing or covering should then be applied. If one is not present, use the cleanest dressing that is available.

☐ When exposure is by ingestion and medical help is unavailable, a poison control agency should be notified for information and guidance. Treatment may vary considerably depending upon the type of chemical ingested.

HAZARDS OTHER THAN TOXIC CHEMICALS

Type of Hazard	Signs and Symptoms
Heat Stress	Heat stress can occur very rapidly-within as little as 15 minutes. It can pose a far greater danger to worker health than chemical exposure. In its early stages, heat stress can cause rashes, cramps, discomfort and drowsiness, resulting in impaired functional ability. Continued heat stress can lead to heat exhaustion, heat stroke, and even death.
	Personnel exhibiting the following symptoms require immediate medical attention.
Heat Exhaustion	Clammy skin Confusion Dizziness Fainting Fatigue Heat rash Lightheadedness Nausea Profuse sweating Slurred speech Weak pulse
Heat Stroke	Confusion Convulsions Hot Skin, high temperature (yet may be chilled) Incoherent speech Staggering gait Sweating stops (yet residual sweat may be present) Unconsciousness/coma
Cold Exposure	Working for extended periods in cold environments can result in hypothermia (generalized lowering of body temperature) or frostbite (freezing of body parts). Wind and working on metal surfaces or with metal tools hasten the onset of injuries due to cold exposure.

Frostbite	Frostbite usually occurs on the face or the extremities. Signs and symptoms include pain followed by numbness and white chalky appearance.
	Personnel experiencing frostbite should be given immediate medical attention.
Electrical hazards	Such as downed or buried cables or improperly installed electrical equipment.
Ionizing radiation	May be present at a scene. While commonly used, protective clothing offers protection from alpha radiation.
Safety Hazards	By their nature, Haz Mat scenes may contain numerous safety hazards. These include but are not limited to holes, ditches and uneven terrain, slippery surfaces, sharp objects, improperly stacked material which may fall and unstable surface which may cave-in or collapse.

(The information on Chemical and Biological Warfare Agents has been provided through Dupont, Chemical *Protective Clothing: The* Last *Line of Defense.)*

Treatment of Heat Stress

Initial treatment for heat stress includes removing the victim to a cool area, at the very least out of the sun. Heavy clothing should be removed and fluids (water/sports drinks) administered.

Heat stroke is a life threatening emergency and should be treated by advanced life support personnel as soon as possible. The same procedures used for heat stress should be followed until medical care is available. Rapid cooling is essential for a victim with heat stroke.

Treatment of Frostbite

A person with frostbite or hypothermia should be taken to a warm area indoors.

The frostbitten area should be covered with a soft cloth and gradually warmed. **It should not be rubbed.** Rubbing will further damage the frozen tissue. Frostbite is a serious injury which, if improperly treated, may result in loss of the affected body part.

II. Rescue Of Overexposed Personnel

The following protocol should be followed by response personnel. Bear in mind the decision making process for victim rescue discussed in the Awareness Course.

RESCUE PROTOCOLS FOR HAZARDOUS MATERIALS ACCIDENT INCIDENTS

1. Approach site with caution, looking for evidence of hazardous materials.
2. If chemical hazard is suspected, position personnel, vehicles, and command post at a safe distance upwind of the site. (Consult DOT ERG for safe distance.)
3. Notify proper authorities and hospital. (DEP Hotline 877 WARNDEP)
4. Put on protective gear.
5. Determine the presence of injured victims.
6. When the hazardous materials do not pose a danger to you, assess and treat life-threatening injuries as soon as possible when it is safe for the rescuers to enter the area.
7. Move victims away from the hazard area, using proper patient transfer techniques to prevent further injury. Stay within the controlled zone if contamination is suspected.
8. Victims should be monitored at the control line for possible contamination. Remove the contaminated victim's clothing, if contamination is present. Decontaminate the victim prior to transport.
9. Move the ambulance cot to the clean side of the control line and unfold a clean sheet or blanket over it. Place the victim on the covered cot and package for transport. Do not remove the victim from the backboard if one is used.
10. Before leaving the controlled area, rescuers should remove protective gear at the control line. If possible, the victim should be transported by personnel who have not entered the controlled area. Ambulance personnel attending to victims should wear gloves and other necessary personal protective equipment.
11. Transport the victims to the hospital emergency department. The hospital should be given additional, appropriate information, and the ambulance crew should ask for any special instructions the hospital may have.
12. Follow the hospital's protocol upon arrival.

III. Confined Space Operations

A confined space as defined by OSHA 29 CFR 1910.146 is an enclosed space which:

1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and
2) Has limited or restricted means for entry or exit (some examples are tanks, vessels, silos, storage bins, hoppers, vaults, pits and diked areas);
3) Is not designed for continuous employee occupancy.

Confined Space Rescue

People can die in confined spaces. Many deaths occur due to changes in the atmosphere after initial monitoring. Since rescue is seldom planned and usually consists of spontaneous reaction in an emergency situation, more than 60% of deaths occur among would-be rescuers. Conditions in familiar areas, and especially confined spaces, can change. Protective measures may be neglected because "I've never had a problem before" or "I'm so experienced that the job will only take a minute or two." These attitudes have frequently proved fatal.

Injuries and fatalities can occur in confined spaces in numerous ways. Some of the hazards are:

IV. Atmospheric Hazards

1. Asphyxiating Atmospheres

OSHA uses the term "asphyxiating atmosphere" when referring to an atmosphere which contains less than 19.5 percent oxygen. 19.5% is not enough oxygen to supply an entrant's respiratory needs when performing physical work. These atmospheres need not contain toxic materials. For example, the oxygen in a space may have been absorbed by materials, such as activated charcoal, or consumed by a chemical reaction, such as the rusting of a vessel or container. In another situation, the original atmosphere may intentionally have been wholly or partly inerted using such gases as helium, nitrogen, methane, argon, or carbon dioxide. Victims often are unaware of their predicament until they are incapable of saving themselves or even calling for help.

Example: A worker in Oklahoma prepared to enter a molasses tank. The atmosphere had not been tested and no respirators, retrieval lines or harnesses were provided. Following a long standing practice at the company involved, employees removed the tank lid and allowed the tank to "ventilate naturally" for several hours before entering. No testing of the tank's atmosphere was undertaken. The first entrant reported feeling ill as soon as he entered, and collapsed almost immediately. Two "standby" workers, required by the plant's SOP entered to rescue him. Each of them collapsed after saying they felt dizzy. All three employees died.

2. Toxic Atmospheres

The term "toxic atmospheres" refers to atmospheres containing gases, vapors or fumes known to have poisonous physiological effects. The toxic effect is independent of the oxygen concentration, which may in fact be greater than 20 percent. The most commonly encountered toxic gases are carbon monoxide and hydrogen sulfide.

Some toxic atmospheres may have severe harmful effects which may not appear until years after exposure, while others may effect the victim quickly. Some can produce both acute and chronic effects. For example, while carbon disulfide at low concentrations may exhibit no immediate sign of exposure, it can cause permanent and cumulative brain damage as a result of repeated "harmless" exposures. At higher concentrations, it can kill quickly.

Example: An employee entered a solvent storage tank to remove toluene residues. The tank was 20 feet tall and 10 feet in diameter. The employer had rented a self contained breathing apparatus (SCBA) and showed the employee how to use it, but again the tank atmosphere had not been tested, nor had any provisions for rescue been made. The employee was provided with a length of rope for his descent into the tank. The employee could not fit through the tank's opening while wearing the SCBA, so the employer decided that the SCBA would be lowered to him, using the same rope, after the employee reached the bottom of the tank. After entry, the employer lowered the SCBA, but the worker collapsed before he could put it on. A call for help was sent to the city fire department.

Because of the small opening, the firemen who responded to the rescue call could also not enter the tank while wearing SCBA. They decided that only by cutting open the tank could they possibly rescue the victim. Despite the precautions taken by the firemen during the cutting of the tank, the toluene vapor in the tank ignited. The explosion killed one fireman and injured 16 others. It was later determined that the entrant was already dead due to the toxic effects of toluene and lack of oxygen before the explosion occurred.

3. Flammable or Explosive Atmospheres

OSHA defines the term "flammable or explosive atmosphere" as an atmosphere which poses a hazard because flammable gases, vapors or dusts are present at a concentration greater than 10 percent of their lower flammable limit. This last subcategory of hazardous atmospheres includes atmospheres containing gases such as methane or acetylene; vapors of solvents or fuels such as carbon disulfide, gasoline, kerosene or toluene; or dusts of combustible materials.

Example: Workers at a refinery in Puerto Rico were cleaning a large storage tank. Since it had last been cleaned, the tank had been used at various times to store gasoline, gas oil, and light and heavy crude oils. The employer expected that the tank would contain residues from these liquids.

The procedures, tools and all other equipment to be used for entry were prescribed by an entry permit prepared by the parent company, not by the refinery. Under the terms of the entry permit, workers were required to use air-supplying respirators, lifelines, explosion proof lighting, and were also required to test the atmosphere for flammable conditions before and during entry. However, no one at the refinery had been made accountable for compliance with the permit.

Employee accounts indicate that the refinery management had originally followed permit procedures, but that permit requirements were generally ignored the day of the incident. For example, even though it was known that the work could generate a flammable atmosphere and that only explosion-proof lighting was allowed where a flammable atmosphere could exist, only two of the twelve lamps illuminating the inside of the tank were explosion-proof; no lifelines were available; and no atmospheric monitoring was done.

Five employees were in the tank when it exploded and burned briefly. The workers outside the tank were unable to help them. The fire burned out in just seconds, but by then four of the workers were dead. The fifth entrant died of massive respiratory injuries several days later.

4. Engulfment

"Engulfment" refers to situations where a confined space entrant is trapped or enveloped, usually by dry bulk materials. The engulfed entrant is in danger of asphyxiation, either through filling of the victim's respiratory system as the engulfing material is inhaled, or through compression of the torso by the engulfing material. In some cases, the engulfing materials may be so hot or corrosive that the victims sustain fatal chemical or thermal burns, but are never buried below a point at which they can breathe.

Example: A group of employees of a Nebraska sawmill entered a 40 foot high storage tank, thought to be nearly full of sawdust. Entry was made through a small opening near the top. One of these workers suddenly disappeared. He had fallen into an air pocket in the sawdust. Rescue operations began immediately, but the worker died of asphyxiation by the time his body was recovered.

Two years earlier, this same employee had narrowly escaped death in a similar incident only because his foreman had seen him sinking into the sawdust and managed to grab his hand and pull him out.

OSHA's report on the fatal incident quotes the sawmill's report of its own investigation of the earlier, non-fatal incident, which concluded that the company "decided for bin workers to use a safe rope." The only "rope" on hand at the time of the fatal incident was a cord formed by knotting together pieces of rotted sash cord. The employees did not use this rope because they recognized that it was useless and also, in the words of the employees, "because it was too much trouble."

5. Mechanical Hazards

Accidents have resulted in confined spaces when employers failed to isolate equipment from sources of mechanical or electrical energy. In each case reviewed, death resulted from mechanical force injury, such as the crushing of the victim. The current preventive action is to secure the machinery or equipment so that it will not be inadvertently activated while employees are in the confined space. This procedure is commonly called "lockout."

Example: A workman entered the bag house in the dust collection system of an Ohio basic-oxygen steelmaking furnace to check the condition of the bags. He stepped onto the dust conveyer, which was not supposed to be operating at the time, and was caught in the machinery. The employee died before rescuers could remove him from the auger pipe conveyer.

6. Untrained Rescuers

A high percentage of confined space accident victims have been untrained rescuers. Indeed, in some cases the unsuccessful rescuers die, while the initial entrant recovers. The likelihood that good intentions and poor preparation will lead to tragedy has led OSHA to establish criteria for rescue which would protect co-workers or volunteers from accidental injury or death.

Example: A Connecticut fuel company owner sent an employee into a large underground vault. The vault's only means of access and ventilation was straight down through six feet of 30-inch steel culvert pipe. The employer reportedly told police that "he heard a clunk" soon after his employee descended into the vault. Concerned because he had lost contact with his employee, he sent in a second employee. This rescuer collapsed at the foot of the ladder. The employer then directed a third employee to go in and help the others. The second rescuer collapsed before he got to the bottom of the ladder, with one leg caught between two ladder rungs. This hung the employee upside-down, interfering with rescue efforts by the firemen who were summoned to the scene.

Both "rescuers" were pronounced dead at the scene. The initial entrant died two days later from massive brain damage caused by prolonged oxygen deprivation.

OSHA subsequently learned from police department records that about six years earlier, two employees were overcome by lack of oxygen in a similar vault operated by the same employer. In that case, the entrants were rescued without loss of life. Unfortunately, the employer had not taken advantage of the close call warning by implementing procedures which would have prevented subsequent incidents.

As far as confined space work is concerned, precautions taken before an emergency are the best emergency actions.

AIR MONITORING FOR HAZARDOUS ATMOSPHERES

Airborne contaminants can present a significant threat to a responder's health and safety. Operations trained personnel should have the capability to monitor the atmosphere in areas in which they will be working. It is imperative that *monitoring instruments be* operated, and their data *interpreted, by qualified individuals who are thoroughly* familiar *with* the particular devices operating principles *and* limitations. The identification and quantification of contaminants through air monitoring is an essential part in determining the actions to be taken at a hazardous materials release. Remember, you are being trained to take defensive actions only, however, measurements of airborne contaminants can be useful in:

☐ Selecting personal protective equipment.

☐ Determining areas where protection is needed (establishing work zones).

☐ Assessing the potential health effects of exposure.

In addition to hazardous materials releases, monitoring of the atmosphere may be necessary for confined space rescues, trench rescues, carbon monoxide detector activations, and carbon dioxide fire control system activations.

Atmospheric hazards can be divided into three main components: oxygen deficiency or enrichment, flammable or explosive atmosphere, and toxic materials.

OXYGEN DEFICIENCY OR ENRICHMENT

To be considered safe, the oxygen concentration must be within the range of 19.5 percent and 23.5 percent. The atmosphere is considered oxygen deficient when the oxygen concentration falls below 19.5 percent. This may result from stagnant air caused by a lack of ventilation or the consumption of oxygen by reactions taking place within a space. An oxygen deficiency can also be caused by introducing an inert gas such as nitrogen in the atmosphere.

Oxygen enrichment occurs when the oxygen concentration exceeds 23.5 percent. In addition to the adverse effects of breathing in an enriched oxygen atmosphere, the potential for and magnitude of fires or explosions are greatly increased.

OXYGEN %	RESPIRATORY EFFECT
20.9	Normal (ANSI Z88.2)
17	First sign of hypoxia. Some increase in breathing volume and accelerated heart rate.
16	Impaired judgment and breathing.
14	Increased breathing volume and heart rate. Impaired attention, thinking and coordination.
10	Very faulty judgment and muscular coordination. Intermittent respiration.
6	Spasmatic breathing, convulsive movements, death in minutes.

