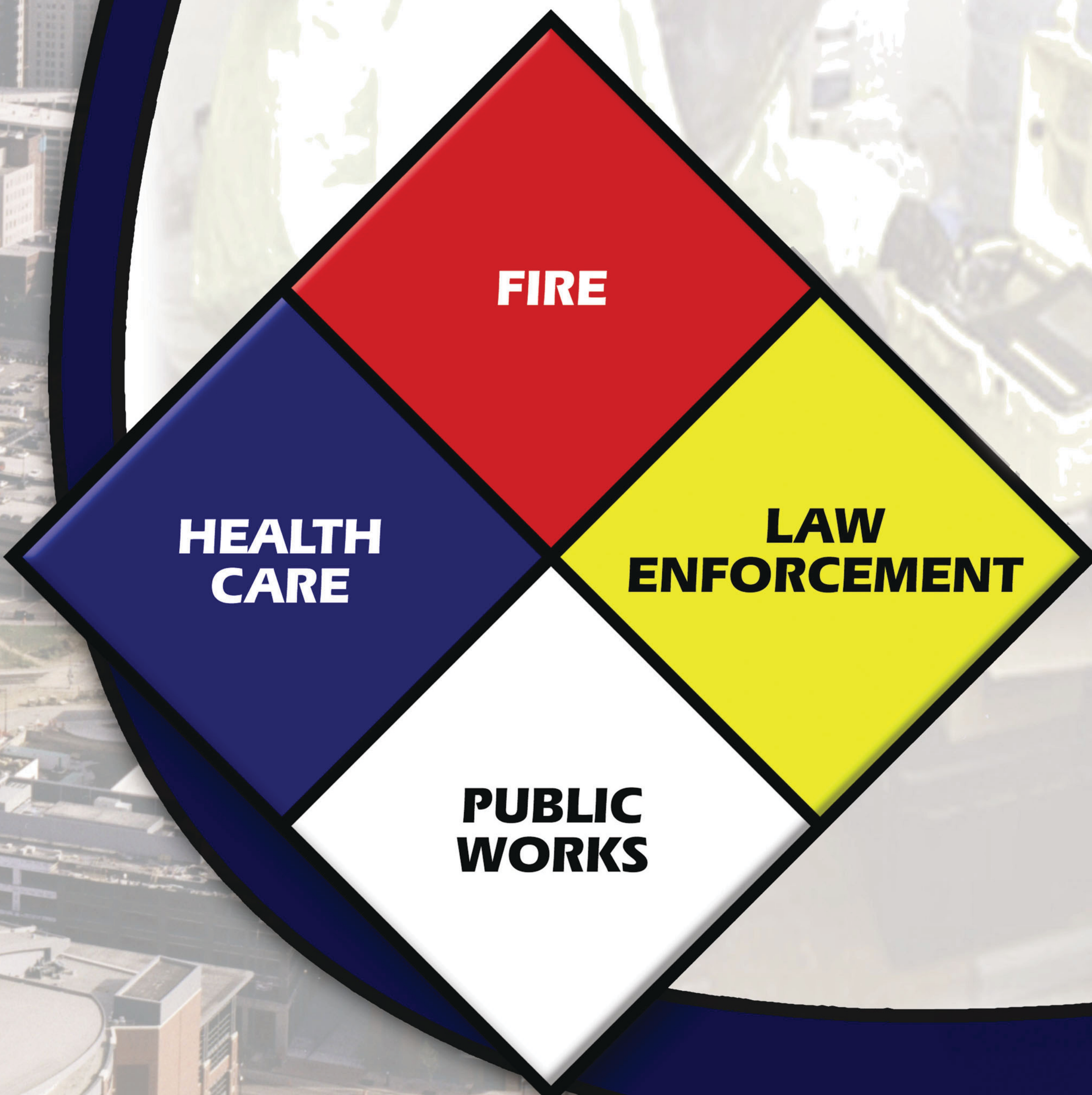
OHIO

HazMat Technician



STUDENT MANUAL

STUDENT COURSE REGISTRATION

Ohio Fire Academy, Registrar
8895 East Main Street
Reynoldsburg, Ohio 43068

Registrar: 614-752-7189 / 888-726-7731
Email: webofa@com.state.oh.us
Fax: 614-752-7111

Website: www.ohiofireacademy.com

Student Information *(Print or type)* *(ALL INFORMATION IN THIS SECTION IS REQUIRED UNLESS NOTED; FAILING TO PROVIDE THIS INFORMATION WILL VOID THE REGISTRATION)*

Student ID or Last 4-digits of SSN ☐☐☐☐☐ - ☐☐☐☐

New Student ☐ Existing Student ☐

Name: FIRST MI LAST

Home Address	City	State	Zip	County	Code #	Date of Birth:

Home # ( ) | Fax # *(optional)* ( ) | Cell / Pager # *(optional)* ( )

Gender: ☐ Male ☐ Female

E-mail Address
(Confirmation information distributed via E-mail)

Current Fire Department / Organization Information

Rank/Title/Position

Current Position: ☐Career ☐Part Paid ☐Volunteer ☐Other (specify)

Fire Department/Organization Name

Address

City	State	Zip	County	Code #	FDID/Agency # (if known)

Chief of Department/Supervisor Signature:

Phone # ( ) Fax # ( )

Course/Dormitory Information

Complete one form for each course

Course Number ☐☐☐☐ Year ☐☐☐☐ Offering ☐☐☐

Course Title

OFFICE USE ONLY

Course Date(s):

Have you met the prerequisites for this class?
☐Yes ☐No enclose appropriate documentation

I request a dormitory on date(s).
☐Yes ☐No

Reservation #

Room #

Payment Information

Method of Payment: ☐ Check/Cash (Payment due at start of course) ☐ FD/Organization-P.O. # ________________ ☐ RCFA (Application must be attached)

☐Charge: Credit Card Number ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ Expiration Date: ☐☐☐☐ Type of Card: ☐ Master Card ☐ Visa

A/R #

Application must be signed by student or responsible party.

I understand that if I register for a course and fail to attend, I will be charged the full enrollment fee, unless I notify the Registrar at least 48 hours prior to the class start date. All cancellations must be approved by the Academy Administration. I acknowledge that I have read, understand and accept the terms of the waiver on the back of this form.

Signature: ***Date:***

County codes and Waiver information is located on the back of this form

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE
An equal opportunity employer and service provider

Revised 1/05

COUNTY CODES

1 Adams	12 Clark	23 Fairfield	34 Harrison	45 Licking	56 Monroe	67 Portage	78 Trumbull
2 Allen	13 Clermont	24 Fayette	35 Henry	46 Logan	57 Montgomery	68 Preble	79 Tuscarawas
3 Ashland	14 Clinton	25 Franklin	36 Highland	47 Lorain	58 Morgan	69 Putnam	80 Union
4 Ashtabula	15 Columbiana	26 Fulton	37 Hocking	48 Lucas	59 Morrow	70 Richland	81 Van Wert
5 Athens	16 Coshocton	27 Gallia	38 Holmes	49 Madison	60 Muskingum	71 Ross	82 Vinton
6 Auglaize	17 Crawford	28 Geauga	39 Huron	50 Mahoning	61 Noble	72 Sandusky	83 Warren
7 Belmont	18 Cuyahoga	29 Greene	40 Jackson	51 Marion	62 Ottawa	73 Scioto	84 Washington
8 Brown	19 Darke	30 Guernsey	41 Jefferson	52 Medina	63 Paulding	74 Seneca	85 Wayne
9 Butler	20 Defiance	31 Hamilton	42 Knox	53 Meigs	64 Perry	75 Shelby	86 Williams
10 Carroll	21 Delaware	32 Hancock	43 Lake	54 Mercer	65 Pickaway	76 Stark	87 Wood
11 Champaign	22 Erie	33 Hardin	44 Lawrence	55 Miami	66 Pike	77 Summit	88 Wyandot

The OHIO FIRE ACADEMY, Division of State Fire Marshal, Ohio Department of Commerce (herein “ACADEMY”), in making available its or other selected facilities, training grounds, equipment, and its staff, and in its provision of an opportunity to learn on the part of its students and other invitees, makes no representation of and assumes no liability for the suitability or condition of its or other selected facilities, training grounds or equipment, or for the competency of its staff, or for the quality and content of its educational services.

The ACADEMY assumes no liability for and shall be indemnified and held harmless for any claims, demands or suits of any nature, kind or description whatsoever, including, but not limited to claims for direct, indirect or consequential damages, acts of god, or any types costs and expenses, for or on account of any loss or damage to property owned or possessed by any student or other invitee or any injury to any student or invitee which may result from any cause, including but not limited to, the condition and operation of ACADEMY facilities, training grounds, and equipment, or the condition and operations of any other selected facilities, training grounds and equipment, and the acts or omissions of members of its staff or the acts or missions of other students or invitees.