FLAMMABLE OR EXPLOSIVE ATMOSPHERES

Operations responders must be able to recognize and anticipate the potential for flammable or explosive atmospheres. A combustible gas indicator (CGI) tests atmospheres that may contain sufficient levels of combustible vapors to support combustion or to cause an explosion. In addition to the fire or explosion hazards at an incident, flammable vapors can also pose inhalation risks for responders. Exposure effects may occur well below the levels that will present flammability problems.

All flammable vapors and gases have a lower (LEL) and upper flammable limit (UEL). The lower explosive limit and upper explosive limit refer to the concentration of a flammable liquid (as a vapor) or a flammable gas in air. Below the lower explosive limit the mixture is too lean to ignite. Above the upper explosive limit the mixture is too rich to ignite. Between the LEL and the UEL, the mixture is explosive or flammable. The target for flammable atmospheres is to maintain an environment below 10 percent of the lower flammable limit. This allows a 90 percent safety margin before the bottom of the flammable range is reached.

FLAMMABLE LIMITS OF SOME COMMON MATERIALS

MATERIAL	LEL %	UEL
Acetone	2.6	12.8
Acetaldehyde	4.0	60.0
Anhydrous ammonia	16	25
Benzene	1.3	7.1
Ethylene Oxide	3.6	100
Gasoline (50-90 octane)	1.4	7.6
Hexane	1.1	7.5
Isopropyl alcohol	2.0	12.0
Kerosene	0.7	5.0
Methyl alcohol	7.3	36
Toluene	1.2	7.1

TOXIC MATERIALS

Toxic exposures are typically measured in parts per million (ppm), parts per billion (ppb), or milligrams per cubic meter. One part per million is equal to 1/1,000,000. One cup of ammonia gas mixed with air for a total volume of one million cups yields one part per million of ammonia gas. Most people can smell ammonia at around 1 to 5 ppm. The concentration of 1 ppm is roughly equivalent to one cup of a gas in a 32 feet by 33 feet room with an 8 foot ceiling.

Gases that are commonly monitored by various digital instrumentation include:

☐ carbon monoxide
☐ hydrogen sulfide
☐ nitrogen dioxide
☐ sulfur dioxide
☐ ammonia chlorine
☐ methane nitric oxide
☐ hydrogen cyanide
☐ oxygen
☐ flammables as a percentage of the LEL

OVERVIEW OF DIRECT READING INSTRUMENTATION

INSTRUMENT	HAZARD MONITORED	APPLICATION
OXYGEN METER	OXYGEN	MEASURES THE PERCENTAGE OF OXYGEN IN THE AIR. SAFE OXYGEN RANGE OF 19.5% TO 23.5%
COMBUSTIBLE GAS INDICATOR (CGI)	FLAMMABLE OR EXPLOSIVE	MEASURES CONCENTRATION OF A FLAMMABLE GAS OR VAPOR. LEL & UEL
COLORIMETRIC TUBES	SPECFIC GASES and VAPORS	MEASURES CONCENTRATIONS OF SPECIFIC GASES AND VAPORS
FLAME IONIZATION DETECTOR, PHOTOIONIZATION DETECTOR, ULTRAVIOLET PORTABLE OF MANY GASES MID VAPORS INFRARED , ETC., ETC., ETC.	GASES AM VAPORS, ORGANIC AND SOME INORGANIC GASES AND VAPORS DEPENDING ON THE INSTRJMENT	MAY MEASURE AND DETECT CONCENTRATION

THE MONITORING PROCESS

Determine need for monitoring.

What atmospheric problems may exist?

Select monitoring equipment:

Calibrate monitoring equipment:

Oxygen deficiency or enrichment	Flammable	Toxic
Monitor oxygen.	Monitor flammables.	Identify specific toxic
Oxygen below 19.5% or	Detect above $10^{\%}$ LEL.	Determine acceptable level.
		tor toxics.
Oxygen above 23.5'		Level exceeds acceptable limits.

Defensive actions to correct problem.

Protect personnel.

Contact haz mat team who can handle offensive actions.

MODULE 5

PERSONAL PROTECTIVE EQUIPMENT (PPE) AVAILABLE TO THE FIRST RESPONDER

OPERATIONS LEVEL

Outline

- **Introduction**
  The First Responder At Hazardous Materials Incidents
    - Operations – Defensive vs Offensive
    - Rules
    - Use of Buddy System
    - ICS - NIMS

  Structural Fire Fighting PPE And Hazardous Materials PPE
    - Recognized Personal Protective Equipment Operating Limitations
    - Routes Of Entry Of Hazardous Materials Into The Human Body
    - Heat Stress – Signs and Symptoms

  Chemical Resistance and Compromise of PPE

  When To Remove Personal Protective Equipment
    - Emergency Decontamination Procedures

MODULE 5

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Haz. Mat.
Operations Level

Objectives

Using Personal Protective Equipment.

The first responder at the operational level shall demonstrate the ability to don, work in, and doff the personal protective equipment provided by the authority having jurisdiction, and shall meet the following related requirements:

(1) Identify the importance of the buddy system in implementing the planned defensive options.
(2) Identify the importance of the backup personnel in implementing the planned defensive options.
(3) Identify the safety precautions to be observed when approaching and working at hazardous materials incidents.
(4) Identify the symptoms of heat and cold stress.
(5) Identify the physical capabilities required for, and the limitations of, personnel working in the personal protective equipment as provided by the authority having jurisdiction.
(6) Match the function of the operational components of the positive pressure self-contained breathing apparatus provided to the hazardous materials responder with the name of the component.
(7) Identify the procedures for cleaning, disinfecting, and inspecting respiratory protective equipment.
(8) Identify the procedures for donning, working in, and doffing positive pressure self-contained breathing apparatus.
(9) Demonstrate donning, working in, and doffing positive pressure self-contained breathing apparatus.

Reference Standard
NFPA- 472-2002

5.3.3 Determining Appropriateness of Personal Protective Equipment. Given the name of the hazardous material involved and the anticipated type of exposure, the first responder at the operational level shall determine whether available personal protective equipment is appropriate for implementing a defensive option and also shall meet the following requirements:

(1)* Identify the respiratory protection required for a given defensive option and the following:
  (a) Identify the three types of respiratory protection and the advantages and limitations presented by the use of each at hazardous materials incidents.
  (b) Identify the required physical capabilities and limitations of personnel working in positive pressure self-contained breathing apparatus.

(2) Identify the personal protective clothing required for a given defensive option and the following:
  (a) Identify skin contact hazards encountered at hazardous materials incidents.
  (b) Identify the purpose, advantages, and limitations of the following levels of protective clothing at hazardous materials incidents:
    i. Structural fire–fighting protective clothing
    ii. High temperature–protective clothing
    iii. Chemical-protective clothing
    iv. Liquid splash–protective clothing
    v. Vapor-protective clothing

Additional Reference Sources
SCBCOM on report November 1999
SCBCOM on PPE for LAW Enforcement & EMS March 2000
USDOJ – Emergency Responder Guidelines and Chemical Biology Hazards July 2002

II. The First Responder at Hazardous Materials Incidents

The first consideration of all operating personnel must be their own ability to survive the incident. That thought sounds simple enough. You would think that if you're out in the street, some distance from the incident in fresh air, that you're okay. This may not necessarily be true! The products involved in hazardous materials incidents can be colorless, odorless, tasteless, and, you may not feel their presence as they envelop you in a destructive cloud that may not be noticed until years later. The question of operating personnel safety is dependent upon three factors:

1. What products are involved in the incident?
2. What are their associated risks under the incident conditions?
3. What level of protection should operating personnel have to deal with the incident?

The first and second factors can only be answered through discovery of what products are involved. **If, and as long as, the products remain unknown,** then a worse case probability should be assumed. Once the product or products are known and the risks have been evaluated accordingly; then the level of personal protection can be set to match the needs of the operational objectives.

All operating personnel must therefore understand what constitutes personal protection or personal protective equipment. This includes all personnel who work in or near the incident site, regardless of whether they be the mayor, police officers, emergency medical services personnel, or firefighters.

The typical first responder will arrive on the scene in the least acceptable level of protection. If it's the Mayor, then it's his emergency services uniform (a sport coat and tie). If it is a police officer it will be a blue uniform with a badge and a side arm for personal protection. Emergency medical personnel will report to the scene with a medical kit, a stethoscope and other implements sticking out of numerous pockets. The firefighter will roll onto the scene in full structural fire fighting gear with hoses and tools ready at hand. **Unless the product exposure risk is known and determined to be no risk at all, or of little risk to personnel, these people should be denied access to the incident site, and their proximity to the operational area should be clearly defined and closely monitored.**

The psychological feeling of invulnerability is a significant factor when dealing with emergency services personnel. The danger must always be in the mind of the incident commander as a concern during operations.

Everyone is vulnerable unless they:

1. Are properly protected before they enter the incident site
2. Are aware of the risks present at the site
3. Know what objectives can be realistically attained.

It should also be noted here that **no one type of personal protection will satisfy every condition encountered** at hazardous materials incidents. The Mayor may find his sport jacket disintegrating; the police officer may find his badge and side arm turning green; the EMS personnel may find themselves unable to dispense medical treatment because they cannot see or breathe, and the firefighter may be running away from the scene at the best possible speed. Obviously, selecting the appropriate level of personal protective equipment necessary for the incident and properly wearing it, is the key to a safe and effective operation.

III. The Difference Between Structural Fire Fighting PPE and Hazardous Materials PPE

To better understand why structural fire fighting equipment and the Mayor's sport jacket are inadequate for the majority of hazardous materials incidents, we have to look at the risks these incidents present to the wearer. There is a difference between normal clothing, structural fire fighting clothing, and personal protective equipment designed for hazardous environments, which may contain acids, bases, poisons, radioactive materials, asphyxiants, thermal products, or biological contaminants.

The Globe Manufacturing Company, one of the foremost manufacturers of firefighter protective clothing, includes this warning in its literature:

> 'Outer shell, Moisture Barrier, and Thermal Barrier meeting all requirements of NFPA 1971 must be utilized and all garment closures must be fastened when in use. DO NOT keep this garment in direct contact with flames or molten metal. DO NOT USE FOR PROXIMITY OR FIRE ENTRY APPLICATIONS OR FOR PROTECTION FROM CHEMICAL, RADIOLOGICAL OR BIOLOGICAL AGENTS. Keep clean—soiling will reduce protective qualities. Maintain and alter only in accordance with manufacturer's instructions. No protective clothing can provide complete protection from all conditions—use extreme care for all emergency operations. Failure to comply with these instructions may result in serious injury or death."

Normal clothing, and even structural fire fighting clothing, **do not afford adequate protection against the contaminants** mentioned. The clothing may absorb liquids, attract dust-like solid particles, and possibly hold gases within the clothing fibers or allow **a** pass through of gases to the body.

Specially designed chemical protective equipment however, is constructed of special materials which prohibit penetration, permeation, and degradation of the suit materials by various hazardous chemicals, and are divided into two types:

1. fully encapsulating.
2. nonencapsulating.

The awareness of the limitations of a first responder's clothing, and the risks present to his health will make the difference between a safe, effective operation, and one in which the first responder becomes a part of the problem. **If the chemicals involved at the incident site are beyond the operational responder's capability, then they should call for specialized hazardous materials help immediately and do not enter the site.**

EPA/COAST GUARD DESIGNATED LEVELS OF PROTECTION

Clothing which is specifically designed for hazardous materials incidents, and for use with specific types of chemicals, falls into four categories: Level A, Level B, Level C, and Level D. The predominant physical, chemical, and toxic properties of a chemical, or chemicals, involved in a hazardous materials incident will dictate the specific type of chemical protection required. The guidelines for the use of these various levels of protection are as follows:

Level A: MAXIMUM PROTECTION

Should be worn when the highest level of respiratory, skin, and eye protection is required.

Level A Conditions:

- Unknown gas concentrations.
- Known extremely toxic or corrosive gases.
- Possible or expected skin exposure to toxic or corrosive liquids, gases or solids.
- IDLH Atmospheres

Level A Configuration:

- Fully-encapsulating chemical resistant suit completely encloses user and SCBA.

Level B: HIGH RESPIRATORY PROTECTION

Should be worn when the highest level of respiratory protection is needed but a lesser level of skin protection is required. (SPLASH PROTECTION)

Level B Conditions:

- Known contaminant levels below IDLH concentrations
- Atmosphere with less than 19.5% oxygen.
- Chemical concentrations which are above the TLV level.

Level B Configuration:

- Chemical resistant clothing including boots and gloves, that generally do not fully enclose user and SCBA.

Level C: LIMITED RESPIRATORY PROTECTION

TOM MIHALEK / AP

Should be worn when the criteria for using air-purifying/respirators has been met.

Level C Conditions:

- Greater than 19.5% oxygen.
- Contaminant level below IDLH and above TLV
- Skin contact hazards are minimal or do not exist.

Level C Configuration:

- Level B and Level C differ only in type of respiratory protection required. The chemical protective clothing requirements are the same.

Level D: MINIMUM PROTECTION

Should be worn only as a work uniform and not on any site with a respiratory or skin hazard.

Level D Conditions:

- No possibility of respiratory exposure.
- No possibility of skin exposure.
- No contaminant levels below TWA.

Level D Configuration:

- Standard Work Uniform.

CHEMICAL PROTECTIVE CLOTHING STANDARDS

NFPA CHEMICAL PROTECTIVE CLOTHING STANDARDS

The National Fire Protection Association has completed the development and publishing of three (3) national standards regarding chemical protective clothing for use during hazardous chemical emergencies.

NFPA 1991 Standard:

This standard is for specifying the design and performance criteria for a chemical protective garment that is intended to be used in a gaseous or vapor atmosphere of chemicals. This garment must be totally encapsulating.

NFPA 1992 Standard:

This standard is for the design and manufacture of a garment that did not have to meet the rigid permeation resistance requirements found in the 1991 standard. In the 1992 standard, Standard on Liquid Splash-protective Suits for Hazardous Chemical Emergencies, the emphasis was basically on two things:

1. single to multi-piece garments
2. suitable chemical test that reflected resistance to liquids.

Its use is for liquid splash environments only.

NFPA 1993 Standard:

This standard deals with support functions and is described as hazardous chemical operations involving controlled chemical uses or exposures in non-flammable atmospheres with minimum threats to loss of life, personnel injury, or damage to property or to the environment. Functions include, but are not limited to, decontamination, remedial cleanup, and training.

OSHA 29 CFR Part 1910 (q)(3)(iv) Final Rule March 6, 1989

(iv) Employees engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard shall wear positive pressure self-contained breathing apparatus while engaged in emergency response, until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection will not result in hazardous exposures to employees.

The level of protection necessary for the hazardous materials responder at an incident should be based on the following factors which must be critically assessed:

A. The type and measured concentration of the chemical substance in the ambient atmosphere and its toxicity.

B. The potential for exposures to substances in the air; to splashes of liquids; and to direct contact with materials or substances due to the work being done at the incident site.

PROTECTION FROM CHEMICAL WARFARE AGENTS

Military-issued equipment to protect against these agents varies widely based on the level of anticipated exposure. Civilian activities in the presence of these materials are regulated by HAZWOPER, which is more stringent than military standards. As in any chemical emergency, use the highest level of protection available until the chemical is identified. Modify that level of protection as appropriate after determining what chemicals are present. For example, nerve and blister agents require SCBA with Level A protection. Other toxic chemicals may require a lower level of protection.

IV. Personal Protective Equipment for the First Responder

Minimum personal protective equipment requirements for the first responder, of necessity, revolve around structural fire fighting equipment. This is because it is the most readily available—not because it is the best protection. Police, fire fighters and emergency medical personnel are usually the first to arrive at the incident scene and this is the type of protective equipment usually available to them. The term “full protective clothing” is synonymous with structural fire fighting clothing, or protective equipment as it is known in the fire service. Yet—”fuIl protective clothing” (structural fire fighting clothing) at hazardous materials incidents is **NOT** the same as full personal protective equipment which is specifically designed for hazardous materials environments.

PROTECTIVE CLOTHING AND DEVICES FOR HAZARDOUS MATERIALS SITE ENTRY

EPA Level	Degree of Exposure	Nature of Exposure	Respiratory Protection	Protective Clothing	Examples Of Work Environments
A	Highest Level Of Eye, Skin And Respiratory Protection Needed.	IDLH In Air and Skin is Met. Absorption Through And Skin & Contact Causes Severe Injury Or Death	S.C.B.A. Air Line with Escape Systems	Fully Encapsulated Suit With Two Intrinsically Safe Radio	Confined Spaces And Oxygen Deficient With Atmosphere. High Exposure Potential. (Explosive Or High Visible Or Suspected Toxic Or Corrosive Vapors And Gases Used When Excavating Leaking Drums (Cyanide Poisons, Arsenic's Pesticides) Emergencies With Known Toxic Environments.
B	Highest Level Of Respiratory Protection But Lesser Skin Protection	Air Concentration Requires High Protection (IDLH In Air) 19.5% Oxygen Or Less. No Severe Skin Hazard Splash Protection	S.C.B.A. Air Line With Escape Systems	Chemical Resistant Coveralls (Splash Suit With Long Underwear, 2 Pair Chemical Resistant Gloves, Boots And Covers Hard Hat, Respiratory Protection And Radio	Toxic Substances Have Been Identified Respiratory Protection Is Needed. No Serve Skin Damage If Exposed To Unprotected Skin. At Temporary Storage Facilities, Toxic Vapors Present Or Potential And Oxygen Deficiency.
C	When Air Purifying Respirator Is Needed	Oxygen Level Is Greater That 19.5% In Air Up To TLV Value Level	Full Face Air Purifying Respirator	Chemical Resistant Coveralls (Splash Suit With Long Underwear, 2 Pair Chemical Resistant Gloves, Boots And Covers Hard Hat, Respiratory Protection And Radio	SCBA Not Needed But Respirator Is Required. No Adverse Affects To Skin If Splashed Direct Reading Instruments Show Slight Above Background or TLV valves Particles Or Dust In Air.
D	No Protection Needed Against Hazards	Less Than TLV Level	Air Purifying Respiratory Or Escape Mask Available Burn Not Required To Be Worn	Coveralls, Boots, Gloves Hard Hat, Eye Shield	Administration of Work Area or site has No Contamination. Low Threat of Hazard Impact.

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RESPIRATORY PROTECTION

The use of respiratory protection at a hazardous materials incident is ***mandatory.*** By OSHA and EPA-US regulations. The level (degree) of respiratory protection must be in compliance with OSHA regulations, NIOSH guidance documents, NFPA Standards and standard operating procedures (SOP's). THEY MUST BE SUITED for the hazard and the wearer.

Air purifying respirators (APR's) and self-contained breathing apparatus (SCBA) are the only two forms of respiratory protection that is addressed.

Air Purifying Respirators (APR's)

The use of APR's is limited to the available approved cartridges or canisters. Both cartridges and canisters have very limited use, if used at all, during a hazardous materials incident. This is due to several very critical factors:

1. APR's are negative system, thus allowing for infiltration of contaminated air into the mask,

2. APR's have very limited use times, which does not afford the wearer any substantial protection,

3. APR's require individual fit testing prior to actual use and wearing,

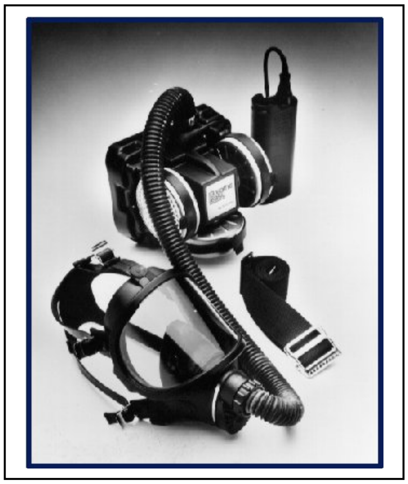
4. APR's do not protect the wearer from unknown air contaminants,

5. APR's ARE NOT APPROVED FOR USE BY EMERGENCY RESPONDERS AT A HAZARDOUS MATERIALS INCIDENT WHEN THE CONTAMINANTS AND THEIR CONCENTRATIONS ARE UNKNOWN.

As stated in 4 above, in order for APR's to provide the safe and proper level of protection necessary for the wearer to be protected, the wearer must know both the contaminant type and concentration. This is not the case for the emergency worker or hazardous materials Responder.

As such, this form of respiratory protection is reserved for use by those workers that are outside both the hot and warm zone, and who have been properly fit tested as well as supplied with the appropriate canister or cartridge, based upon verifiable air monitoring. ONLY UNDER THE DIRECT SUPERVISION OF THE ON SCENE COORDINATOR OR OTHER HEALTH OR SAFETY OFFICER

Kenneth Lambert / AP



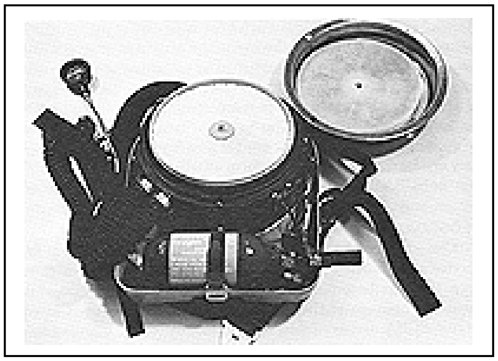
CAN THESE DEVICES BE USED AT A HAZARDOUS MATERIALS INCIDENT.

Self-Contained Breathing Apparatus (SCBA)

The SCBA affords the wearer the best, and highest, level of respiratory protection (Level A & B). It provides the wearer with his or her personal air supply, totally segregated from the outside environment.

There are various makes, models, styles, and manufacturers, the important thing to remember is that there exists only three types:

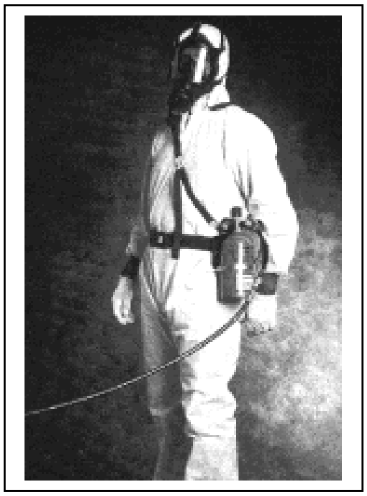
1. Re-breathers,
2. Demand,
3. Pressure Demand.



RE-BREATHERS are basically OXYGEN generators. The wearer is supplied with a closed, recirculating system, whereby exhaled air is sent through a carbon dioxide scrubber, and returned, after a small “injection” of oxygen. The wearer also carries a small canister of oxygen in the unit.

The DEMAND type, ARE NOT APPROVED FOR USE AT HAZARDOUS MATERIAL or FIRE INCIDENTS. These units have been phased out, but still exist in some areas. These units allow a negative pressure to the user upon inhalation. As such, the wearer through normal breathing can pull in contaminants from the outside air directly into the mask. This creates and extreme risk to the wearer during any emergency operations into a contaminated atmosphere

The PRESSURE DEMAND type (POSITVE PRESSURE) is the ONLY TYPE APPROVED FOR USE AT HAZARDOUS MATERIAL INCIDENTS, since positive pressure is always present in the system, thus preventing the wearer from inhaling environmental air.



SAR –Supplied air Respirator (air line system) In the use of an airline or SAR, the worker is “tethered” to a fixed air supply with a pressurized airline. The wearer may also be equipped with a dual mode operating SCBA or an escape pack. IN AN IDLH environments the wearer must have a SAR unit (escape pack 10-15 minutes) This operational set-up is used during extensive containment or remedial operations. NIOSH & OSHA have placed a restriction on the use of air line systems in that the wearer can not be more than 300 ft. from the air source.

THERE IS VERY LITTLE COMPARISON BETWEEN THE PROTECTION AFFORDED BY STRUCTURAL FIRE FIGHTING CLOTHING AND FULLY ENCAPSULATING CHEMICAL SUITS OR OTHER EQUIPMENT SPECIFICALLY DESIGNED TO BE USED IN CHEMICAL SPILL ENVIRONMENTS.

A. Minimum Personal Protective Equipment Requirements:

The National Fire Protection Association. The N.F.P.A. 1971-2000, Standard on Protective Clothing for Structural Fire Fighting states that:

> "Protective Ensemble is multiple elements of clothing and equipment designed to provide a degree of protection for fire-fighters from adverse affects fire-fighting operations and certain other emergency operations." These include an approved helmet, turn-out coat and pants or coverall, approved footwear, gloves, protective hood and interface components (i.e. self-contained breathing apparatus, PASS Devices)

B. Additional Personal Protective Equipment considerations:

Additional recommendations to insure that all exposed areas of skin are covered are:

1. Have gloves that fully cover the wrists. Gloves must also be selected in relation to the material involved. Two sets of gloves should be worn; an inner and an outer glove. Gloves made of synthetic fibers, cotton or leather should not be used as they can absorb liquids or other contaminants which may come into contact with the skin. Once the chemical is absorbed into the gloves it is usually not possible to decontaminate them.

2. PASS (personal alert safety system) devices should be provided to each member involved in the operational aspects of the incident.

3. Inspection should be made of seams, stitches and binding surface abrasions, zippers and closures, head gear and eye protection before entering the site and after decontaminations to determine integrity and possible damage.

It is important to remember that this level of protective clothing does not provide adequate protection against chemical permeation and degradation. In fact, some chemical vapors could cause unseen and unknown degradation of this type of protective clothing, which may not become apparent until some time after the exposure incident. Furthermore, because this type of protective clothing is generally made of fibrous, woven material, it may not be possible to fully decontaminate this equipment when exposed to dusts or particulate matter.

Full protective clothing of the type described here should be considered for use ONLY when operating in a DEFENSIVE mode and no contact with the hazardous material is intended.

REMEMBER:

> "Full protective clothing", as referenced to structural fire fighting clothing, can be worn at hazardous materials incidents, but it should not be worn as a defense against hazardous chemicals effects. It IS NOT designed for the potential risks, and

operating requirements within the HOT zone or the WARM zone. It can be utilized upwind of the incident and outside of any contamination zone. It can also be used in cold zones where support activities are being performed, and it is only to be worn during defensive activities.

V. Recognizing Personal Protective Equipment Operating Limitations

> ***"First responders must be able to identify the hazards to health and safety created by hazardous materials. They must recognize their limitations based on lack of specialized protective clothing, equipment and training."***

This statement from the State of Arizona *Hazardous Materials Response Training,* Level I training manual implies a broad responsibility for first responders. It is also a very general statement about the hazardous materials problem.

What are the specific limitations the first responder should be aware of? Some concerns have already been covered in previous sections and will be more clearly identified to increase awareness of the personal risks relative to protective clothing. Limitations on, and factors which determine the level and choice of personal protective equipment depend on the hazardous materials involved at the incident site; the prevailing conditions at the site; and the complicating factors which impact on operations objectives.

A. The Hazardous Materials Involved:

The form of hazardous material involved at an incident site will have a direct bearing on the choice of personal protective equipment, or the decision to withdraw from the area. There are three broad categories of hazardous material to consider: chemical materials, biological (etiologic) materials, and radioactive materials.

These categories can be defined as follows:

1. **Chemical Materials: Are** materials which are hazardous because of their chemical and physical properties.

2. **Biological Materials: Are** organisms which can have a dangerous effect on life or the environment, and they can exist in normal ambient environments.

3. **Radioactive Materials:** These are materials which emit ionizing radiation.

Each of these categories and the risks associated with that particular category of hazardous material will influence the choice of personal protective equipment. In addition, the type of material, as referenced to these categories, can have far reaching effects on how personal protective equipment is used (operationally), how and whether it can be decontaminated, and whether it can be reused during the operation. An incident involving radioactive material, for example, can lead to the disposal of all personal protective equipment utilized during the incident—and **it can never be used again.** This can certainly be an expensive proposition for many communities.

The physical state of the hazardous material involved is also a factor of concern in choosing protective equipment. Materials, or elements, can be classified into three basic states of matter: gases, liquids, and solids. Each of these states can affect your choice of equipment and how you wear it. As an example, large solids are not as much of a problem as liquids, gases or fine dusts (solid particles) and vapors, which can permeate or penetrate protective clothing as well as contaminate it.

B. Incident Conditions:

Hazardous materials incident conditions can play a major role in the choice of personal protective equipment necessary for the operation. The incident risks, operational problems, and objectives, establish specific demands on personnel and their personal protective equipment. Some of the conditions which must be evaluated are:

1. The inability to identify the material or materials involved at the incident site. In this instance no immediate approach should be made and a “worse case” possibility should be considered.

2. Whether the incident problem involves a leak, spill, or a vapor release. Each of these factors can make a big difference in defensive operational objectives, and therefore, influence the choice of protective clothing needed.

3. A fire in progress or the risk of a fire developing during operations because of the product involved. This factor usually broadens the overall scope of the operation because it is an added complication beyond simple confinement and clean-up. In this

specific instance thermal personal protective equipment must be a definite consideration.

4. An explosion or the risk of an explosion. As in the fire risk—overall operations are expanded in scope as soon as an explosion potential exists or one has occurred. Risk to operating personnel and civilians is the main concern. Thermal protection is a personal protective equipment consideration here, along with the possible damage that might occur to the protective equipment itself, thus eliminating its protective barrier.

5. The risk or damage that a chemical product represents to the environment also affects the possible choices of personal protective equipment. In swampy areas where there is a spill you will most likely need 3/4 length boots rather than turnout pants for example. Work parties may have to be increased and split into multiple areas to confine spill runoff, thus requiring larger quantities of a specific type of protective clothing than might otherwise be necessary.