The members of the ACADEMY staff and the instructors who are independent contractors with the state, in their personal and representative capacity, assume no liability for and shall be indemnified and held harmless for any claims, demands or suits of any nature, kind or description whatsoever, including, but not limited to claims for direct, indirect or consequential damages, acts of god, or any types costs and expenses, for or on account of any loss or damage to property owned or possessed by any student or other invitee or any injury to any student or invitee which may result from any cause, including but not limited to, the condition and operation of ACADEMY facilities, training grounds, and equipment, or the condition and operation of any other selected facilities, training grounds and equipment, and the acts or omissions of members of its staff or the acts or omissions of other students or invitees.

Student or invitee hereby authorizes the ACADEMY to seek emergency medical assistance on his or her behalf, as necessary, and agrees to pay for any and all medical expenses incurred on his or her behalf, Student or invitee shall indemnify and hold harmless the ACADEMY for any and all such emergency medical expenses and for any claims related to the aid rendered to the student or invitee by the Academy or its Staff during any such emergency situation.

By signing this document, the student or invitee hereby voluntarily acknowledges that he or she understands and accepts the above terms as a condition of the student or invitee’s participation in any Academy sponsored event, training, class, use of any State property or equipment or other circumstance as described in paragraph one of this waiver and that any such participation in the aforementioned activities may involve difficult, strenuous and dangerous physical activities to be undertaken by the student or invitee and that the student or invitee expressly assumes all of the risks associated with such activities. The student or invitee further expressly agrees not to bring a suit for damages against the State of Ohio, its employees or any independent contractors based upon any of student or invitees liabilities they waived in this document. This document constitutes the complete agreement between the parties.

ACADEMY COURSE REGISTRATION

Enrollment is open to any firefighter and other persons interested in the vocation of firefighting. Registration forms must be completed and returned to the Ohio Fire Academy (OFA). Anyone admitted to the program will receive a letter of confirmation approximately three weeks prior to the beginning of the course. Course offerings and/or course descriptions are subject to change after publication of the catalog. If a course offering is changed or cancelled, all students enrolled will be notified. Class size is limited. Student will be assigned to classes on a first come, first served basis. Insufficient enrollment will result in course cancellation.

Veterans may be eligible for Veterans Administration benefits for certified courses, which include:

Certified E.M.S. First Responder	Firefighter 1-A
Certified Fire Instructor	Firefighter 1-B
Certified Fire Safety Inspector	Firefighter 1-C
E.M.T. - Basic	Firefighter I & II
E.M.T. -Bridge	

For more information about veterans benefits, contact the Registrar at the Ohio Fire Academy.

Enrollment fees are used to help defray the cost of instruction and materials. The billing authorization section on the Course Registration Request must be received by OFA three weeks before the course begins. **We prefer to bill you, your department or organization at the conclusion of the course.**

If an individual is unable to attend a course, another person may be substituted any time before the course begins. The substitute must complete a registration form and submit it to the OFA Registrar prior to or upon arrival. If a substitute is not available, please notify the Registrar as soon as possible so that another individual may attend. An individual who registers for a course but fails to attend will be charged the enrollment fee for the course unless the Registrar is notified at least 48 hours before the course begins. All cancellations must be approved by the OFA Deputy Superintendent.

Dorm reservations at the OFA will be made for those requesting them on a first come, first served basis. Students will be notified in the event that accommodations are not available on the date(s) requested. The cost is $10 per night (subject to change).

Registration check-in will be held in your assigned classroom on the first day of each course. Classroom assignments are posted in the OFA lobby.

Classes begin at 9 A.M. on the first day, unless the course confirmation letter states a different time. After the first day of each course, schedules are subject to change by the instructor.

In the event that the front entrance is locked upon arrival, ring the bell located on the brick wall to the right of the main entrance and wait. The custodian or the security guard will open the door. Automobiles and other vehicles should be parked in the North Student parking area. Do not leave property visible on seats and keep vehicles locked at all times. NEITHER THE STATE FIRE MARSHAL NOR THE OFA IS RESPONSIBLE FOR THEFTS OR DAMAGES.

If you have questions regarding courses or registration procedures, please contact the OFA Registrar at (614) 752-7189 or 1-888-726-7731 (toll free), Monday-Friday, 8 A.M. to 5:00 P.M. The Academy FAX number is (614) 752-7111.

OHIO FIRE ACADEMY

Direct Delivery Evaluation Form

Course Number _______-______-_______ Course Title ________________________________

Instructor(s) Name ____ Date ____________

MATERIAL EVALUATION

	Excellent	Good	Fair	Poor	N/A
1. Student manuals were easy to follow [if applicable]	[ ]	[ ]	[ ]	[ ]	[ ]
2. Program material covered topic adequately	[ ]	[ ]	[ ]	[ ]	[ ]
3. Audiovisual (video, slides, PowerPoint)	[ ]	[ ]	[ ]	[ ]	[ ]
4. Did the course increase your knowledge base?	[ ]	[ ]	[ ]	[ ]	[ ]

Comment: ____

What changes, if any, would you suggest for improvement? ______________________________

____

____

What additional training do you require? ____

What other programs would you like the Academy to offer?______________________________

____

PROGRAM EVALUATION (If you are a State Certified Teacher, or Fire, EMS, or Law Enforcement Instructor, please complete the following.

	Excellent	Good	Fair	Poor	N/A
1. Objectives – clearly stated and met	[ ]	[ ]	[ ]	[ ]	[ ]
2. Presentation – Instructor was qualified & held interest	[ ]	[ ]	[ ]	[ ]	[ ]
3. Effectiveness – Instructor was organized and effective	[ ]	[ ]	[ ]	[ ]	[ ]
4. Skill Practice – adequate time and good skill demonstrations	[ ]	[ ]	[ ]	[ ]	[ ]

Comment: ____

____

____

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Incident Command Duties

Objective(s): NFPA 472, 2008 Edition, 7.1.2.2 (3) (a); 7.4.1

Primary Task: Given the emergency response plan or standard operating procedures and a scenario involving a hazardous materials/WMD incident, the hazardous materials technician shall demonstrate the duties of an assigned function in the hazardous materials branch or group within the incident command system and shall identify the role of the hazardous materials technician during hazardous materials/WMD incidents.

Skill No. 472HMTECH-001 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be given a hazardous materials/WMD incident scenario, emergency response plan or standard operating procedures.
2. The evaluator will assign the candidate a function within the hazardous materials branch or group.
3. The candidate will verbally describe the duties of the assigned function within the hazardous materials branch or group.
4. The candidate shall verbally describe the role of a hazardous materials technician during a hazardous materials/WMD incident.
5. The candidate shall be given the instructions below before beginning the exercise.
6. The candidate shall have 20 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a hazardous materials/WMD incident scenario and assigned a function within the incident command hazardous materials branch or group; you shall verbally describe the duties of the assigned function within the hazardous materials branch or group and you shall also verbally describe the role of a hazardous materials technician during a hazardous materials/WMD incident."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Accurately described the role of the assigned function within the incident command hazardous materials branch or group.	©		
2. Accurately described the overall incident command structure as related to a hazardous materials/WMD incident.	©		
3. Accurately described the role of a hazardous materials technician during a hazardous materials/WMD incident.	©		
	TOTAL		

© ***Critical Step* – Failure on this step mandates failure on task!**	***CANDIDATE MUST COMPLETE (3) STEPS TOTAL TO PASS SKILL***
Time:	TEST DATE: ________________ LOCATION: ______________________ EVALUATOR NAME: (PRINT) ________________________________ EVALUATOR SIGNATURE: ________________________________ EVALUATOR NAME: (PRINT) ________________________________ EVALUATOR SIGNATURE: ________________________________
Prevent & Stop Unsafe Acts!	

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Using Protective Clothing and Respiratory Protection

Objective(s): NFPA 472, 2008 Edition, 7.1.2.2(3) (b), 7.4.2 (4)

Primary Task: Demonstrate the ability to don, working in, and doffing liquid splash-protective, vapor-protective, and chemical-protective clothing provided by the AHJ. For this task this shall be Level "A" personal protective equipment (PPE).

Skill No. 472HMTECH-002 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with the incident and chemical information, Level A PPE, chemical resistance chart, respiratory protection, a 2 person team, and a specific "HOT" zone task.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 25 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to work in the "HOT" zone of an incident, don, work in and doff the appropriate Level "A" Personal Protective Equipment."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Select proper PPE.	©		
2. Inspect equipment prior to donning.	©		
3. Don the Level A PPE according to manufacturer's direction, adjust equipment as needed.	©		
4. Safely enter the "hot zone" and perform work as a team.	©		
5. Exit as a team.	©		
6. Properly remove PPE.	©		
	TOTAL		

© ***Critical Step* – Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (6) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: _____________________

EVALUATOR NAME: (PRINT) ____

EVALUATOR SIGNATURE: ____

EVALUATOR NAME: (PRINT) ____

EVALUATOR SIGNATURE: ____

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Using Protective Clothing and Respiratory Protection

Objective(s): NFPA 472, 2008 Edition, 7.1.2.2(3) (b), 7.4.2 (4)

Primary Task: Demonstrate the ability to don, working in, and doffing liquid splash-protective, vapor-protective, and chemical-protective clothing provided by the AHJ. For this task this shall be Level "B" personal protective equipment (PPE).