6. The life safety of both civilians and incident operations personnel can determine the need for special protection, as well as the overall quantity of various levels of protective clothing, to deal with search, rescue, evacuation and defensive site control.

7. The risk to property, and to the community as a whole, by the hazardous materials incident and the materials involved, can greatly affect the need for protective equipment to accomplish objectives geared to property and community preservation.

8. Those methods of dealing with a hazardous materials incident, in and of itself, can be a determinant in the type of personal protective equipment necessary.

C. Complicating Factors:

The complicating factors at a hazardous materials incident can demand higher levels of personal protective equipment than are initially available to the first responder. They may also force a strategy decision to stand off from the incident rather than make an approach. The consequences of mixed commodities and the inability to determine the specific risk they represent is one example. Extremely limited access and escape corridors to an incident site where flammable or explosive materials are involved represents another decision point for both operations objectives and personal protective equipment adequacy.

Weather conditions can have significant impacts on the use and protective qualities of personal protective equipment. Rain, particularly a wind driven rain, can force contaminants through improperly secured openings, increase the possibility of permeation and penetration, and decrease visibility which in turn requires increased safety precautions. It can increase runoff and the size of the contamination zone. Weather conditions can complicate the incident problem for the incident commander and personnel to the point where the ability to cope is almost impossible. The need to evaluate its impact on protective equipment is always a factor of importance. The dynamics of weather require a constant re-evaluation of equipment adequacy and performance.

It is also extremely important to understand the mechanisms, or means, by which personal protective equipment may be violated and rendered ineffective. These are defined below.

The term TRACEM-P is used here to help remember the term and its meanings:

Thermal:

Structural fire fighting equipment is specifically designed for use against the effects of heat and fire. This equipment however, has maximum temperature and duration limitations which cannot be exceeded. These limits are at what can be considered the low end of both the temperature and duration scale. Consult the manufacturer of the equipment for the limits.

Thermal considerations are not limited to the 20O~ to 3000 Fahrenheit range. Thought should also be given to liquefied gases and cryogenic materials which can cause frostbite or thermal damage to equipment.

Radioactive:

Radiation is an unseen risk that can be destructive to both life and equipment within hours, days, weeks, months or years of exposure. It can be airborne, becoming part of the products of combustion in the smoke cloud, and be inhaled or deposited on your PPE causing damage. It can be present at the incident site emitting deadly radiation which passes through protective clothing, and causes a breakdown of PPE fabric and the protective properties.

You must know what type of radiation source is present at the incident site and the level of radiation being emitted from the source material to determine what type of protective clothing and equipment is necessary. It may be that the protective equipment available is inadequate for your protection. In this instance you should not enter the incident site nor any downwind contamination zones. The structural fire fighting clothing usually available to the first responder offers minimal protection against specific low level radiation sources.

Asphyxiating (Confined Space/Oxygen Deficiencies:)

The danger of confined special/oxygen deficiencies is an important factor that should not be overlooked at hazardous materials incident sites. For that matter it should be considered at all chemical incident sites, even if the chemical or product involved is not considered hazardous. The reason for this is because the lack of oxygen at an incident site cannot be readily determined. Some gases which are not hazardous can displace oxygen in sufficient amounts to cause death. Chemicals in a fine dust form, if suspended in air, can clog the throat and nasal passages, cutting off oxygen to the lungs, making it difficult or impossible to breathe. The only way to overcome these difficulties is to wear self-contained breathing apparatus on your arrival upon hazardous materials incident sites. This may even mean wearing them as you ride to the site. In the case of emergency response vehicle drivers it may be wise to place the SCBA tank on the seat or floor of the vehicle and have the facepiece on with air flowing to the facepiece as you approach the incident area.

Chemical:

The effects of chemical damage to protective clothing can violate the protective barrier and cause injury, death or incapacitation to incident personnel. As with radiation, chemicals can destroy both PPE fabric and protective treatments.

Etiologic:

The problem with etiologic or biological exposure is that it is either impossible, or very difficult to initially detect if operating personnel have been exposed or if there is a risk of exposure at an incident site. It may also be difficult to determine exactly what routes of entry into the body are possible for the agent involved. With these severe limitations present it is almost impossible to determine the aspects of personal protective clothing which are critical for the safety of personnel.

Mechanical:

Mechanical damage may occur to protective clothing during incident operations which can violate the protective qualities of the equipment. It is also important to recognize that damage may occur to protective clothing from previous incident operations as well. Before entering an incident site involving hazardous materials a pre-inspection should be made of protective clothing to insure that the protective qualities of the clothing are still intact. Inspections should also be made at intervals during operations and following decontamination procedures before the clothing is stored for future use. Examples of this damage are holes, tears, rips, or faulty zippers, snaps, or closures.

Psychological:
Impact generated upon the individual by the event. A mental impression which can cause long lasting effects or can alter one ability to perform or alter the manner in which they live.

VII. Routes Of Entry Of Hazardous Materials Into The Human Body

There are four main routes for hazardous materials to enter into the human body for chemicals. An understanding of these routes is essential for the first responder so that he can recognize the need for the protective envelope provided by protective clothing, and its limitations. The four main routes are:

A. Inhalation:

Dusts and fine particles can be inhaled and find their way into the lungs, and then into the bloodstream to move to vital internal organs to cause damage. A largely unknown fact is that a substance can enter the respiratory tract through a punctured eardrum. If a first responder has a punctured eardrum, a medical evaluation is needed to determine if exposure to hazardous materials is an acceptable risk.

B. Skin absorption:

Some chemicals may be absorbed through the skin and enter the bloodstream. Absorption can also occur when a toxic substance comes in contact with the eye. The small blood vessels at the surface of the eye will readily absorb many toxic substances. Contact lenses can trap toxic substances between the lens and the eye where they will remain to cause damage to the eye or internal body organs. Always wear full face protection when a contamination risk is present. In these instances full body covering protection, which is designed to prevent chemical absorption by the body, is required. Structural fire fighting clothing will not meet this protective requirement.

C. Ingestion:

The ingestion of a hazardous chemical can occur by the simple act of touching your lips with your hand, licking your lips with your tongue, or smoking a cigarette. In each instance the consequences can be damaging or fatal. First responders should never smoke or eat at or near an incident site. They should also be fully decontaminated before they leave the incident site to a relief area for food or beverages.

D. Injection:

The injection' of hazardous materials into the body sounds, at first, like a bad joke. Who in his right mind would inject themselves—especially when it is not required by a doctor? However, it can occur by stepping on a sharp object, or impaling yourself on or being cut by a sharp object while working at an incident site. It will happen before you even realize it has occurred and the reality of possibly being internally contaminated sinks in. The best precaution for this eventuality is to have protective clothing on, including steel shank and toed foot protection, and by strictly instituting and observing safe work habits.

VIII. The Means By Which Personal Protective Equipment Performance May Become Compromised

Personal protective equipment used by the first responder may become defective leaving incident personnel vulnerable to the life threatening effects of hazardous chemicals. First responders' personal protective equipment must be inspected on a regular basis to determine if its reliability meets the minimum protection requirements to sustain the protective envelope. This inspection should include structural fire fighting clothing even if you have more advanced chemical protective clothing available.

Personal protective equipment may be affected in the following ways:

Chemical resistance is the ability of the chemical material or materials which make up the protective clothing and equipment to prevent or reduce degradation and permeation of the fabric by the attack chemical. In the case of structural fire fighting clothing this ability is extremely limited as compared to the numerous chemical products which may affect its integrity.

Degradation is a chemical action involving the molecular breakdown of the material due to contact with a chemical.

Permeation is a chemical action involving the movement of chemicals, on a molecular level, through intact material. There usually is no indication that this process is occurring.

Penetration is the movement of material through a suit's closures, such as zippers, buttonholes, seams, flaps or other design features. This also includes loose stitching, and rips and tears in personal protective clothing.

IX. When To Remove Personal Protective Equipment (PPE) If It Has Been Contaminated

There is always the possibility that circumstances will cause PPE to become contaminated despite all precautions. Personnel should continually check each other to detect any contamination. The question of exactly when it is safe to remove contaminated PPE is dependent on several factors which can become quite complicated. The scope of the incident and the probability that multiple chemicals are involved must be considered. The dilemma goes beyond "when" to: where can protective equipment be removed; why should it always be removed when you leave the incident area; what should be removed based on the conditions; and who should do the removal of the equipment. Who, what, when, where, why and how are all critical questions which must be answered by the incident commander when dealing with the removal of personal protective equipment.

The removal of personal protective equipment should never be done within the incident "hot zone or in any contaminated area until recognized professionals have determined, through the use of appropriate equipment, that the hazard risk has been removed. The incident commander is responsible for insuring that incident operations in the work area, the decontamination area, and any other areas used during the incident are safe.

If contaminated it will be necessary to decontaminate air cylinders for SCBA equipment after they have been removed and **before** they are refilled to insure that breathing air, the face piece and regulator, and the air filling station equipment are not contaminated. Under contamination threatening conditions the best approach is to stand off, secure the area, and turn the operation over to a private concern.

If personal protective clothing and equipment is removed within the incident site, even where it has been declared safe, incident commanders must continue to monitor personnel, who should be checking each other, to insure that symptoms of exposure are not becoming apparent. There is always the chance that something was missed. A test may have been performed incorrectly or a testing device may fail. The final responsibility again lies with the incident commander.

Regardless of the type of contaminated protective clothing, from Level I (structural fire fighting clothing or similar clothing) to the most advanced fully encapsulating protective clothing (Level A), the removal of the protective envelope should be a closely monitored and planned exercise. It should only be done when it has been declared safe to do so, and only in an area which has been specifically designated and designed for the purpose. Where the risks to health are unknown or found to be serious—great care must be taken in removal supervision and personnel safety. Personnel are not safe until they have removed their protective clothing and equipment, and are returned to a safe and clean environment.

IN SUMMARY

Who? What? When? Where? Why? How?

ONLY the Incident Commander, his designee or the Safety Officer can order the removal of PPE.

1. **All equipment that passes the CONTAMINATION CONTROL POINT.**

2. **EVERY time it crosses the CONTAMINATION CONTROL POINT.**

    A. **ALWAYS in an area designated and designed for PPE removal (DECON)**
    B. **NEVER in "HOT ZONE"**
    C. **NEVER in a contaminated area**

You are never safe from contamination until all protective equipment and contaminated clothing are removed.

Under supervision of personnel assigned to perform decon.

MODULE 6

PLANNING THE RESPONSE

BASIC HAZ MAT CONTROL

Outline

- ☐ **Introduction**
- ☐ **Distinguishing Defensive and Offensive Control Actions Definitions**
- ☐ **Control Techniques**
- ☐ **Available Equipment and Reference Materials**
- ☐ **Student Activity**

MODULE 6

PLANNING THE RESPONSE

Objectives

The student will be able to:

1. Distinguish between defensive and offensive control actions.
2. Define the terms control, confinement and containment.
3. Name 2 of 3 control techniques available to the operational responder.
4. List three items commonly found on fire apparatus that can be used for defensive control measures.
5. List three additional items of equipment that are readily accessible and can be used for defensive control measures.
6. Name two reference books that could be used by the first responder for basic haz mat control.

INTRODUCTION

The emergency responder, in particular the FIRST RESPONDER, is normally arriving at a situation with little or no knowledge of what the substance is, or what measures need to be taken. Consequently, it is imperative that this responder operates in a DEFENSIVE MODE since levels of protection, environmental and health risks, and proper operating procedures are not known. Defensive strategy calls for control of the situation with limited exposure to hazards and risks and which there is no direct or purposeful contact made with the substance or material.

Remember to follow these steps during a hazardous materials spill response:

1. Identify the material and its associated hazards;

2. Know how to select and use proper personal protective equipment provided to you;

3. Stop the flow at the source if it could be done safely and without making contact with the material;

4. Confine the spill to the immediate area;

5. NOTE: If you can't safely stop the release with the available resources, then possibly you may be able to confine the spilled material, secure the scene, and call for qualified assistance. It involves, but is not limited to:

I. Distinguishing Defensive and Offensive Control Actions

A. Defensive Control Actions: The actions taken during a hazardous material emergency/incident in which there is NO CONTACT with the specific product.

It involves, but is not limited to:

☐ confinement and containment techniques to keep a release in a designated area

☐ elimination of ignition sources

☐ vapor suppression

Advantages of defensive control actions:

☐ The problem may be controlled without direct exposure of personnel to the haz mat.

☐ Special haz mat leak control equipment may not be required.

☐ First responders can perform most defensive control operations with minimal supervision from technical or specialty terms.

B. Offensive Control Actions: The actions taken by a hazardous materials technician/specialist, in appropriate chemical protective clothing, to handle an emergency/incident which may result in contact with the released material.

It involves, but is not limited to:

- ☐ transferring the product
- ☐ plugging and patching damaged containers (except stopping or slowing a small non spraying leak with obstructing material. That action, with no contact with material, could be considered defensive)
- ☐ uprighting leaking containers and sealing them in place

II. Methods of Control

Physical Methods
Absorption
Covering
Dikes, Dams, Diversions, Retention
Overpack
Plug/Patch
Vapor Suppression
Venting

Chemical Methods
Adsorption
Gelation
Neutralization
Dispersion
Controlled Burning

A. Physical Methods

Absorption-The process in which materials hold liquids through the process of wetting. Absorption is accompanied by an increase in the volume of the sorbate/sorbent system through the process of swelling. These materials can be used for confinement, however, the sorbed liquid can be desorbed under mechanical or thermal stress. Sorbent and imbiding materials retain the spilled material until they are put through a chemical process to reverse molecular adhesion. Examples of absorbent materials are: sawdust, clays, charcoal, and polyolefin type fibers.

Considerations when using sorbents:

- ☐ sorbent must be compatible with the spilled substance
- ☐ sorbent will also become contaminated and will have to be disposed of accordingly
- ☐ contaminated sorbent materials possess all of the hazards of the chemicals they have absorbed: flammability, toxicity, reactivity, etc.
- ☐ dirt is much more absorbent than sand
- ☐ sawdust can react with some materials, and does not hold onto the absorbed material for very long

Covering-A temporary form of mitigation for radioactive, biological, and some chemical substances. It may also be used to reduce vapor production from spilled liquids.

Dikes, Dams, Diversions, Retention-When a liquid is spilled, it tends to seek the lowest level of the terrain. Therefore, the use of physical barriers may be needed to prevent or reduce the quantity of liquid flowing into the environment. Dikes or dams usually refer to concrete, earth, and other barriers to hold back the spill or leak. Diversion refers to the methods used to physically change the direction of flow of the liquid. Try to avoid digging holes or trenches in the path of the liquid to contain or direct it since this may increase the rate of soil permeation and possible groundwater contamination. You may protect storm drains by covering them with plastic sheeting or tarp, and lining the edges with dirt or heavy objects.

Dikes are effective when constructed quickly. They can be constructed from practically any readily available materials such as dirt, plastic tarps, straw, sand, boards, roof ladders, pike poles, and even backboards.

Bagged materials such as tree bark, sand, and kitty litter tend to make sturdy barriers. All dike construction should begin with large materials for reinforcement, followed by an outer layer of lighter material such as dirt.

A common error made during size-up is to underestimate the number of people required to build a dike.

Some factors that limit dike construction are:

a) area is concrete or asphalt with no available dirt

b) the ground is frozen

c) essential equipment such as pointed shovels are unavailable

Like any other procedure dealing with hazardous materials, the dike area should be constructed upwind of the incident when possible.
Types of dames:

☐ Simple dam-wall that keeps the chemically-contaminated water in one place
☐ Overflow dams-used to trap immiscible substances that tend to sink in water
☐ Underflow dams-used to trap immiscible substances that tend to float on water

Considerations when using dams:

☐ dirt dams are only temporary and require constant monitoring and reinforcement
☐ simple dirt dams can be improved by lining them with plastic sheeting, or by placing the soil in plastic garbage bags before placement
☐ it may be necessary to build two or more dams downstream to buy sufficient lead time to complete larger, complex separation dams

Diversion refers to the methods used to physically change the direction of flow of the liquid. A flowing, land-based spill can quickly be diverted by placing a barrier, normally dirt, ahead of the spill. Fire Service personnel can immediately implement the diversion method upon arrival at the scene. The use of pressurized fire lines to act as berms will channel the runoff to or away from a particular object or geographic location. To be successful, the barrier must be built well in advance of the spill. The idea behind this is to sacrifice some territory in order to save the prime real estate.

Retention can be implemented independently of diversion or diking or a backup to the other methods. If resources are unavailable to construct a dike, it may be possible to contain the haz mat at a sewer drain. The materials will move toward the drain following the contour and grading designed to direct the flow of water. Using salvage covers or plastic to prevent the material from entering the drain, you will be able to hold the material in that one location. Other options such as portable chemical tanks, drafting basins and swimming pools can be considered.

Overpack-The most common form of overpacking is through the use of an oversized container. Overpack containers should be compatible with the hazards of the materials involved. When possible, the spilled materials should be treated or properly disposed of.

Plug/Patch-The use of compatible plugs and patches to reduce or temporarily stop the flow of materials from small holes, rips, tears, or gashes in containers.

Vapor Suppression-The reduction or elimination of vapors emanating from a spilled or released material through the use of specially designed agents. Sometimes referred to as blanketing, vapor suppression can also be considered a chemical method of mitigation.

Venting-The controlled release of the material to reduce and contain the pressure and diminish the probability of an explosion.

B. Chemical Methods

Adsorption-The process in which a hazardous liquid interacts with a solid sorbent.

Gelation-The process of forming a gel. A gel is a colloidal system consisting of two phases, a solid and a liquid.

Neutralization-The process of applying acids or bases to a spill to form a neutral salt. The application of solids for neutralizing can often result in confinement of the spilled material. One must be cautious when using this method since often heat is generated and violent reactions may occur.

Dispersion-Dispersants are most often applied to spills on water. Chemical or biological agents can be used to disperse or break up the materials involved in a liquid spill. The dispersant breaks down a liquid spill into many fine droplets.

Controlled Burning-Controlled combustion is considered a chemical method of control. It should be used only by trained personnel with consultation by appropriate environmental authorities.

III. Readily Available "Haz Mat" Equipment and Supplies

Vehicles responding to a haz mat incident range from police and fire service to first aid and public utility trucks. As the vehicles vary, so does the equipment that is carried by each vehicle. From jacks, shovels, lights, first aid supplies and speedy dry, probably no two vehicles carry the same equipment. The only resource that may be standard is the knowledge of the first responder at the operational level. This knowledge will help to achieve a safe, defensive control technique without jeopardizing the health or safety of those involved.

A. The following is a list of supplies and materials commonly found on fire apparatus that can be used for defensive control measures in a release situation. They are:

1. Tarps-used to cover spilled material, or to cover storm drains, or even to "diaper" saddle tanks.
2. Pressurized Hose-line to act as diversion berms to channel run-off or as boom for spills in water.
3. Shovels, Axes, Brooms-used to construct dikes or other barriers to prevent the movement of the haz mat.
4. Fans-used to direct air releases away from the public.
5. Spray nozzles-used to disperse vapors or "settle" powders or dust.

B. The following is a list of additional equipment that is readily accessible and can be used for defensive control measures:

1. Plastics, drop clothes, and pool liners-adequate for confinement, containment, collecting, or "diapering."
2. Rakes, hoes, picks-for the construction of dikes, berms, channels, or collection holes.

Keep in mind that in the winter, ice, snow, and frozen dirt is just as adequate for construction.

3. Buckets, pails, tubs, kiddie pools, trash cans, storage containers-all work well to assist in the confinement or collection of materials, wet or dry.
4. Air splints-used to seal floor or road storm drains to prevent run-off.
5. Speedy dry, kitty litter, dirt, peat moss, cement, sand, mattress-used for absorption as well as for confinement techniques (diversion, diking, retention).
6. Air mattresses, inner tubes, inflatable pools-can serve as covers for storm drains, berming materials, and diversion channels. Inflation can be accomplished very rapidly by using air tanks or mobile cascade systems.

IV. Reference Books for Control Techniques

There are other problems that may face the first responder in addition to the hazardous material presence. Information from various guide books (a minimum of 3 guide books should be consulted), as well as your department's standard operating procedures, may tend to be contradictory or inconsistent. If this situation arises, the most conservative approach is recommended. The first responder can act only in a defensive mode. The first responder may find his or her actions resembling offensive procedures even though they are not.

Reference Books such as the DOT Hazardous Material *Guidebook* and the American Association of Railroads' Surface Transportation of Hazardous Materials provide information on defensive methods that are available for those responders limited in haz mat training and specialized equipment. Information such as fire suppression, runoff hazard, spill or leak confinement techniques, and reaction with other materials are available and should be utilized. In addition, information dealing with basic decontamination is also available. This information can be extremely helpful when used properly. THINK DEFENSIVE.

Additional reference books that are available to the first responder are, but not limited to:

1. Fire Protection Guide on Hazardous Materials
2. Hazardous Chemicals Data *Book*
3. The *Merck Index*
4. *NIOSH* Pocket Guide to Chemical Hazard
5. *Dangerous* Goods Guide to Initial Emergency Response (Canada)
6. Chris *Manual*

V. Exercise Problems for Study

The first responder operating at Level I is always working in the defensive mode in that there must be NO INTENTIONAL OR PLANNED CONTACT WITH THE HAZARDOUS MATERIAL. The responsibility is to minimize, as safely as possible, the spread or escalated release of the material to the environment. With this in mind, read each of the following three scenarios and determine what type of defensive action you would take.

CASE 1

You respond to a jackknifed tractor trailer that is placarded "1993." (Diesel Fuel) The driver has already been transported to a local hospital in an unconscious state. Your response was initiated when the local police noticed that the tractor mirror bracket had broken loose and punctured the trailer. You have been asked to perform safety measures. Describe the type and amount of defensive activity you would use.

CASE 2

You are responding to a call of smoke emitting from a dry cleaning establishment. Upon arrival, the owner advises you that he had inadvertently mixed two dry cleaners that began reacting. He assures you that the products will not burn and that this has happened several times in the past. What defensive measures would you employ?

CASE 3

A multi-vehicle accident has caused the following:

1 car on fire, no trapped passengers
1 tractor trailer resting on side in stream
2 pick-up trucks entangled, no fire
1 driver still trapped in pick-up

Upon arrival you notice the trailer cargo has ruptured the side and is in various stages of damage. An obvious discoloration exists in the stream. The trapped driver is alive and appears to be in somewhat stable condition. A slight unknown odor is noticed in approaching the driver.

The driver of the rig advises you that his load consisted of car batteries, antifreeze, assorted automobile fluids, and miscellaneous parts and supplies. He also advises you that he thought he heard electrical arcing in the engine compartment just prior to losing control. What would be your course of action?

ESTIMATING SPILL AREA SIZE

THE FOLLOWING SPILL AREAS IN SQUARE FEET WERE DETERMINED BY RELEASING A NON-TOXIC DYED WATER OVER VARIOUS SURFACE TYPES.

LEVEL PAVEMENT

AMOUNT OF LIQUID	AREA IN SQUARE FEET
ONE GALLON	4 BY 8 FEET, OR 32 SQUARE FEET
FIVE GALLONS	12 BY 12 FEET, OR 144 SQUARE FEET
FIFTY-FIVE GALLONS	JUST OVER 1,200 SQUARE FEET

DIRT SURFACE

AMOUNT OF LIQUID	AREA IN SQUARE FEET
FIVE GALLONS	SOAKED IN AFTER COVERING 25 SO. FT
55 GALLONS	COVERED 490 SQUARE FEET

GUTTER (STREET)

FIVE GALLONS	135 FEET IN THREE MINUTES
FIFTY-FIVE GALLONS	460 FEET

IN SUMMARY, LIQUIDS OF WATER-LIKE VISCOSITY, SUCH AS GASOLINE OR LIGHT FUEL OILS, TENDED TO TRAVEL APPROXIMATELY 30-35 SQUARE FEET PER GALLON. SPILLS TRAVEL ABOUT 30 FEET/GALLON IN A CLEAN GUTTER.

MODULE 7

IMPLEMENTING THE

PLANNED RESPONSE

BASIC DECONTAMINATION PROCEDURES

Outline

Introduction

Definitions & Types

Procedures

Key Points

MODULE 7

IMPLEMENTING THE PLANNED RESPONSE

BASIC DECONTAMINATION PROCEDURES

Objectives

The *student* will *be able to:*

1. Identify the two types of decontamination.
2. List two common sense techniques to follow prior to leaving the incident.
3. Name two criteria to be considered when selecting a basic decontamination site.
4. Describe two precautions that could eliminate or reduce the need for basic decontamination.
5. List two types of equipment that can be used to perform Basic Decontamination.

I. INTRODUCTION

A. DEFINITION

Decontamination is the process of removing potentially harmful contaminants from exposed individuals and equipment in order to reduce the spread of contamination in the work area and to prevent inadvertent and unnecessary contact with contaminated materials.

Personnel should not handle a contaminated suit, tool, or person without proper protective equipment. Failure to do so may lead to skin absorption or inhalation of the contaminant, resulting in injury, illness, or death.

B. TYPES OF DECONTAMINATION

Decontamination falls into two categories: basic decontamination and full (definitive) decontamination. The Level 2 Operational Responder will be required to know how to perform basic decontamination.

C. DEFINITIONS

1. BASIC DECONTAMINATION-Is the common sense approach used by first responders when unintentional contact is made with a hazardous material product. He/she should keep whatever is outside of the suit outside, remove the product and leave the product at the scene of the incident.
2. FULL DECONTAMINATION-The use of decontamination stations used to remove hazardous material.
3. HOT ZONE-An area where materials are contained or expected to be contained. Contamination is expected to occur within this zone and only personnel properly equipped for the material(s) present are allowed to enter this zone.
4. WARM ZONE-Located adjacent to the Hot Zone. Personnel operating in this zone must be equipped to properly operate as a decontamination team for the materials present in the Hot Zone.
5. COLD ZONE-Is located upwind and uphill of the Hot and Warm Zone. Command and other support activities occur in this zone.
6. CONTROL POINT-Is established to regulate access to work zones. A site must be controlled to reduce the possibility of: 1) contact with any contaminants present and 2) removal of contaminants by personnel or equipment leaving the site.

II. BASIC DECONTAMINATION

A. DECONTAMINATION PLAN

Besides the obvious reasons of why we perform decon, we must remember that we are required to perform decontamination procedures according to regulations and standards. At the Operations level, the standard states that you will "know how to implement basic decontamination procedures."

Also addressed in OSHA 1910.120(q) is the Emergency Response Plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, decontamination. Finally, OSHA discusses decontamination in Appendix C-Compliance Guidelines and Appendix E-Training Guidelines, both found in the back of the standard.

Appendix C states that "decontamination should be tailored to the specific hazards of the site, and may vary in complexity and number of steps, depending on the level of hazard and the employee's exposure to the hazard. Decontamination procedures and PPE decontamination methods will vary depending upon the specific substance, since one procedure or method may not work for all substances. Evaluation of decontamination methods and procedures should be performed, as necessary, to assure that employees are not exposed to hazards by re-using PPE."

In addition to the OSHA standard, the National Fire Protection Association addresses decontamination in its 472 standard.

B. DECONTAMINATION PROCEDURES

The ability to perform Basic Decon is essential to the Operational First Responder. Although Basic Decontamination will not be used at every incident, the need to use this procedure will come sooner or later. As a responder at this level of training, you will be limited to the type of incident in which you could take a defensive course of action. As your ability to perform certain tasks are limited, so are your capabilities in performing decontamination to personnel and equipment.

COMMON SENSE TECHNIQUES

When performing basic decontamination, the goals, as well as the tasks needed to accomplish these goals, should be kept simple. There are "common sense" techniques that could be used to help protect the health and safety of all personnel involved and to prevent the spread of the hazardous material. Some of the "common sense" techniques to be considered are the following:

1. Check your own hands and feet (both should be protected upon arrival at the incident) for any signs of contamination.
2. Observe each other. Do a complete visual check of other personnel for signs of contamination. If a substance is noted, do not touch, but rather, wait until decontamination procedures can be employed.

3. If you are unsure that any piece of protective clothing or equipment has been completely decontaminated, carefully remove articles and leave them behind to be properly collected. **YOUR SAFETY COMES FIRST. EQUIPMENT CAN BE REPLACED.**

4. While decontaminating, avoid direct contact with the contaminated item.

BRUSH OFF METHOD

Basic decontamination can be accomplished using several different methods. Since you should not come in direct contact with the contaminated item, brooms, sponge mops, dust mops, and other such utensils can be used to brush off the material or apply cleaning agents. Brushing off the material, from a contaminated person or piece of equipment, could eliminate any need for further decontamination. The material that is brushed off should be collected in plastic or polyfilm sheeting.

HOSE OFF METHOD

Another method of basic decontamination requires a hose line and catch basins. The individual to be decontaminated is directed into a diked or basin area. The diked or basin area will prevent runoff and will divert the material to a safer area for later treatment and disposal.

If the contaminated individual must be assisted, such assistance must be given with a minimum of direct handling until decontamination is completed. As much distance as possible should be placed between contaminated personnel and workers conducting decontamination.

The contaminated individual is then "hosed off" using dilution with water to flush the hazardous material from protective clothing and equipment. Firefighters can use this method without requiring specialized equipment. Water is readily available and can be used liberally. A support line or garden hose with high pressure, low volume will remove a large percentage of gross contaminants. By lowering water pressure, the chances of overspray or splashing will be minimized.

A disadvantage of using water is reactivity with certain materials. Be sure to check with a reference source (e.g., U.S. DOT Guidebook) for information on the material to prevent a greater hazard. The application of water to most hazardous materials generally reduces concentration but does not change the material chemically.