Skill No. 472HMTECH-003 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with the incident and chemical information, Level B PPE, chemical resistance chart, respiratory protection, a 2 person team, and a specific "HOT" zone task.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 25 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to work in the "HOT" zone of an incident, don, work in and doff the appropriate Level "B" Personal Protective Equipment."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Select proper PPE.	©		
2. Inspect equipment prior to donning.	©		
3. Don the Level B PPE according to manufacturer's direction, adjust equipment as needed.	©		
4. Safely enter the "hot zone" and perform work as a team.	©		
5. Exit as a team.	©		
6. Properly remove PPE.	©		
	TOTAL		

© ***Critical Step* – Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (6) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: _____________________

EVALUATOR NAME: (PRINT) ____

EVALUATOR SIGNATURE: ____

EVALUATOR NAME: (PRINT) ____

EVALUATOR SIGNATURE: ____

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ___________________________________

Introduction and Reporting and Documenting the Incident

Objective(s): NFPA 472, 2008 Edition, 7.1.2.2 (5) (a) (b) (c) and 7.6.3 (2)

Primary Task: Demonstrate the proper completion and documentation of the reports required by the emergency response plan or standard operating procedures. Assist in the incident debriefing, assist in the incident critique, and provide the reports and documentation to the incident commander.

Skill No. 472HMTECH-004 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with the incident reports that are required by the emergency operations plan or the standard operating procedures i.e. personnel exposure reports, debriefing reports, critique reports, activity log, and exposure reports, hot zone entry/exit logs, etc.; pens, pencils or computer.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 30 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to complete the required incident reports properly as provided; provide the completed reports and documentation to the incident commander, assist in the incident debriefing, and assist in the incident critique,"

PERFORMANCE	CRITICAL STEP	YES	NO
1. Date, incident location, personnel involved are listed.	©		
2. Correct information is listed in appropriate locations on report forms.	©		
3. Proper grammar and spelling use for narrative portions of the report.	©		
4. Assist in the incident debriefing.	©		
5. Assist in the incident critique.	©		
6. Provides completed reports and documentation of the incident to the incident commander.	©		
	TOTAL		

<table>
<tr><td>© Critical Step – Failure on this step mandates failure on task!</td><td>CANDIDATE MUST COMPLETE (6) STEPS TOTAL TO PASS SKILL</td></tr>
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OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.5 (1)

Primary Task: Given three hazardous materials/WMD, one of which is a solid, one a liquid, and one a gas, the candidate shall demonstrate the correct techniques to identify the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity) using a carbon monoxide meter.

Skill No. 472HMTECH-005 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a sample of a solid, a liquid, and a gas, and a carbon monoxide meter.
2. The candidate will demonstrate the operation of the detector, identify and quantify the results.
3. The candidate shall be given the instructions below before beginning the exercise.
4. The candidate shall have 20 minutes from set up time of meter to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a sample of a solid, a liquid, and a gas, and a carbon monoxide meter; you shall demonstrate the operation of the meter and the proper techniques to identify and quantify the hazards."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Correctly determined which sample the carbon monoxide meter is to test.	©		
2. Demonstrated the operation of the meter.	©		
3. Test sample.	©		
4. Correctly identifies the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity).	©		
5. Correctly quantifies the results.	©		
	TOTAL		

© ***Critical Step* – Failure on this step mandates failure on task!**	***CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL***
Time:	TEST DATE: _______________ LOCATION: _____________________ EVALUATOR NAME: (PRINT) ____________________________________ EVALUATOR SIGNATURE: ___________________________________ EVALUATOR NAME: (PRINT) ____________________________________ EVALUATOR SIGNATURE: ___________________________________
Prevent & Stop Unsafe Acts!	

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.5 (2)

Primary Task: Given three hazardous materials/WMD, one of which is a solid, one a liquid, and one a gas, the candidate shall demonstrate the correct techniques to identify the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity) using colorimetric tubes.

Skill No. 472HMTECH-006 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a sample of a solid, a liquid, and a gas, and colorimetric tubes with pump.
2. The candidate will demonstrate the operation of the colorimetric tubes, identify and quantify the results and identify the limitations of the tubes.
3. The candidate shall be given the instructions below before beginning the exercise.
4. The candidate shall have 20 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a sample of a solid, a liquid and a gas, and colorimetric tubes with pump; you shall demonstrate the operation of the colorimetric tubes with pump and the proper techniques to identify and quantify the hazards and identify the limitations of the tubes."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Identifies the purposes of the colorimetric tubes (concentration of substance in air, and determining presence of a specific substance).	©		
2. Select appropriate tube for suspected substance.	©		
3. Following manufacturer instructions properly prepare tube and pump for sampling.	©		
4. Draws sample.	©		
5. Correctly identifies the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity).	©		
6. Correctly quantifies the results.	©		
7. Identifies limitations tubes (Large number must be kept on hand for many different substances, shelf life of 1 to 2 years, one time use, tubes are designed to operate between 32^{oF} and 104^{o}F, high humidity can affect quantitative readings).			
	TOTAL		

<table>
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OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.5 (3)

Primary Task: Given three hazardous materials/WMD, one of which is a solid, one a liquid, and one a gas, the candidate shall demonstrate the correct techniques to identify the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity) using a combustible gas indicator.

Skill No. 472HMTECH-007 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a sample of a solid, a liquid, and a gas, and a combustible gas indicator (% LEL).
2. The candidate will demonstrate the operation of the combustible gas indicator, identify and quantify the results.
3. The candidate shall be given the instructions below before beginning the exercise.
4. The candidate shall have 20 minutes from set up time of meter to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a sample of a solid, a liquid and a gas, and a combustible gas indicator; you shall demonstrate the operation of the combustible gas indicator and the proper techniques to identify and quantify the hazards."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Identifies the monitoring capabilities of the instrument.	©		
2. Correctly identifies the operation of the combustible gas indicator.	©		
3. Completes the operational check of the instrument.	©		
4. Test sample.	©		
5. Correctly identifies the hazard (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity).	©		
6. Correctly quantifies the results.	©		
	TOTAL		

© ***Critical Step* – Failure on this step mandates failure on task!**	***CANDIDATE MUST COMPLETE (6) STEPS TOTAL TO PASS SKILL***
Time:	TEST DATE: _______________ LOCATION: ______________________ EVALUATOR NAME: (PRINT) _____________________________________ EVALUATOR SIGNATURE: ____________________________________ EVALUATOR NAME: (PRINT) _____________________________________ EVALUATOR SIGNATURE: ____________________________________
Prevent & Stop Unsafe Acts!	

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.5 (4)

Primary Task: Given three hazardous materials/WMD, one of which is a solid, one a liquid, and one a gas, the candidate shall demonstrate the correct techniques to identify the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity) using an oxygen meter.

Skill No. 472HMTECH-008 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a sample of a solid, a liquid, and a gas, and an oxygen meter.
2. The candidate will demonstrate the operation of the oxygen meter, identify and quantify the results.
3. The candidate shall be given the instructions below before beginning the exercise.
4. The candidate shall have 20 minutes from set up time of meter to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a sample of a solid, a liquid and a gas, and an oxygen meter; you shall demonstrate the operation of the oxygen meter and the proper techniques to identify and quantify the hazards."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Identifies the monitoring capabilities of the instrument	©		
2. Correctly identifies the operation of the oxygen meter.	©		
3. Completes the operational check of the instrument.	©		
4. Test sample.	©		
5. Correctly identifies the hazard (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity).	©		
6. Correctly quantifies the results.	©		
	TOTAL		

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OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.5 (5)

Primary Task: Given three hazardous materials/WMD, one of which is a solid, one a liquid, and one a gas, the candidate shall demonstrate the correct techniques to identify the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity) utilizing a passive dosimeter.