Following the "hose off," a soap and water solution scrub down of protective clothing will usually remove any remaining contaminants. If protective clothing has been breached or there was an absence of protective clothing, the contaminated individual must be stripped and then decontaminated using the previous methods. However, one should consider using water during cold weather due to the medical risk of the individual and of the decontamination personnel.

C. SITE SELECTION

Selection of the decontamination site should be based on:

1. Accessibility to the incident
2. Secure dike or basin areas
3. Proximity to environmentally sensitive areas such as streams and ponds

The entire area for decon should be taped off and isolated. No one working in the decon area should be there without personal protective equipment.

Equipment, clothes, or material that becomes contaminated should be left in the decon area until they can be properly decontaminated, evaluated and analyzed, or disposed of. Household type plastic trash bags may suffice as containment for contaminated items. Provisions should be made to bag personal property, separately from clothing to avoid reopening contaminated clothing bags. All bags should be labeled.

REMEMBER, if you have entered the Hot Zone (only for defensive action), the conservative action is always to assume contamination, therefore, you must go through the decon process.

The possibility of exposure or transfer of substances can be reduced or eliminated in a number of ways:

a) Setting up security and physical barriers to exclude unnecessary personnel.
b) Minimizing the number of personnel and equipment on-site.
c) Establishing work zones.
d) Establishing control points to regulate access to work zones.

D. KEY POINTS (PRECAUTIONS)

1. Before getting into basic decon, it's important to mention that prevention of contamination can be thought of as decontamination. Prevention can be accomplished by having:

    a) No contact with any contaminants present.
    b) No contaminants being removed from scene by personnel or equipment.

2. Prevention of contamination can be thought of as decontamination.
3. Decontamination personnel should be in full protective clothing needed to protect them from the hazards.
4. If possible, victims are not to be transported until decontaminated.
5. When wearing firefighter turnout gear, the SCBA is the last item of PPE to be removed when processing through basic decontamination. Facepiece is taken off last.
6. Equipment that is available for basic decon:

Brushes, mops, pitchforks, shovels, etc. Moderate pressure and low volume hose line. Catch basins to contain cleansing water for proper disposal.

Polyfilm or plastic sheeting (could also use a tarp if available for certain procedures). Household type plastic trash bags with labels.

7. When necessary, decon equipment, vehicles, PPE, etc.
8. Some equipment, such as leather, radios, instruments can't be decontaminated.
9. Be wary of equipment such as that used by the Fire Service that could be very porous (e.g., wooden handles or hose beds). Liquids can soak into wood and flow into metal cracks and seams or under bolts. Fire apparatus exposed to hazardous materials should be completely washed with detergent and rinsed.
10. The Incident Commander, or his designee, must decide how much decon is necessary and when and where it will be utilized.

CHEMICAL WARFARE AGENT DECONTAMINATION

Few HAZMAT teams are equipped to provide the extensive level of decontamination called for in these situations. Residual contamination on the CPC components can cause injury long after the incident itself. Therefore, response teams need to consider how to safely dispose of the contaminated equipment.

In addition, commercial cleanup companies that typically clean up chemical spills may not be prepared to deal with these chemical agents. Specialized government teams would be involved in the cleanup and decontamination of any chemical warfare incident.

PREVENTING HOME CONTAMINATION

Contamination of worker's homes with hazardous chemicals and substances transported from the workplace is a world wide problem. So says the National Institute for Occupational Safety and Health (NIOSH), which has released a report on this issue.

NIOSH found that workers can inadvertently carry hazardous materials home from work on:

✔ clothes
✔ hair
✔ in their vehicles
✔ skin
✔ tools

The incidents of home contamination have resulted in a wide range of diseases and, in some cases, death among workers' families.

Here are some tips to prevent contamination at work and at home:

☐ Change clothes before going home and leave soiled clothing at work to be laundered by the employer
☐ Store street clothes in separate areas of the workplace to prevent their contamination
☐ Shower before leaving work
☐ Prohibit removal of toxic substances or contaminated items from the workplace
☐ Do not allow family members to visit the workplace
☐ Inform workers of the risk to family members and of preventive measures
☐ If contaminated clothing must be laundered at home, keep it separate from family laundry

Some procedures you might use for decontamination include: air showers, laundering, vacuuming and other methods of surface cleaning, and destruction and disposal of contaminated items. Generally, hard surfaces are more easily decontaminated than clothes, carpets, and soft furniture. Normal house cleaning and laundry practices appear to be inadequate for decontaminating worker's clothes and homes. Decontamination methods such as laundering and vacuuming can actually increase the hazard to the person performing the operation and other household members.

A copy of the NIOSH report can be found on the Internet at http://www.cdc.gov/niosh/contamin.html. Information provided by BLR Safety Works for Supervisors. November, 1996, Issue No. 279.

MODULE 8
EVALUATING PROGRESS

FIRST RESPONDER OPERATIONAL SOP'S, RECORD KEEPING AND

Outline

- S.O.P'S
- Pre-Incident
- RTK
- Alarm On-Site

MODULE 8

EVALUATING PROGRESS

Objectives

The student will be able to:

1. Define the D.E.C.I.D.E. Process
2. State the main reason for establishing S.O.P's.
3. State the definition of a Standard Operating Procedure.
4. Identify who has the authority to deviate from a procedure.
5. List three pre-incident records.
6. Describe 3 items of information which you have the right to obtain from your employer under RTK.
7. List 2 employer RTK requirements.
8. List the most important on-site record.

SOP PHILOSOPHY

Over the course *of* time people have come to realize that it is necessary to write *down* procedures in order to save the experience *gained when dealing* with a recurring problem. Procedures *then,* are guidelines that have been shown to have a high probability *of* success in certain situations. With new situations general procedures are used until experience allows us to be more specific. An SOP fulfills the *need* for consistency in performance with a concern for safety. It must always be *remembered* that decisions are made based on experience, either personal or that written into a procedure, *and* the decision maker has the final say not the procedure.

SOP DEFINITION

An SOP in an established and prescribed method for performing task and operations that occur on a routine basis.

STANDARD OPERATING PROCEDURES

The importance of developing and implementing effective standard operating procedures has been continually stressed as one of the major ingredients of an effective safety program. Indeed, SOP's must be established and followed to assure safe, effective emergency scene operation.

But SOP's have an often overlooked trap that can cause problems. The trap is that while personnel may follow the SOP, they may not understand the reason behind it. For example, an SOP for a residential structure fire may require the second arriving company to ventilate the fire floor and the floors above.

When personnel are questioned as to why they are to ventilate they should be able to explain that ventilation is required to release accumulated heat, smoke and toxic gases which improves visibility, reduces the interior temperature and minimizes the potential for a backdraft. The reason for ventilation should not simply be "because it's required by the SOP, the hazards it addresses, and the intended outcome of following the SOP"

It is also important to understand the "whys" behind an SOP so that personnel can easily recognize when conditions are such that additional or alternative action is required. In most cases the SOP will be worded such that the company officer or incident commander have the authority to deviate from the SOP when the situation exceeds the original intent of the SOP Of course they should be held accountable for the consequences of any such deviations.

As you implement SOPs make sure that appropriate training and education for all personnel is part of the implementation program so that everyone knows, not just what the SOP is, but also why it must be followed.

GUIDE FOR S.O.P. FORMAT

This guide will be used for the drafting of S.O.P. and O1's prior to submission to the Planning Bureau.

S.O.P.	EFFECTIVE DATE	NUMBER
	SUBJECT	
REFERENCE	RESCINDS	

I AUTHORITY

II INTRODUCTION OR PURPOSE

III MECHANICS

1. **Effective Date**: Denote date this S.O.P. should become effective.
2. **Number**: Uniformity in numbering can be obtained only where there is a central review of index numbering. (Insert "DRAFT," number will be assigned by Planning.)
3. **Subjec**t: Self-explanatory.

4. Reference: All other related S.O.P. and/or statutes, rules, agreements, and Orders.
5. Rescinds: List all S.O.P. which this Order cancels or replaces.
6. Department Info: Can be used for your department needs.
7. I. Authority: A brief statement, indicating the legal or quasi-legislative sources or base, from which the S.O.P is drawn. Should include, but is not limited to:
    a. Statutory Law
    b. Case Law
    c. Rules and Regulations
    d. N.J. Administrative Codes
    e. N.J. Civil Service Rules and Regulations
    f. Court Rules
    g. Contractual Agreements
    h. Organizational Authority of Superintendent
    i. Attorney General's Decision
    j. Executive Orders of the Governor

II. INTRODUCTION or PURPOSE: A concise explanation of the Order. Should include a policy statement if applicable.

III. MECHANICS: A guide to carrying out the intended purpose or policy of the Order. General or specific instructions as to what must, what may, and what must not be done.

Format: All major paragraphs should have a heading. Subparagraphs should also have a heading when it will assist the reader in finding a specific subject. The sequence or location of certain paragraphs in the text increases the effectiveness of an S.O.P.

Margins and Indentations: The inside or left margin of each page should be 1'/4 inches for ease of reading when inserted in binders. The following outline form will be used for S.O.P.:

I. Make plans when writing directives

A. Study published and written material 1.

Responsibility of writer...

a. Know your reader...

(1) Needs and limitations...

(a) Operational or administrative

1) Responsibility of implementer

Page Numbering: The first page should not be numbered. Start with "2." Then number the remaining pages consecutively, center page numbers at bottom.

Attachments: Enclosures or exhibits to a directive should be clearly marked as "annexes." They may include: lists, reports, formats, illustrations, forms, or charts. They will be lettered alphabetically and numbered consecutively.

Transmittal Sheets: Transmittal sheets will be used to forward directives (S.O.P., etc.) to prospective readers or users. Although Orders are self-transmitting by design, it may be necessary or desirable to give a summary of the contents or to outline the changes that have occurred. The users time is conserved by making it unnecessary to read the entire directive and makes it easy to compare the old version with the changes. Transmittal sheets will also be used as a canceling device. In the case of a change or revision to an Order, the transmittal sheet will give proper instructions to the person maintaining the S.O.P. binder by using such captions as "insert," "remove," "new," "obsolete," etc.

Cross-References: All material to which an originator makes a cross-reference must be checked to determine whether it is current and whether all recipients of the Order have the referenced material. When an Order is revised, the references must be checked. When a reference is made, it is a good idea to tell the reader why he needs the referenced material.

NOTE: Orders must always serve the user, not the originator. Since a single user may receive orders written by many people, it is extremely important that the content of Orders be presented in a clear, consistent way. As a guide to the originator, the following suggestions are presented:

Be Specific: An order must be as specific as possible. Avoid ambiguous terms such as adequate, reasonable, or appropriate. If used, explain how to judge what is adequate, reasonable, or appropriate. Avoid the terms large, small, soon, later, etc., give ideas in numbers and quantities. Explain how many minutes or hours soon or later might be.

Be Brief: Do not repeat what already has been said. Use tables and lists if they cut down on explanations. Do not copy material from other sources that are available to the reader; simply refer to the other source. Use examples to clarify instructions.

Write directly to the reader.

Key Words: Freedom of Choice on the part of the reader can be suggested by certain words. Use "will" and "will not," "shall" and "shall not" when reader will have no choice. Use "should" when he is to do something if he is able or if circumstances permit, but he should not do if time, equipment, skill, cooperation, or other circumstances make it impossible or at least difficult. Use "may" when there is freedom of choice, i.e., "You shall make out a daily activity report." "You should make it out upon completion of shift." "You may make a copy of it if you wish."

Public employers are required to label containers and train employees about hazardous substances. Private employers generally follow federal OSHA rules regarding labeling and training. All employers are subject to the provisions of the NJ Right to Know Act that call for labeling of all containers at a work site.

Hazardous Substance Fact Sheets, developed by DOH, provide information about the hazardous substances covered by the law, and are available to employers, workers and the public. Emergency response teams can obtain complete sets of Fact Sheets from the DOH RTK Program.

WHO IS COVERED BY THE ACT?

The New Jersey Legislature designated the types of employers covered under the Right to Know Act.

Employers covered by the law include manufacturers, law and garden services, pipelines, transportation services, communications, utilities, car dealers, gas stations, commercial testing labs, dry cleaners, automotive repair, hospitals, schools, and state, county, and local government. Contact your county agency, DEP, or DOH for more information about the businesses that are covered and their responsibilities under the law.

PUBLIC EMPLOYEE RIGHTS UNDER RTK IN NEW JERSEY

RTK sets forth some very specific rights for the employee and provides the procedure to be followed in exercising these rights. They are detailed in Section 16 of the act.

Right to Information from Employer (Section 16a) You, or your representative (attorney, bargaining unit steward, holder of power of attorney, etc.) may make written request to your employer for:

1. A copy of a RTK survey.
2. A copy of a hazardous substance fact sheet or MSDS.
3. Where applicable, an environmental survey for the facility where employed.
4. The chemical name and CAS number of any substance contained in any container which is not labeled pursuant to the labeling requirements of RTK.

Employer must comply with all such requests within five working days in each case.

Right to Refuse to Work (Section 16a) Should you make a written request for information (as above), and it is not honored within five working days, you may refuse to work with * the substance involved with no loss of pay or forfeit until your request is honored.

(*"work with" may be construed for purposes of this training to also mean "in the proximity of.")

Right to Complain (Section 16b) Should you or your representative feel that your department has not complied with action initiated under Section 16a, you or your representative may file a complaint directly with the DOL Commissioner. The DOL Commissioner must then investigate and conduct an administrative hearing to determine if the provisions of Section 16a have been violated.

Right to Information from DOH (Section 10d) Anyone may request in writing a copy of a workplace survey for a facility, together with appropriate hazardous substance fact sheets. When requested, this information must be provided by DOH within thirty days, and the request shall be treated as confidential.

Right to Freedom From Discrimination (Section 17a & 17b)

1. You may not be discharged, disciplined, penalized, nor discriminated against in anyway as a result of your exercising any of your rights under RTK.
2. If you believe that any such disciplinary action, penalty or discrimination has occurred because you have exercised your rights under RTK; you may, within thirty days of the violation or of your becoming aware of it, complain directly to the DOL Commissioner. The commissioner must conduct an investigation within thirty days of your complaint, and if he finds a cause for action the matter will be referred to the Office of Administrative Law for further action.

Native Language Rights (Section 11 a) If your native language is Spanish, and you cannot read or speak English above a sixth grade level, you have the right to obtain information specified in RTK, training and safety data, in Spanish.

PUBLIC EMPLOYER RESPONSIBILITIES UNDER RTK IN NEW JERSEY
Several sections in RTK deal with specific duties for the employer. Here, we are concerned primarily with explaining the employer's direct responsibilities to you, the employee. Your employer must:

☐ Establish and maintain a central file at each facility containing:

1. A copy of the RTK survey.
2. Appropriate hazardous substance fact sheets or MSDS.
3. A copy of the RTK Hazardous Substance List.

☐ Post on bulletin boards, readily accessible to employees, a notice of the availability of the information in the file described above.

☐ Upon request, provide the specified RTK information within five working days.

☐ Establish an education and training program to inform employees in writing, and orally, of the nature of hazardous substances to which they are (may be) exposed in the course of employment. Said program must be provided to current employees by December 31, 1985. Employees hired after that date must have this training provided within the first month of employment. The training must be repeated annually, thereafter.

☐ Must provide DOH, upon request, with any health and/or exposure records kept on an employee. Examples would be any pre-employment physical exams, health histories, medical surveillance program records, etc.

☐ If any employee speaks Spanish as a native language, and cannot read or speak English above the sixth grade level, bulletin board notices and RTK file information must be provided in that language. Upon specific request, training must also be conducted in Spanish.

☐ Label every container with the chemical name and CAS number(s) of the substance(s) it contains. Exceptions to this requirement are those containers determined by the DOH to be exempted.

SECTION II ALARM

Reporting

The type of response that your department makes to a hazardous materials incident will be based on the information that you are able to obtain. See figure A-1.

There are several methods through which the Municipality, the County, or the New Jersey Department of Environmental Protection (NJDEP), may be advised of incidents involving the release or potential for release of hazardous substance pursuant to the Spill Compensation and Control Act (N.J.S.A. 58:10-23, 11, et seq.) and Emergency Notification Act (N.J.S.A. 13:1 K-17) A310.

HAZ MAT INITIAL CONTACT MESSAGE FORM

1. ____________ PRESENT TIME ____________ PRESENT DATE

2. PERSON CALLING: ____________ PHONE: (____) ____________

FROM: ____________ TIME THEY RECEIVED CALL: ____________

____ FROM NJDEP TRENTON DISPATCH NJDEP T.D. CASE #: ____________

3. INCIDENT LOCATION: ____________

REPORTED BY/FROM: ____________ PHONE: (____) ____________

ADDRESS: ____________ CITY: ____________ COUNTY: ____________

4. DATE/TIME OF EVENT: ____________ / ____________

5. MATERIALS INVOLVED: ____________ PLACARD ID #'s: ____________

____________ ____________

STATE OF MATERIALS: ___GAS ___LIQUID ___SOLID

AMOUNTS INVOLVED: ____________ ACTUAL ___POTENTIAL ___ESTIMATED

____________ MATERIALS CONTAINED: (Y/N/U): ____________

6. INCIDENT DESCRIPTION: ___FACILITY ___ROAD ___RAIL ___SHIP ___OTHER: ____________

INJURIES (Y/N/U): ___NUMBER: ____________ PUBLIC EXPOSURE (Y/N/U): ____________

FACILITY EVACUATION (Y/N/U): ___NUMBER: ____________ POLICE AT SCENE (Y/N/U): ____________

PUBLIC EVACUATION (Y/N/U): ___NUMBER: ____________ FIREMEN AT SCENE (Y/N/U): ____________

CONTAMINATION MODE: ___AIR ___LAND ___WATER ___WIND FROM/SPEED: ____________ / ____________

WATERWAYS AFFECTED: ____________ PRECIPITATION: ___RAIN ___SNOW ___NONE

LOCATION TYPE: ___RESIDENTIAL ___INDUSTRIAL ___RURAL

SENSITIVE POPULATION: ___HOSPITAL ___SCHOOL ___NURSING HOME ___OTHER: ____________

7. STATUS AT SCENE: ____________

____

____

____

8. RESPONSIBLE PARTY: (___Same as INCIDENT LOCATION—Item #3) ___UNKNOWN

COMPANY: ____________ CONTACT: ____________ PHONE: (____) ____________

ADDRESS: ____________ CITY: ____________ STATE: ____________

9. AGENCIES & PERSONS CONTACTED (SPECIFY REFERRAL/ENROUTE/AT SCENE):

____________ TIME: ____________ PHONE: (____) ____________

____________ TIME: ____________ PHONE: (____) ____________

____________ TIME: ____________ PHONE: (____) ____________

____________ TIME: ____________ PHONE: (____) ____________

____________ TIME: ____________ PHONE: (____) ____________

10. ADDITIONAL NOTES: ____________

____

____

____

11. REPORT FILED BY: ____________ HAZMAT ICMF-1 5/21/87

SECTION III ON SITE

- ✔ Chronological Log
- ✔ Access Control Log
- ✔ Exposure Records
- ✔ Methods of Decontamination

Once you arrive on site records must be kept for safe operations. Throughout the incident a **chronological control log** should be maintained at the command post. This may be the most important document at the completion of the incident to determine why decisions were made, actions taken and who performed them, are vital pieces of information needed in post incident analysis.

While operations are taking place, an **access control log** should be maintained for information as to the specific individual who may be on site when the emergency takes place; the Operations Officer or Safety Officer has to know who was on site and what they were doing. This log should also show the time an individual went on SCBA air, the estimated duration, and anticipated exit time. The type of exposure to each individual along with **decontamination methods** used are part of the reporting process.

CONTENT OF EVENT LOG ENTRIES

- ☐ **TIME YOU WERE CONTACTED**
- ☐ **DATE/TIME THE EVENT OCCURRED**
- ☐ **WHO CONTACTED YOU**
- ☐ **WHAT ORGANIZATION THEY REPRESENT**
- ☐ **WHAT IS THE CONTACT PHONE NUMBER**
- ☐ **WHAT OCCURRED**
- ☐ **WHERE DID IT OCCUR**
- ☐ **WHAT ORGANIZATIONS ARE INVOLVED**

MODULE 9

TERMINATING THE INCIDENT

Outline

MODULE 9

TERMINATING THE INCIDENT

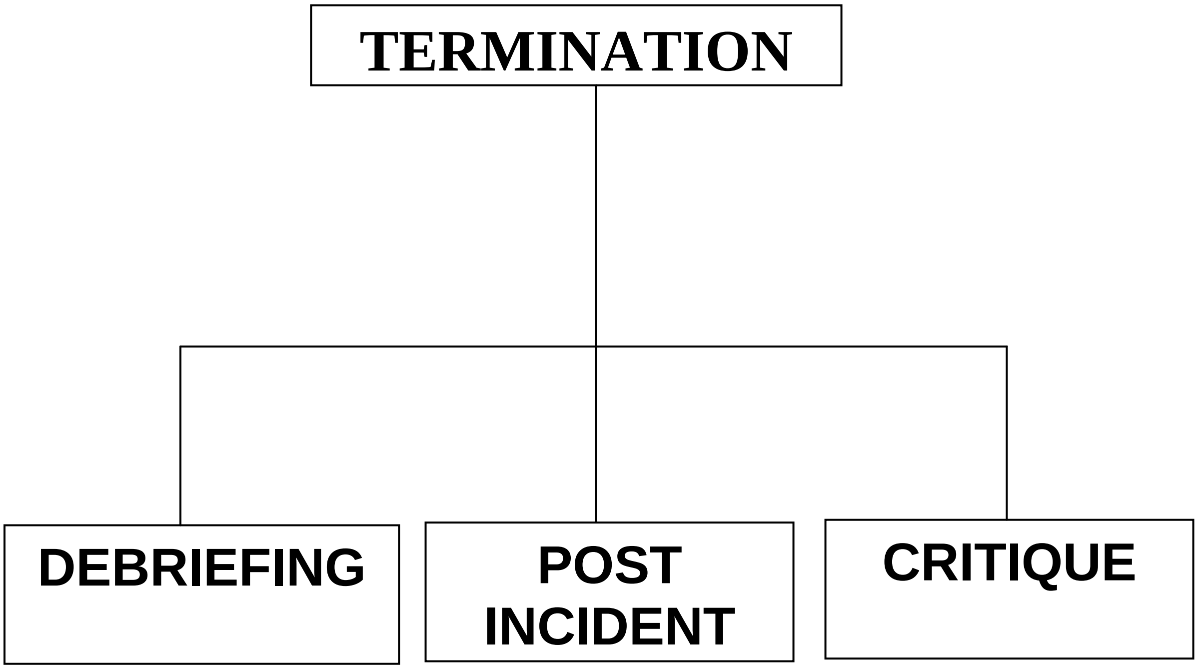
Objectives

The student will be able to:

1. List three phases of termination

1. WHAT ARE THE ACTUAL OR POTENTIAL IMPACTS
2. WHAT ACTION HAS BEEN TAKEN
3. WHAT IS REQUESTED
4. WHAT ACTION YOU HAVE TAKEN IN RESPONSE TO THE SITUATION

TERMINATION ACTIVITIES



TERMINATION

DEBRIEFING

POST INCIDENT

CRITIQUE

SECTION IV TERMINATION

Termination: The cessation of emergency tactical operations to include documentation, debriefing and the eventual post incident analysis, and critiquing.

Termination activities are divided into three phases: (1) debriefing the incident, (2) post-incident analysis, and (3) critiquing the incident.

1. An effective debriefing should:
   - a. Inform responders exactly what hazmats they were exposed to.
   - b. Identify equipment damage and unsafe conditions requiring attention.
   - c. Assign information, gathering responsibilities for post-incident analysis and critique.
   - d. Summarize the activities performed.
   - e. Reinforce the positive aspects of the response.

2. Post-incident analysis is conducted to:
   - a. Determine the level of financial responsibility.
   - b. Establish a clear picture of the emergency response for further study. The post-incident analysis should focus on four key topics:
     Command and control
     Tactical operations
     Resources
     Support services

3. Critiques

Many injuries and fatalities have been prevented as a result of critique sessions. A commitment to critique all haz mat responses will improve emergency responder performance by improving efficiency and pinpointing weaknesses.

The crucial person to a good critique is the critique leader; the critique leader should:

1. Control the critique.
2. Ensure that direct questions receive direct answers.
3. Ensure that all participants play by the critique rules.
4. Ensure that each operational group presents their observations.
5. Keep notes of important points.
6. Sum up the lessons learned.

SUMMARY

Hazardous materials incidents should be formally terminated to ensure emergency responder safety, to establish a record of events, and to document the lessons learned from the entire incident.

APPENDIX 1

DOH HAZARDOUS SUBSTANCE FACT SHEETS and MATERIAL SAFETY DATA SHEETS:

The Department of Health Hazardous Substance Fact Sheets will tell you about the behavior of over 2000 pure substances that the DOH has placed on the New Jersey Hazardous Substance List. The Fact Sheet is written in a six-page standard format. Page six is the most important page for emergency responders. On this page, you will find NFPA hazard ratings, emergency information, and physical data for the material.

On the other pages of the Fact Sheet you *will find:*

page 1; Identification, hazard summary, exposure limits, and ways to reduce exposure.

page 2; Health hazard information, medical testing to detect exposure, and workplace controls.

page 3; Personal protective equipment required by industrial workers.

page 4; Handling and storage procedures, common questions from the public.

page 5; Glossary of terms.

The **Material Safety Data Shee**t is a source of information supplied by manufacturers on the materials that they produce. While the DOH Fact Sheet deals with pure chemicals, the MSDS deals with products (which may be mixtures of several chemicals) as they come from the shelf. An MSDS is written in nine sections and may be a single or multi page document. The sections of the document (not necessarily in this order) are:

1. Identity (material and manufacturer)
2. Physical data
3. Hazardous ingredients
4. Fire and explosion hazard data
5. Health hazard data
6. Reactivity data
7. Spill or leak procedures
8. Special protection required
9. Special precautions and comments

Sample MSDS

Page 188

Page 189

Page 190

Page 191

Page 192 GP MSDS

Page 193 GP MSDS

HSFS page 194-200

RTK Survey Form 203-210

APPENDIX 3

APPLICATION OF VAPOR SUPPRESSION FOAMS

I. VAPOR SUPPRESSING FOAMS

The effectiveness of vapor suppressing foam agents depend on a number of factors. These factors are as follows:

1) Type of foam

2) Expansion ratio of the foam

3) The 25 percent drainage time of the foam

4) Rate of the application of the foam

5) The application (gpm/sq ft) density (gallons/sq ft) of the foam

Training in the use of foam as a fire extinguishing agent is not sufficient to qualify an individual for foam application as a vapor suppressing agent.

II. TWO GENERAL CATEGORIES OF FOAM AGENTS

1) CHEMICAL FOAM
2) MECHANICAL FOAM

CHEMICAL FOAM is produced by a chemical reaction between salts of weak acids and weak bases. It is becoming obsolete and has never been tested as a vapor suppression foam agent.

MECHANICAL FOAM is produced by mechanically mixing a dilute solution of the foam concentrate and water with air, producing an expanded foam. Mechanical foam agents have been tested both as fire extinguishing agents and as vapor suppressing agents.

III. TWO BROAD CATEGORIES OF MECHANICAL FOAM

1) PROTEIN FOAM AGENTS
2) SYNTHETICALLY DERIVED FOAMS

PROTEIN FOAM AGENTS are derived from a hydrolyzed protein substance such as hoof and horn meal or feather meal. These are naturally occurring substances.

SYNTHETICALLY DERIVED FOAMS are based on the surfactant composition. Synthetic foams may contain surfactants of the hydrocarbon surfactant type, i.e. detergents; or they may contain surfactants that are fluorinated and are known generically as AFFF (Aqueous Film Forming Foam).

AFFF form an aqueous film on a hydrocarbon liquid surface in spite of the fact that the hydrocarbon is less dense than water.

IV EXPANSION RATIO OF SYNTHETICALLY DERIVED FOAMS

TYPE	EXPANSION RATIO
LOW EXPANSION	20 TO 1 OR LESS
MEDIUM EXPANSION	BETWEEN 200 TO 1 AND 20 TO 1
HIGH EXPANSION	EXCESS OF 200 TO 1 AND TYPICALLY IN VICINITY OF 750 TO 1. A SYNTHETIC HYDROCARBON SURFACTANT FOAM, IT HAS BEEN USED FOR TOTAL FLOODING OF CONFINED SPACES AND FOR DISPLACEMENT OF VAPORS, HEAT AND SMOKE. UNDER SUITABLE CONDITIONS, IT MAY BE BUILT UP INTO VERY THICK LAYERS BUT ITS USE IS LIMITED BY WIND.

V SIX CATEGORIES OF LOW EXPANSION FOAMS (BASED ON CHEMICAL COMPOSITION)

CATEGORY	CHEMICAL COMPOSITION
1st CATEGORY	DERIVED FROM HYDROLYZED PROTEINS
2nd CATEGORY	DERIVED FROM PROTEIN FOAM TO WHICH A FLUOROCHEMICAL SURFACTANT HAS BEEN ADDED
3rd CATEGORY	SYNTHETIC HYDROCABON TYPE SURFACTANTS OR DETERGENT FOAMS
4th CATEGORY	REFERRED TO AS AAAF FORMULATED FROM SYNTHETIC FLUORO-CHEMICAL AND HYDROCABON SURFACTANTS IN CONJUNCTION WITH SOLVENTS
5th CATEGORY	MODIFICATION OF THE FLUOROPROTEIN FOAM. REFERRED TO AS FFFP (FILM FORMING FLUOROPROTEIN FOAM)
6th CATEGORY	CAN EXTINGUISH HYDROCARBON FIRES INCLUDING HYDROCARBONS THAT ARE REFERRED TO AS POLAR SOLVENTS

VI. FACTORS FOR CONSIDERATION WHEN USING FOAM

FOAM STABILITY of the foam blanket is determined by foam quality. Foam quality is measured in terms of three parameters: foam expansion ratio, foam 25 percent drainage time, and foam viscosity.