Skill No. 472HMTECH-009 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a sample of a solid, a liquid, and a gas, and a passive dosimeter.
2. The candidate will identify the correct techniques to identify the hazards.
3. The candidate shall be given the instructions below before beginning the exercise.
4. The candidate shall have 10 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a sample of a solid, a liquid and a gas, and a passive dosimeter; you will identify the techniques identify the hazards."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Identifies the hazards that a passive dosimeter will detect (radiation, hydrocarbons, organic vapors, mercury vapors, formaldehyde, anesthetic gases, or others).	©		
2. Identifies who, when, where and how long a worker should wear a passive dosimeter.	©		
3. Identifies location where a passive dosimeter can be sent to determine worker exposure.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**	***CANDIDATE MUST COMPLETE (3) STEPS TOTAL TO PASS SKILL***
Time:	TEST DATE: ______________ LOCATION: ____________________
Prevent & Stop Unsafe Acts!	EVALUATOR NAME: (PRINT) ______________________ EVALUATOR SIGNATURE: ______________________ EVALUATOR NAME: (PRINT) ______________________ EVALUATOR SIGNATURE: ______________________

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.5 (6)

Primary Task: Given three hazardous materials/WMD, one of which is a solid, one a liquid, and one a gas, the candidate shall demonstrate the correct techniques to identify the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity) using pH indicators and pH meter.

Skill No. 472HMTECH-010 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with the incident information, a sample of an unknown substance, a pH meter and indicator strips, and appropriate PPE.
2. The candidate will demonstrate the operation of the pH meter and indicator strips, identify and quantify the results.
3. The candidate shall be given the instructions below before beginning the exercise.
4. The candidate shall have 20 minutes from set up time of meter to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a sample of a solid, a liquid and a gas, and a pH meter and indicator strips; you shall demonstrate the operation of the pH meter and indicator strips and the proper techniques to identify and quantify the hazards."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Identifies the capabilities of the instrument and indicator strips.	©		
2. Correctly identifies the operation of the pH meter and indicator strips.	©		
3. Test sample.	©		
4. Correctly identifies the hazard (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity).	©		
5. Correctly quantifies the results.			
	TOTAL		

<table>
<tr><td>© Critical Step – Failure on this step mandates failure on task!</td><td>CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL</td></tr>
<tr><td>Time:</td><td rowspan="2">TEST DATE: _______________ LOCATION: _____________________
EVALUATOR NAME: (PRINT) ____________________________________
EVALUATOR SIGNATURE: ________________________________
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OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.5 (7)

Primary Task: Given three hazardous materials/WMD, one of which is a solid, one a liquid, and one a gas, the candidate shall demonstrate the correct techniques to identify the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity) using photoionization and flame ionization detectors.

Skill No. 472HMTECH-011 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a sample of a solid, a liquid, and a gas, and a photoionization and flame ionization detector.
2. The candidate will demonstrate the operation of the detector, identify and quantify the results.
3. The candidate shall be given the instructions below before beginning the exercise.
4. The candidate shall have 20 minutes from set up time of meter to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a sample of a solid, a liquid and a gas, and a photoionization and flame ionization detector; you shall demonstrate the operation of the detector and the proper techniques to identify and quantify the hazards."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Correctly determined which sample the photoionization and flame ionization detector is to test.	©		
2. Demonstrated the operation of the detector.	©		
3. Test sample.	©		
4. Correctly identifies the hazard (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity).	©		
5. Correctly quantifies the results.	©		
	TOTAL		

© ***Critical Step* – Failure on this step mandates failure on task!**	***CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL***
Time:	TEST DATE: _______________ LOCATION: _____________________ EVALUATOR NAME: (PRINT) ____________________________________ EVALUATOR SIGNATURE: ____________________________________ EVALUATOR NAME: (PRINT) ____________________________________ EVALUATOR SIGNATURE: ____________________________________
Prevent & Stop Unsafe Acts!	

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.5 (6)

Primary Task: Demonstrate the proper techniques to identify and quantify the hazards using radiation detection instruments.

Skill No. 472HMTECH-012 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a radiation monitoring instrument.
2. The candidate shall demonstrate the operation of the instrument.
3. The candidate shall demonstrate the procedures for calibrating or verifying its calibration.
4. The candidate shall verbalize the purpose of the instrument, and interpret readings.
5. The candidate shall be given the instructions below before beginning the exercise.
6. The candidate shall have 20 minutes from ready time of meter to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a radiation monitoring instrument, you shall demonstrate the operation of the instrument, and you will demonstrate the procedures for calibrating or verifying its calibration. You will verbalize the purpose of the instrument and interpret its readings."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Completes the operational checks of the instrument.	©		
2. Identifies instrument ranges (highs and lows).	©		
3. Turns selector switch to respective dosage.	©		
4. Measures gamma dose rate.	©		
5. Detects beta radiation.	©		
6. Verifies readings.	©		
7. Identifies need for personnel monitoring.			
8. Identifies need for clean up and decontamination operations.			
9. Identifies the need for monitoring radioactive contamination in food and water,			
	TOTAL		

<table>
<tr><td>© Critical Step – Failure on this step mandates failure on task!</td><td>CANDIDATE MUST COMPLETE (6) STEPS TOTAL TO PASS SKILL</td></tr>
<tr><td>Time:</td><td rowspan="2">TEST DATE: _______________ LOCATION: ______________________
EVALUATOR NAME: (PRINT) _____________________________________
EVALUATOR SIGNATURE: ____________________________________
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OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.5 (9)

Primary Task: Given three hazardous materials/WMD, one of which is a solid, one a liquid, and one a gas, the candidate shall demonstrate the correct techniques to identify the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity) using reagents.

Skill No. 472HMTECH-007 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a sample of a solid, a liquid, and a gas, and a chemical identification kit with reagents.
2. The candidate will demonstrate the operation of the chemical identification kit to identify and quantify the results.
3. The candidate shall be given the instructions below before beginning the exercise.
4. The candidate shall have 20 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a sample of a solid, a liquid and a gas, and a chemical identification kit with reagents; you shall demonstrate the operation of the chemical identification kit and the proper techniques to identify and quantify the hazards."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Select appropriate chemical identification kit.	©		
2. Verbalize capabilities, limiting factors and operation of equipment	©		
3. Safely handled sample.	©		
4. Tested sample according to kit directions.	©		
5. Correctly identified chemical and chemical family	©		
	TOTAL		

© ***Critical Step* – Failure on this step mandates failure on task!**	***CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL***
Time:	TEST DATE: _______________ LOCATION: ______________________ EVALUATOR NAME: (PRINT) _____________________________________ EVALUATOR SIGNATURE: ____________________________________ EVALUATOR NAME: (PRINT) _____________________________________ EVALUATOR SIGNATURE: ____________________________________
Prevent & Stop Unsafe Acts!	

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 4.2.1.3.5 (10)

Primary Task: Given three hazardous materials/WMD, one of which is a solid, one a liquid, and one a gas, the candidate shall demonstrate the correct techniques to identify the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity) using test strips.

Skill No. 472HMTECH-014 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a sample of a solid, a liquid, and a gas, and test strips.
2. The candidate will demonstrate the use of the test strips to identify and quantify the results of the test.
3. The candidate shall be given the instructions below before beginning the exercise.
4. The candidate shall have 20 minutes from set up time of meter to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a sample of a solid, a liquid and a gas, and test strips; you shall demonstrate the operation of the test strips and the proper techniques to identify and quantify the hazards."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Selected an indicator test strip.	©		
2. Test sample.	©		
3. Correctly identifies the hazard (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity).	©		
4. Correctly quantifies the results.	©		
	TOTAL		

<table>
<tr><td>© Critical Step – Failure on this step mandates failure on task!</td><td>CANDIDATE MUST COMPLETE (4) STEPS TOTAL TO PASS SKILL</td></tr>
<tr><td>Time:</td><td rowspan="2">TEST DATE: ______________ LOCATION: ____________________
EVALUATOR NAME: (PRINT) ________________________________
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OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____________________________________

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.5 (11)

Primary Task: Given three hazardous materials/WMD, one of which is a solid, one a liquid, and one a gas, the candidate shall demonstrate the correct techniques to identify the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity) using WMD detectors (chemical and biological).

Skill No. 472HMTECH-015 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a sample of a solid, a liquid, and a gas, and WMD detectors (chemical and biological).
2. The candidate will demonstrate the operation of the WMD detectors (chemical and biological), identify and quantify the results.
3. The candidate shall be given the instructions below before beginning the exercise.
4. The candidate shall have 20 minutes from set up time of meter to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a sample of a solid, a liquid and a gas, and WMD detectors (chemical and biological); you shall demonstrate the operation of the WMD detectors and the proper techniques to identify and quantify the hazards."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Identifies the monitoring capabilities of the WMD detectors.	©		
2. Correctly identifies the operation of the WMD detectors.	©		
3. Completes the operational check of the instrument.	©		
4. Test sample.	©		
5. Correctly identifies the hazard (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity).	©		
6. Correctly quantifies the results.	©		
	TOTAL		

© *Critical Step* – **Failure on this step mandates failure on task!**	***CANDIDATE MUST COMPLETE (6) STEPS TOTAL TO PASS SKILL***
Time:	TEST DATE: ______________ LOCATION: ____________________ EVALUATOR NAME: (PRINT) ______________________________ EVALUATOR SIGNATURE: ______________________________ EVALUATOR NAME: (PRINT) ______________________________ EVALUATOR SIGNATURE: ______________________________
Prevent & Stop Unsafe Acts!	

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.5 (12)

Primary Task: Given three hazardous materials/WMD, one of which is a solid, one a liquid, and one a gas, the candidate shall demonstrate the correct techniques to identify the hazards (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity) utilizing any other equipment that is provided by the AHJ to identify the hazards.

Skill No. 472HMTECH-016 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a sample of a solid, a liquid, and a gas, and any other equipment that is provided by the AHJ to identify hazards. (Evaluator to determine the type of equipment provided by the AHJ).
2. The candidate will demonstrate the operation of that equipment, identify and quantify the results.
3. The candidate shall be given the instructions below before beginning the exercise.
4. The candidate shall have 20 minutes from set up time of the equipment to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You will be given a sample of a solid, a liquid and a gas, and detection equipment provided by the AHJ; you shall demonstrate the operation of the detection equipment provided by the AHJ and the proper techniques to identify and quantify the hazards."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Identifies the detection equipment and capabilities of that equipment.	©		
2. Completes the operational check of the equipment.	©		
3. Test sample.	©		
4. Correctly identifies the hazard (Corrosivity, flammability, oxidation potential, oxygen deficiency, radioactivity, toxicity, and pathogenicity).	©		
5. Correctly quantifies the results.	©		
	TOTAL		

© ***Critical Step* – Failure on this step mandates failure on task!**	***CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL***
Time:	TEST DATE: _______________ LOCATION: ______________________ EVALUATOR NAME: (PRINT) ______________________________________ EVALUATOR SIGNATURE: ____________________________________ EVALUATOR NAME: (PRINT) ______________________________________ EVALUATOR SIGNATURE: ____________________________________
Prevent & Stop Unsafe Acts!	

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.3.6

Primary Task: Demonstrate the field maintenance and testing procedures for monitoring equipment, test strips, and reagents.

Skill No. 472HMTECH-017 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with the monitoring equipment, test strips, (example, oxidizer test strip) and reagents.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 30 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to provide field maintenance and testing procedures for monitoring equipment, test strips, and reagents.

PERFORMANCE	CRITICAL STEP	YES	NO
1. Handle in a safe manner.	©		
2. Follow manufacturer instructions: -clean and purge -field test -field calibrate	©		
3. Check and articulate expiration date.	©		
4. Return to proper storage.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (4) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: ______________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ______________________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ______________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ______________________________________

Surveying the Hazardous Materials/WMD Incident

Objective(s): NFPA 472, 2008 Edition, 7.2.1.5 (1) (2) (3)

Primary Task: The hazardous materials technician shall demonstrate methods for collecting samples of the following; gas, liquid, and solid with the equipment provided by the AHJ.

Skill No. 472HMTECH-018 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with a gas, a liquid, and a solid, and shall demonstrate methods of collecting samples from all three, with equipment provided by the AHJ.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 20 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You shall be provided with a gas, a liquid, and a solid; and you shall demonstrate methods for collecting samples from all three with the equipment provided by the AHJ."

PERFORMANCE	CRITICAL STEP	YES	NO
Gas Sample			
1. Selected appropriate equipment.	©		
2. Used proper technique.	©		
3. Correctly recorded results.	©		
4. Samples properly handled, secured, and marked.	©		
Liquid Sample			
1. Selected appropriate equipment.	©		
2. Used proper technique.	©		
3. Correctly recorded results.	©		
4. Samples properly handled, secured, and marked.	©		

Solid Sample			
1. Selected appropriate equipment.	©		
2. Used proper technique.	©		
3. Correctly recorded results.	©		
4. Samples properly handled, secured, and marked.	©		
	TOTAL		

© ***Critical Step* – Failure on this step mandates failure on task!**	***CANDIDATE MUST COMPLETE (12) STEPS TOTAL TO PASS SKILL***
Time:	TEST DATE: _______________ LOCATION: _____________________
Prevent & Stop Unsafe Acts!	EVALUATOR NAME: (PRINT) ____________________________________ EVALUATOR SIGNATURE: ______________________________ EVALUATOR NAME: (PRINT) ____________________________________ EVALUATOR SIGNATURE: ______________________________

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ______________________________

Using Protective Clothing and Respiratory Protection

Objective(s): NFPA 472, 2008 Edition, 7.4.2 (3)

Primary Task: Demonstrate the ability to don, work in, and doff self-contained breathing apparatus in addition to any other respiratory protection provided by the AHJ.

Skill No. 472HMTECH-019 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall provide or be provided a self-contained breathing apparatus that is of the type provided by the AHJ.
2. The candidate shall have and wear full personal protective clothing, including PASS device, during this evaluation.
3. The candidate shall utilize a mask that has been properly fit tested to the candidate.
4. The candidate shall demonstrate donning, working in, and doffing of the self-contained breathing apparatus.
5. The candidate shall demonstrate returning the equipment to service.
6. The candidate shall have 10 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"Demonstrate the ability to don, work in, and doff the self-contained breathing apparatus provided by your department."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Wears appropriate PPE correctly per manufacturer's recommendations.	©		
2. Inspects SCBA cylinder pressure; endures usable pressure (min 90% capacity).	©		
3. Opens cylinder valve fully, listens for audible alarm to sound.	©		
4. Checks by-pass valve and compares regulator gauge pressure with cylinder pressure.	©		
5. Properly dons the SCBA, securing all straps in appropriate sequence.	©		
6. Properly dons the face piece, sung to fit, checks face seal, goes on air.	©		
7. Activates and checks PASS device.	©		
8. Works in hazard area, performs control functions as required.	©		

9. Exits the hazard area.	©		
10. Properly doffs SCBA and PPE.	©		
11. Cleans, disinfectants, and inspects SCBA and PPE per manufacturer's recommendations.	©		
12. Refills SCBA and returns to service.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**	***CANDIDATE MUST COMPLETE (12) STEPS TOTAL TO PASS SKILL***
Time:	TEST DATE: _______________ LOCATION: _____________________
Prevent & Stop Unsafe Acts!	EVALUATOR NAME: (PRINT) ____________________________________ EVALUATOR SIGNATURE: ____________________________________ EVALUATOR NAME: (PRINT) ____________________________________ EVALUATOR SIGNATURE: ____________________________________

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Using Protective Clothing and Respiratory Protection

Objective(s): NFPA 472, 2008 Edition, 7.4.2 (3)

Primary Task: Demonstrate the ability to don, work in, and doff the respiratory protection provided by the AHJ.

Skill No. 472HMTECH-020 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall provide or be provided with the respiratory protection provided by the AHJ i.e. supplied air respirators, or air purifying respirators.
2. The candidate shall have and wear full personal protective clothing, including PASS device, during this evaluation.
3. The candidate shall utilize a mask that has been properly fit tested to the candidate.
4. The candidate shall demonstrate donning, working in, and doffing of the types of respiratory protection provided by the AHJ, i.e. supplied air respirators, or air purifying respirators.
5. The candidate shall demonstrate returning the equipment to service.
6. The candidate shall have 10 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"Demonstrate the ability to don, work in, and doff the respiratory protection provided by your department."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Determines proper PPE and type of respiratory protection according to the hazardous materials/WMD involved.	©		
2. Wears appropriate PPE correctly per manufacturer's recommendations.	©		
Supplied Air Respirator (SAR):			
1. Inspects the supplied air respirators air supply, including, escape bottle for serviceability.	©		
2. Inspects air hose for damage and to determine if length is sufficient.	©		
3. Properly dons the SAR, securing all straps in appropriate sequence.	©		
4. Properly dons the face piece, sung to fit, checks face seal, goes on air.	©		
5. Activates and checks PASS device.	©		
6. Works in hazard area, performs control functions as required.	©		
7. Exits the hazard area.	©		

8. Properly doffs SAR and PPE.	©		
9. Cleans, disinfectants, and inspects SAR and PPE per manufacturer's recommendations.	©		
10. Refills SAR air supply and returns to SAR service.	©		
Air Purifying Respirators (APRs):			
1. Inspects the air purifying respirator air supply for serviceability.	©		
2. Determines type of mask filter needed according to the hazardous materials/WMD involved.	©		
3. Properly dons the APR.	©		
4. Activates and checks PASS device.	©		
5. Works in hazard area, performs control functions as required.	©		
6. Exits the hazard area.	©		
7. Properly doffs APR and PPE.	©		
8. Cleans, disinfectants, and inspects APR and PPE per manufacturer's recommendations.	©		
9. Returns APR to service	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**	***CANDIDATE MUST COMPLETE (ALL) STEPS IN THE APPOPRIATE SECTION TO PASS SKILL***
Time:	TEST DATE: ______________ LOCATION: ____________________ EVALUATOR NAME: (PRINT) ______________________________ EVALUATOR SIGNATURE: ______________________________ EVALUATOR NAME: (PRINT) ______________________________ EVALUATOR SIGNATURE: ______________________________
Prevent & Stop Unsafe Acts!	