FOAM EXPANSION RATIO-Volume of foam obtained from a unit volume of foam liquid dilute solution. The expansion ratio for low expansion foams is less than 20 to 1.

25 PERCENT DRAINAGE TIME is the time required for 25 percent of the foam liquid to drain from the foam. This is the property that is generally used to measure the stability of the foam, and it, in combination with the expansion ratio, will determine how the thickness of the foam blanket will vary with time.

VAPOR PRESSURE of the fuel can vary widely depending on the type of fuel. For example, the vapor pressure of unleaded regular gasoline is certainly considerably higher than the vapor pressure associated with fuel oil. It is important to have a good thick foam blanket continuously on the fuel surface.

FOAM BLANKETS must be maintained in such a fashion that there are no openings for vaporization to occur that could result in fire or in exposure to human life.

MEDIUM & HIGH EXPANSION FOAMS can be used for vapor suppression but both are technique dependent, less mobile on the fuel surface, and in general result in foams that are more impaired by climatic conditions such as wind, velocity, wind direction, precipitation, etc.

FOAM AGENTS that are designed specifically to be used as vapor suppressants for spills involving acidic or caustic materials are not fire extinguishing agents. They can never be used when a fire is involved with the acidic or basic material.

APPENDIX 4

HANDS-ON OPERATIONS TRAINING

PROTECTIVE CLOTHING

Equipment needed-Turn out gear for appropriate response agencies.

Instructor will have a student suit up in the department's standard turn out ensemble. Instructor will point out the advantages and disadvantages of turn out gear in a haz mat response including:

1. Leather Patches-cannot be decon.
2. Corduroy Collars-cannot be decon.
3. Point out that the material may be porous and not resistant to chemicals.
4. In the case of 3/4 boots and coats, product can enter under the coat.
5. Leather helmets cannot be decon.
6. All leather goods (wallets, belts, hat brims, etc.) must be removed-cannot be decon.
7. Contact lenses must be removed.
8. With SCBA in place, demonstrate the routes of entry of a hazardous material into the body and why firefighter turn out gear is inadequate for haz mat response.
9. Using CPC, contrast it with firefighter turn out gear. I.E.-Plain Tyvek, Tyvek PVC, acid suit (re-usable), etc.

BASIC HAZ MAT CONTROL

Equipment needed-Standard equipment carried on fire apparatus brooms, shovels, pike poles, hose, tarps, plastic sheeting. Also 55 gallon drum, 5 gallon pail.

Explain defensive vs offensive actions.

Create a leak by using a garden hose or opening a pump drain or outlet.

DIVERSION

Demonstrate use of charged hose line to divert material.

Demonstrate use of sand/dirt to construct a dike or berm around a storm drain. Use a tarp or plastic sheeting with dirt or sand to block a storm drain.

Dig a shallow trench to divert flow.

Use wood (2 x 4) with dirt to divert flow.

CONTAINMENT

Using a 5 gallon pail as a container demonstrate:

- ☐ Placing the cover on the pail using a shovel and a broom or pike pole.
- ☐ Using the above tools, demonstrate how alternate materials (plywood, garbage can covers, etc.) can be used in containment.
- ☐ Using a 55 gallon drum demonstrate how to roll the drum so the breach (hole) is on top, then use wood, etc., to block it in place.
- ☐ Using a tarp, demonstrate its use in blanketing (use ropes on corners to extend safe distance).
- ☐ Demonstrate (or explain) the use of foam in blanketing.
- ☐ Demonstrate the use of Fog streams in vapor dispersion and suppression.
- ☐ Demonstrate the use of other equipment commonly carried on your apparatus in defensive control, confinement and containment of hazardous material.

BASIC DECONTAMINATION

Equipment needed-Large tarp or 6 mil plastic sheeting, brushes, brooms, booster or 1 1/2 line with fog/spray nozzle or "goose neck fog nozzle" (ideal) 2 1/2, " 3" or " 5" hose line. 2 milk crates or concrete blocks.

Procedure

Locate an area properly suited for decon (per operations student guide).

- ☐ Using large diameter hose line create a "Figure 8" for 2 decon "pools." Then use additional line to create a "Berm" around the "pools."
- ☐ Place a milk crate or concrete block in each pool so firefighter is not standing in the runoff. Use a low pressure fine spray to grossly decon in the first pool, special emphasis on soles of boots, hands, underarms and "crotch."
- ☐ Direct firefighter to move to the second pool without stepping in the run off. Stand on milk crate, use brushes, brooms to wash off the turn out gear. Start at the head and work down, special concentration to soles of feet, hands, etc., (stress the need to contain the run off in the pool or within the berm).
- ☐ Demonstrate proper removal of gear and disposal in plastic bags. When in turnout gear, the SCBA mask is removed last.
- ☐ Reinforce the need to leave the contaminant at the scene. If it is not, it can contaminate co-workers, family and friends.

APPENDIX 5 Acronyms and Abbreviations

ACM	Asbestos-containing materials
ACO	Administrative Compliance Order (Chapter III) Administrative Consent Order (Chapter VI)
AHERA	(Federal) Asbestos Hazard Emergency Response Act
ARAR	Applicable or relevant and appropriate requirements
ARP	Accidental Release Prevention
BACT	Best available control technology
BAT	Best available technology economically achievable
BCT	Best conventional pollutant control technology
BEAC	(New Jersey) Bureau of ECRA Applicability and Compliance
BEECRA	(New Jersey) Bureau of Environmental Evaluation Cleanup and Responsibility Assessment
BMP plan	Best Management Practices plan
BOD	Biochemical oxygen demand
BPT	Best practicable control technology currently available
CAA	(Federal) Clean Air Act
CAMU	Corrective action management unit
CAS	Chemical Abstracts Service
CBOT	Chicago Board of Trade
CEPP	Chemical Emergency Preparedness Program
CERCLA	(Federal) Comprehensive Response, Compensation, and Liability Act of 1980
CERCLIS	CERCLA Information System
CFC	Chlorofluorocarbon
CFFV	Clean-fuel fleet vehicle
CO	Carbon monoxide
COD	Chemical oxygen demand
CTG	Control techniques guidelines
CWA	(Federal) Clean Water Act
DCR plan	Discharge Cleanup and Removal plan
DEP	(New Jersey) Department of Environmental Protection
DMR	Discharge Monitoring Report
DOH	Department of Health
DOT	Department of Transportation
DPCC plan	Discharge, Prevention, Containment or Countermeasure plan
DTW	Domestic treatment works
DWPL	Drinking Water Priority List
ECRA	(New Jersey) Environmental Cleanup Responsibility Act
EHS	Extraordinarily hazardous substances
EHSARA	EHS Accident Risk Assessment
EP	Extraction procedure
EPA	(U.S.) Environmental Protection Agency
EPCRA	(Federal) Emergency Planning and Community Right-to-Know Act of 1986
ERA	(New Jersey) Environmental Rights Act
ESI Survey	Emergency Services Information Survey
ETR	Employer trip reduction
FDFs	Fundamentally different factors
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FWPCA	Federal Water Pollution Control Act
GACT	Generally available control technology
GIS	General Information Submission
HAP	Hazardous air pollutant
HAZWOPER	Hazardous Waste Operations and Emergency Response (Standard)
HCFCs	Hydrochlorofluorocarbons
HCS	Hazard Communication Standard
HEC	High environmental concern
HMTA	(Federal) Hazardous Materials Transportation Act
HON	Hazardous Organic NESHAPs
HRS	Hazard Ranking System
HSWA	(Federal) Hazardous and Solid Waste Amendments of 1984
I&M	Inspection and maintenance
ICS	Individual control strategy
ID	Identification
IOC	inorganic chemical
ISRA	Industrial Site Recovery Act
LC 50	Lethal concentration, 50 percent
LCCA	(Federal) Lead Contamination Control Act of 1988

DOL	Department of Labor
LEC	Low environmental concern
LEV	Low-emission vehicle
LUST	Leaking Underground Storage Tank Fund
MACT	Maximum achievable control technology
MCL	Maximum contaminant level
MCLG	Maximum contaminant level goal
MEC	Medium environmental concern
MIC	Methyl isocyanate
MPRSA	(Federal) Marine Protection, Research, and Sanctuaries Act
MSDS	Material safety data sheet
NAAQS	National Ambient Air Quality Standards
NACETT	National Advisory Committee on Environmental Technology Transfer
NASA	National Aeronautics and Space Administration
NCP	National Oil and Hazardous Substance Pollution Contingency Plan (National Contingency Plan)
NESHA	National Emissions Standard for Hazardous Air Pollutants
NIOSH	National Institute for Occupational Safety and Health
NJPDES	New Jersey Pollutant Discharge Elimination System
$N0_2$	Nitrogen dioxide
NO,	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPDWR	National primary drinking water regulation
NPL	National Priorities List
NSPS	New source performance standard
03	Ozone
OSC	On-Scene Coordinator
OSH Act	Occupational Safety and Health Act
OSHA	Occupational Safety and Health Administration
PAN	Peroxyacetyl nitrate
PCB	Polychlorinated biphenyl
PEL	Permissible exposure limit
PMN	Premanufacture notice
PEOSH	(New Jersey) Public Employees Occupational Safety and Health Act
POTWs	Publicly owned treatment works
ppm	Parts per million
PRP	Potentially responsible party
PSD	Prevention of significant deterioration
LD 50	Lethal dose, 50 percent
R&D	Research and development
RACT	Reasonably available control technology
RCRA	(Federal) Resource Conservation and Recovery Act
RI/FS	Remedial Investigation and Feasibility Study
RMP	Risk Management Program
ROD	Record of Decision
RQ	Reportable quantity
SARA	(Federal) Superfund Amendments and Reauthorization Act of 1986
SDWA	(Federal) Safe Drinking Water Act
SERC	State emergency response commission
SES	Site evaluation submission
SIC	Standard Industrial Classification
SIP	State implementation plan
SIU	Significant indirect user
SNAP	Significant new alternatives policy
SNC	Significant noncomplier
SNUB	Significant new use report
$S0_2$	Sulfur dioxide
SOC	Synthetic organic chemical
SPCC plan	Spill Prevention Control and Countermeasure plan
SQG	Small quantity generator
STEL	Short term exposure limit
SWDA	(Federal) Solid Waste Disposal Act
SWMA	(New Jersey) Solid Waste Management Act
TCLP	Toxicity characteristic leaching procedure
TCPA	(New Jersey) Toxic Catastrophe Prevention Act
TPQ	Threshold planning quantity
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
TSD facility	Treatment, storage, and disposal facility
TVOS	Toxic volatile organic substance
TU	Treatment unit
TWA	Time-weighted average
U.S.	United States
UST	Underground storage tank
VOC	Volatile organic compound

ENVIRONMENTAL INFORMATION HOTLINES

Air Risk Hotline 919-541-0888
Information on health, exposure, and risk assessment with regard to toxic air pollutants.

Bureau of Explosives Hotline 202-639-2222
Offers assistance in hazardous materials incidents involving railroads and often contacted through

Cancer Information Service Hotline 800-422-6237
Provides information on cancer and cancer risk and referrals to proper sources for local support services.

CHEMTREC Hotline 800-424-9300
The Chemical Transportation Emergency Center will identify unknown chemicals, advise on response methods and procedures for chemicals and situations, provide help in contacting shippers/carriers/manufacturers and product response teams.

Consumer Product Safety Commission 800-638-2772
Information on consumer safety and guidelines on what to do if you come in contact with formaldehyde, asbestos, lime and air pollutants. Also provides product recall information.

Department of Defense Hazardous Technical Information Services (HTIS) 800-848-HTIS
Information to DoD Components concerning the compliant management of hazardous materials and wastes.

Department of Transportation Hotline 800-467-4922
Informational assistance on Hazardous Materials Regulations, training materials, Federal Register publications, and reporting violations.

Environment Defense Fund Recycling Hotline 800-225-5337
Recycling information and locations.

Environmental Protection Agency 800-245-4505
Agency for vendors treating groundwater, soil, sludge, sediments & solid waste.

National Response Center
U.S. Coast Guard Hotline 800-424-8802
Washington, DC Area 202-267-2675
This hotline should be used to report accidental releases of oil and hazardous or toxic substances per 40 CFR Part 300. Contact this center to report chemical spills. Operated 24 hours a day by Coast Guard personnel.

National Pesticide Telecommunications Network Hotline 800-858-7378
Information regarding all aspects of pesticide handling.

Northeast Industrial Waste Exchange Inc. 410-280-2080 Northeast Area

This hotline provides information on waste exchange in the northeast but with access to other areas. It matches those who generate waste with those who can reuse or recycle waste.

Plastics Recyclers Information Line 800-243-5790
Information regarding plastic recycling locations according to area.

Public Information Hotline, EPA 202-260-2080
Will answer inquiries from the public about EPA and offers a variety of general, nontechnical information materials.

Public Laws Update Service 202-523-6641 Washington, DC Area
This recording of the Office of the Federal Register lists what pending public laws have been signed or vetoed by the President. It is updated as laws become available.

RCRA/EPCRA/Superfund/UST Hotline 800-535-0202
Answers questions concerning the Resource Conservation and Recovery Act, Superfund, UST SARA Title In and hazardous waste regulations.

Safe Drinking Water Hotline 800-426-4791
Information of policy and regulations regarding public water supply programs.

Small Business and Asbestos Ombudsman 800-368-5888 Washington, DC Area 703-305-5938
An EPA hotline that gives advice and information to small businesses on complying with EPA regulations and problems encountered by small-quantity generators of hazardous waste and other small businesses with environmental concerns.

Stratospheric Ozone Information Hotline, EPA 800-296-1996
Information on ozone protection regs and requirements under Title VI of the Clean Air Act Amendments of 1990 and other general aspects of stratospheric ozone depletion/protection.

TSCA Assistance Information Service Hotline 202-554-1404
The Toxic Assistance Office at EPA will answer questions and offer general and technical assistance on the Toxic Substances Control Act. Staff will help you to obtain guidance on TSCA regulations including guidance on PCBs and asbestos issues.

U.S. Army Environmental Center Hotline 800-USA-3845 OCONUS 410-671-1699 DSN 584-1699
Provide information on environmental policy & guidance, references, points of contact, stewardship, and Federal and state environmental laws/regulations. Send e-mail to Environmental Technology Email Hotline.

Wetlands Protection Hotline, EPA 800-832-7828
Information regarding values of wetlands and efforts for wetlands protection.

Whistle Blower Hotline, EPA 800-424-4000
Allows for reporting of fraud, waste and abuse in EPA programs.