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3 (1) (a); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the appropriate method to contain a leak from a fusible plug

Skill No. 472HMTECH-021 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a chlorine tank or similar vessel, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a leak from a fusible metal plug type vessel as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: ________________ LOCATION: ______________________

EVALUATOR NAME: (PRINT) ____

EVALUATOR SIGNATURE: ____

EVALUATOR NAME: (PRINT) ____

EVALUATOR SIGNATURE: ____

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ______________________________________

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3 (1) (b); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the appropriate method to contain a leak from fusible plug threads.

Skill No. 472HMTECH-022 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a chlorine tank or similar vessel, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a leak from a fusible plug thread as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: ______________________

EVALUATOR NAME: (PRINT) ______________________________________

EVALUATOR SIGNATURE: ______________________________________

EVALUATOR NAME: (PRINT) ______________________________________

EVALUATOR SIGNATURE: ______________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(1) (c); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the appropriate method to contain a leak from the side wall of a cylinder.

Skill No. 472HMTECH-023 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a chlorine tank or similar vessel, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.
4.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a leak from a side wall of a cylinder as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: ______________________

EVALUATOR NAME: (PRINT) ______________________________________

EVALUATOR SIGNATURE: ____________________________________

EVALUATOR NAME: (PRINT) ______________________________________

EVALUATOR SIGNATURE: ____________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(1) (d); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the appropriate method to contain a leak from a valve blowout on a pressure vessel.

Skill No. 472HMTECH-024 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a chlorine tank or similar vessel, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a leak from a valve blowout part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: ______________ LOCATION: ____________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: __________________________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: __________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(1) (e); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the appropriate method to contain a leak from a valve gland on a pressure vessel.

Skill No. 472HMTECH-025 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a chlorine tank or similar vessel, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a leak from a valve gland as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: ______________ LOCATION: ____________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: ________________________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: ________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(1) (f); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the appropriate method to contain a leak from the valve inlet threads of a pressure vessel.

Skill No. 472HMTECH-026 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a chlorine tank or similar vessel, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a leak from the valve inlet threads of a pressure vessel as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
Reference	**TOTAL**		

© *Critical Step* – Failure on this step mandates failure on task!

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: ______________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ______________________________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ______________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(1) (g); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the appropriate method to contain a leak from the valve seat of a pressure vessel.

Skill No. 472HMTECH-027 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a chlorine tank or similar vessel, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.
4.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a leak from valve seat of a pressure vessel as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step* – Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: ______________ LOCATION: ____________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: ________________________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: ________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(1) (h); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the appropriate method to contain a leak from a valve stem assembly blowout.

Skill No. 472HMTECH-028 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a chlorine tank or similar vessel, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 20 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a leak from valve stem assembly blowout as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: ______________ LOCATION: ____________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: ________________________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: ________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2002 Edition, 6.1.2.2(3)(c), 6.4.2(4), 6.4.3(2)(a); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the ability to perform the following on the fittings of a pressure container: Close valves that are open.

Skill No. 472HMTECH-029 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a chlorine tank or similar vessel, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 5 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to close valves that are open on a pressure container as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: ______________ LOCATION: ____________________

EVALUATOR NAME: (PRINT) ______________________________

EVALUATOR SIGNATURE: ______________________________

EVALUATOR NAME: (PRINT) ______________________________

EVALUATOR SIGNATURE: ______________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(2) (b); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the ability to perform the following on the fittings of a pressure container: Replace missing plugs.

Skill No. 472HMTECH-030 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a chlorine tank or similar vessel, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 10 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to replace missing plugs on a pressure container as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: ______________ LOCATION: ____________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: ________________________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: ________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(2) (c); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the ability to perform the following on the fittings of a pressure container: Tighten loose plugs.

Skill No. 472HMTECH-031 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a chlorine tank or similar vessel, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 5 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to tighten loose plugs that are leaking on a pressure container as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: ______________________

EVALUATOR NAME: (PRINT) ____

EVALUATOR SIGNATURE: ____

EVALUATOR NAME: (PRINT) ____

EVALUATOR SIGNATURE: ____

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(3) (a); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the ability to contain the following type of leaks in a 55 gallon drum: bung leak.

Skill No. 472HMTECH-032 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a 55 gallon drum, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 5 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a bung leak on a 55 gallon drum as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: _____________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ______________________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ______________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(3) (b); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the ability to contain the following type of leaks in a 55 gallon drum: chime leak.

Skill No. 472HMTECH-033 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a 55 gallon drum, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a chime leak on a 55 gallon drum as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: ______________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ____________________________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ____________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(3) (c); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the ability to contain the following type of leaks in a 55 gallon drum: forklift puncture.

Skill No. 472HMTECH-034 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a 55 gallon drum, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a forklift puncture leak on a 55 gallon drum as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: ______________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ______________________________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ______________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ______________________________________

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(3) (c); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the ability to contain the following type of leaks in a 55 gallon drum: nail puncture.

Skill No. 472HMTECH-035 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), a simulated leak in a 55 gallon drum, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 5 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to contain a nail puncture leak on a 55 gallon drum as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Identify source and type of leak.	©		
3. Select appropriate containment material or equipment.	©		
4. Safely contain leak.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: ______________ LOCATION: ____________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: _______________________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: _______________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(4) (a)

Primary Task: Demonstrate the ability to place a 55 gallon drum into the overpack drum using the following method: rolling slide-in method.

Skill No. 472HMTECH-036 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), overpack drum, a simulated leak in a 55 gallon drum, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to place a 55 gallon drum into an overpack drum utilizing the rolling slide-in method, as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Place 55 gallon drum and overpack drum at an angle to each other.	©		
3. Slide 55 gallon drum into the overpack drum utilizing the rolling slide-in method.	©		
4. Upright overpack drum with 55 gallon drum inside and place lid on overpack drum.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: ______________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ____________________________________

EVALUATOR NAME: (PRINT) ____________________________________

EVALUATOR SIGNATURE: ____________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(4) (b)

Primary Task: Demonstrate the ability to place a 55 gallon drum into the overpack drum using the following method: slide-in method.

Skill No. 472HMTECH-037 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), overpack drum, a simulated leak in a 55 gallon drum, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to place a 55 gallon drum into an overpack drum utilizing the slid-in method, as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Place 55 gallon drum and overpack drum end to end, or at an angle to each other.	©		
3. Slide 55 gallon drum into the overpack drum.	©		
4. Upright overpack drum with 55 gallon drum inside and place lid on overpack drum.	©		
5. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (5) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: _______________ LOCATION: ______________________

EVALUATOR NAME: (PRINT) _____________________________________

EVALUATOR SIGNATURE: _____________________________________

EVALUATOR NAME: (PRINT) _____________________________________

EVALUATOR SIGNATURE: _____________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3(4) (c)

Primary Task: Demonstrate the ability to place a 55 gallon drum into the overpack drum using the following method: slip over method.

Skill No. 472HMTECH-038 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), overpack drum, a simulated leak in a 55 gallon drum, plugging equipment, appropriate tools, materials, 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 10 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to place a 55 gallon drum into an overpack drum utilizing the slip-over method, as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter area as a team.	©		
2. Place the overpack drum over the 55 gallon drum.	©		
3. Upright overpack drum with 55 gallon drum inside and place lid on overpack drum.	©		
4. Exit area as a team.	©		
	TOTAL		

© ***Critical Step*** **– Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (4) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: ______________ LOCATION: ____________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: ________________________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: ________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Performing Control Functions Identified in Incident Action Plan

Objective(s): NFPA 472, 2008 Edition, 7.4.3 (8); 7.1.2.2 (3) (a)

Primary Task: Demonstrate the ability to install a dome cover clamp on an MC-306/DOT-406 cargo tank.

Skill No. 472HMTECH-039 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided: appropriate personal protective equipment (PPE), MC-306/DOT-406 cargo tank, dome clamp, any tools that are required, and a 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 10 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to place a dome cover clamp on an MC-306/DOT-406 cargo tank as part of a 2 person team."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Safely enter hazardous materials area as a team.	©		
2. Safely access dome area of MC-306/DOT-406 cargo tank.	©		
3. Correctly install dome clamp	©		
4. Exit area as a team.	©		
	TOTAL		

© ***Critical Step* – Failure on this step mandates failure on task!**

CANDIDATE MUST COMPLETE (4) STEPS TOTAL TO PASS SKILL

Time:

TEST DATE: ______________ LOCATION: ____________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: _________________________________

EVALUATOR NAME: (PRINT) ________________________________

EVALUATOR SIGNATURE: _________________________________

Prevent & Stop Unsafe Acts!

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ________________________________

Implementing the Planned Response

Objective(s): NFPA 472, 2008 Edition, 7.4.5 (1)

Primary Task: Demonstrate the ability to setting up and implement technical decontamination operations in support of entry operations.

Skill No. 472HMTECH-040 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with the incident information, decontamination equipment, PPE, manpower as needed, and a decontamination scenario.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 30 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to set up and implement technical decontamination operations in support of entry operations."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Determine appropriate type of decontamination (wet, dry, other)	©		
2. Select appropriate site; uphill, upwind of incident.	©		
3. Clearly marked entry point.	©		
4. Tool drop.	©		
5. Containment of decontamination solutions and runoff water.	©		
6. Wash station, (may be multiple).	©		
7. Rinse station, (may be multiple).	©		
8. SCBA drop/bottle change.	©		
9. PPE drop station(s).	©		
10. Clearly marked exit point.	©		
11. Inner –clothing removal.	©		
12. Personnel shower.	©		
13. Provided for medical evaluations as necessary.	©		
	TOTAL		

<table>
<tr><td>© Critical Step – Failure on this step mandates failure on task!</td><td>CANDIDATE MUST COMPLETE (13) STEPS TOTAL TO PASS SKILL</td></tr>
<tr><td>Time:</td><td rowspan="2">TEST DATE: ________________ LOCATION: ______________________
EVALUATOR NAME: (PRINT) ____
EVALUATOR SIGNATURE: _____________________________________
EVALUATOR NAME: (PRINT) ____
EVALUATOR SIGNATURE: _____________________________________</td></tr>
<tr><td>Prevent & Stop Unsafe Acts!</td></tr>
</table>

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Implementing the Planned Response

Objective(s): NFPA 472, 2008 Edition, 7.4.5 (2)

Primary Task: Demonstrate the ability to setting up and implement technical decontamination operations involving ambulatory and nonambulatory victims.

Skill No. 472HMTECH-041 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with the incident information, decontamination equipment, PPE, manpower as needed, and a decontamination scenario (either a victim or entry team).
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 30 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to set up and implement technical decontamination operations involving both ambulatory and nonambulatory victims."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Determined appropriate type of decontamination (wet, dry, other)	©		
2. Determined appropriate PPE for decontamination team members.	©		
3. Set up and implemented technical decontamination corridor.	©		
4. Provided for nonambulatory victims.	©		
5. Use proper method(s) to decontaminate.	©		
6. Contained and prevented spread of contamination.	©		
7. Determined effectiveness of decontamination.	©		
8. Provided for medical evaluation of victims as necessary.	©		
	TOTAL		

<table>
<tr><td>© Critical Step – Failure on this step mandates failure on task!</td><td>CANDIDATE MUST COMPLETE (8) STEPS TOTAL TO PASS SKILL</td></tr>
<tr><td>Time:</td><td rowspan="2">TEST DATE: _______________ LOCATION: _____________________
EVALUATOR NAME: (PRINT) ____
EVALUATOR SIGNATURE: ____
EVALUATOR NAME: (PRINT) ____
EVALUATOR SIGNATURE: ____</td></tr>
<tr><td>Prevent & Stop Unsafe Acts!</td></tr>
</table>

OHIO FIRE ACADEMY
HAZARDOUS MATERIALS/WMD TECHNICIAN
COMPETENCY EVALUATION

Candidate Name: ____

Implementing the Planned Response

Objective(s): NFPA 472, 2008 Edition, 7.4.5 (3)

Primary Task: Demonstrate the ability to setting up and implement a mass decontamination operation involving ambulatory and nonambulatory victims.

Skill No. 472HMTECH-042 **PERFORMANCE CRITERIA AND INSTRUCTIONS**

INSTRUCTIONS TO THE EVALUATOR

1. The candidate shall be provided with the incident information, decontamination equipment, PPE, engines, hoses and other equipment as requested, and a 2 person team.
2. The candidate shall be given the instructions below before beginning the exercise.
3. The candidate shall have 15 minutes to accurately complete all the elements of the skill test.

INSTRUCTIONS TO THE CANDIDATE

"You have been given an assignment to set up and implement a mass decontamination operation involving ambulatory and nonambulatory victims."

PERFORMANCE	CRITICAL STEP	YES	NO
1. Selected an appropriate site; uphill, upwind of incident if possible	©		
2. Determine type of mass decontamination (large stream nozzles, decontamination corridor, large quantities of water)	©		
3. Set up and implemented decontamination corridor.	©		
4. Clearly marked entry point.	©		
5. Clearly marked exit point.	©		
6. Provided for nonambulatory victims.	©		
7. Provided for medical evaluation of victims as necessary.	©		
	TOTAL		

<table>
<tr><td>© Critical Step – Failure on this step mandates failure on task!</td><td>CANDIDATE MUST COMPLETE (7) STEPS TOTAL TO PASS SKILL</td></tr>
<tr><td>Time:</td><td rowspan="2">TEST DATE: ________________ LOCATION: ______________________
EVALUATOR NAME: (PRINT) ____
EVALUATOR SIGNATURE: _____________________________________
EVALUATOR NAME: (PRINT) ____
EVALUATOR SIGNATURE: _____________________________________</td></tr>
<tr><td>Prevent & Stop Unsafe Acts!</td></tr>
</table>

NAME

SCORE

FINAL TEST

Ohio HazMat and WMD Technician
Final Test

1. Which of the following is part of OSHA's requirements for your emergency response plan?
    a. Site security
    b. Lines of authority
    c. Training requirements
    d. All of the above are requirements found in 29CFR1910.120(q)(2)

2. Your local jurisdictions ability to respond is part of the…?
    a. Local ERP
    b. NCP
    c. SERC
    d. GOG

3. The alarm level for an oxygen deficient atmosphere is…?
    a. 20.9%
    b. 15%
    c. 19.5%
    d. 23.5%

4. The alarm level for the IDLH level of a flammable vapor or gas is…?
    a. 10% of the product in the air
    b. 10% of the products L.E.L
    c. 10% of the products U.E.L.
    d. 10% of the products flash point

5. When in contact with acidic vapors pH paper turns…?
    a. Green
    b. Blue
    c. Gray
    d. Red

6. Low oxygen levels can cause…?
    a. Low oxygen readings on an air monitor
    b. Incorrect readings on an L.E.L. sensor
    c. High CO readings
    d. Both a and b are correct

7. In order for a PID to detect a substance its lamps I.P. must be…?
    a. More then the products I.P.
    b. Less then the products I.P.
    c. The same as a products I.P.
    d. 10.7 e.v.

8. M8 and M9 detect?
    a. Products of combustion
    b. Chemical warfare agents
    c. Alpha and Beta only
    d. Hydrocarbons only

9. The position responsible for the HazMat branch is…?
    a. HazMat Branch Officer
    b. HazMat Section Leader
    c. HazMat Group Supervisor
    d. HazMat Support Leader

10. 29 CFR 1910.120(q) states that there are three things the Safety Officer should do when an activity is judged to be IDLH. They are…?
    a. Stop, drop and roll
    b. Terminate, stop and cease the activity
    c. Alter, suspend or terminate the activity
    d. First notify the I.C.

11. The position responsible for gathering information on the chemical properties of a product is the…?
    a. Information Officer
    b. Research Officer
    c. Delta Team Leader
    d. HazMat Safety Officer

12. What are the two major types of respiratory protection?
    a. Gas mask and SCBA
    b. APR and SAR
    c. SCBA and in-line air
    d. SCUBA and SCBA

13. Which of the following is an advantage of using an SCBA?
    a. Unlimited air supply
    b. Lighter then in-line air
    c. Higher protection level then an APR
    d. Fire safety

14. Which of the following is one of the seven items that must be known before you wear an APR?
    a. Oxygen content of the atmosphere
    b. Name of chemical
    c. Cartridge compatibility
    d. All of the above are one of the seven

15. Break-thru time measures...?
    a. Permeation
    b. Degradation
    c. Penetration
    d. Detoxification

16. If the chemical is capable of actually dissolving the chemical suit…this is known as?
    a. Permeation
    b. Degradation
    c. Penetration
    d. Detoxification

17. Dry hot skin could be a sign for?
    a. The heartbreak of psoriasis
    b. Heat cramps
    c. toxemia
    d. Heat Stroke

18. Glove compatibility is the direct responsibility of…?
    a. Incident Command
    b. Lead Tender Timer
    c. Decon Team Leader
    d. Research Officer

19. Which of the below is not one of the three items of information that must be assessed on a HazMat incident?
    a. Containers
    b. Products
    c. Environment
    d. Cost

20. A container that holds less then 119 gallons is considered…?
    a. A bulk container
    b. A pressure container
    c. A non-bulk container
    d. A tanker

21. Which of the following is not one of the container stressors?
    a. Construction
    b. Thermal
    c. Chemical
    d. Mechanical

22. The four types of release events for a container breach are…?
    a. Spills, Leaks, Drips and Runs
    b. Runs, Drips, Spills and Violent Rupture
    c. Detonation, Violent Rupture, Rapid Relief and Spills and Leaks
    d. Cracks, Runs, Detonation and Leaks

23. A Cloud, Cone, Plume and/or Stream are examples of the four different…?
    a. Product types
    b. Dispersion Patterns
    c. Gas releases
    d. Cameo plot models

24. Which one of the below is not one of the four basic areas of a release into the environment?
    a. Into a room
    b. Onto the Ground
    c. Into the air
    d. Into the water

25. An MC312 is…?
    a. A corrosive drum
    b. A corrosive tank car
    c. A flammable liquid tank car
    d. A bulk tote

26. The zone in which the command post should be set-up is..?
    a. The Warm Zone
    b. The Twilight Zone
    c. The Cold Zone
    d. The Hot Zone

27. Keeping the product inside its original container is called?
    a. Confinement
    b. Containment
    c. Control
    d. Congestion

28. An overflow dam can be used to stop…?
    a. miscible liquids
    b. in-miscible liquids with a density of less then 1
    c. in-miscible liquids with a density of more then 1
    d. Solids

29. Plugging a leaking pressure relief device is always a good idea?
    a. True
    b. False
    c. True, if it can be done quickly

30. The best solution for emergency decon is…?
    a. Alcohol
    b. Consult the MSDS of the chemical
    c. Water
    d. Bleach

31. The best solution for technical decon is…?
    a. Alcohol
    b. Consult the MSDS of the chemical
    c. Soap and water
    d. Bleach

32. Neutralization may be dangerous to use on suits because…?
    a. It creates heat
    b. It creates pressure
    c. It may not work
    d. It creates water

33. Which of the following is a surfactant?
    a. Soap
    b. Chlorine
    c. Alcohol
    d. Ammonia

34. The termination procedure that includes discussion of the chemicals involved and their hazards is…?
    a. Debrief
    b. Critique
    c. After action procedures

35. The termination procedure that includes reporting requirements, documentation and equipment replacement is…?
    a. Debrief
    b. Critique
    c. After action procedures

36. The termination procedure that includes an honest look at how things might go better the next time is?
    a. Debrief
    b. Critique
    c. After action procedures

37. Flp, LEL, UEL and SADT are terms of…?
    a. Corrosiveness
    b. Flammability
    c. Chemical properties
    d. Physical properties

38. The weight of a product compared to water is its…?
    a. Vapor density
    b. pH
    c. Specific Gravity
    d. Vapor pressure

39. A vesicant is…?
    a. A nerve agent
    b. An incapacitating agent
    c. An explosive
    d. A blister agent

40. Water's vapor pressure at room temperature is…?
    a. 14.6 psi
    b. 25 mmHg
    c. 760 mmHg
    d. 1 Bar

41. Persistence means…?
    a. Burns readily
    b. Self igniting
    c. Dangerous when wet
    d. Resists evaporation

42. Which of the following is a halogenated hydrocarbon?
    a. Methyl alcohol
    b. Acetone
    c. Chloro-difluoromethane
    d. Di hydrogen monoxide

43. Which of the following is an aromatic hydrocarbon?
    a. Hydrogen chloride
    b. Chlorine
    c. Benzene
    d. Acetic acid

44. Miscibility is another word for?
    a. Solubility
    b. insolubility
    c. reactive
    d. concentration

45. Based on statistics by the FBI, which of the following is the weapon of choice for terrorist criminals?
    a. Chemical weapons
    b. Explosives
    c. Biological dispersion devices
    d. Dirty bombs

46. Target analysis is the examination of potential targets to determine which one would have the most desirable effect by terrorists or criminals
    a. True
    b. False

47. Basic Life Support consists of a number of life-saving techniques focused on:
    a. Bleeding, Broken bones and Eating
    b. Breathing, Bleeding and Drinking
    c. Airway, Bleeding and Ambulatory
    d. Airway, Bleeding and Circulation

48. During the Hazard Elimination phase after the emergency is over, there is no need to placard the materials being transported
    a. True
    b. False

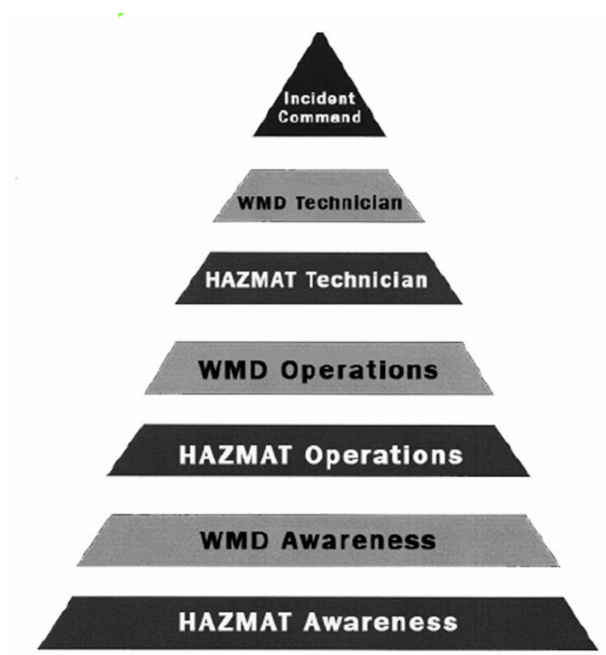
49. Which of the four below **is not** a part of the plume making suite?
    a. CAMEO
    b. MAPALOT
    c. ALOHA
    d. MARPLOT

50. "Physical Evidence" is any tangible object that establishes that a crime has been commited.
    a. True
    b. False

MODULE 1

HAZARDOUS MATERIALS

TECHNICIAN



ACKNOWLEDGEMENTS

This course and accompanying participant's manual have been developed for the training of Technician level responders. The material has benefited from the creative and technical talents of many dedicated individuals, each of whom has distinguished themselves as experts in the field of WMD.

The following individuals were responsible for the instructional design and authorship of both the course and manual:

William E. Brobst Jr
Matthew Lehman

The following individuals provided technical guidance and review:

Frank Dalton
Matt Nobel
Mark Vedder
Tim Walker

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External review and approval provided by the following individuals and organizations:

State of Ohio Security Task Force

Department of Public Safety
Department of Education
Department of Natural Resources
Attorney General
Adjutant General
Department of Health
Office of Criminal Justice Services
Department of Agriculture
Department of Administrative Services
Environmental Protection Agency
Department of Transportation
State Fire Marshal
Public Utilities Commission of Ohio
Ohio State Highway Patrol
Emergency Medical Services
Emergency Management Agency
Department of Mental Health
Department of Insurance
Ohio Community Service Council
House of Representatives
The Senate

Table of Contents

Publication Date: October 2008
Scheduled Revision Date: October, 2010

This manual is an integral part of the Ohio First Responder training pyramid. By itself, it does not constitute complete and comprehensive training. The training must be accompanied by instruction from a certified State of Ohio instructor qualified to teach this material.

The information outlined in this manual reflects the standard of knowledge and accepted practices in the State of Ohio, as well as the United States, at the time of publication. It is the reader's responsibility to stay informed of changes in the procedures outlined in this manual.

Any and all questions related to the material printed herein should be sent to:

Ohio HazMat / WMD Technician Training
Ohio Fire Academy
8895 East Main Street
Reynoldsburg, OH 43068

Introduction

This course is designed to build upon the training and knowledge that you have obtained from participating in the “Ohio HAZMAT & WMD Awareness and Operations for First Responders” courses. It is divided into two modules:

Module 1 will address the standards established in NFPA 472 Chapter 7 “Competencies for Hazardous Materials Technicians” and will meet all the competencies as established by the Occupational Safety and Health Administration (OSHA 29 CFR 1910.120) and the US Environmental Protection Agency (EPA 40 CFR part 311).

Module 2 will address the Performance Level B (Technician) guidelines for law enforcement and fire service personnel and guidelines for hazardous materials technicians as found in the Emergency Responder Guidelines published by the Office of Domestic Preparedness (ODP), and give advanced info about CBRNE weapons.

HazMat Technician
(OSHA / NFPA)
Lesson Plan

Title
Hazardous Materials Technician

Mission
This training module is designed for personnel who will respond to mitigate releases of a hazardous substance.

Target Audience
Fire Service
Law Enforcement
Emergency Medical Services
Emergency Management Agency
Public Works
Private Industry
Health Care

Level of Training
Technician Level (OSHA / NFPA)

Scope
The purpose of this module is to train responders in the standards set forth by OSHA 1910.120, NFPA 472, and US EPA 40 CFR part 311, which enable them to offensively mitigate hazardous substance releases.

Terminal Learning Objective
At the end of this module of training each student will have completed the necessary requirements to meet OSHA, NFPA, and US EPA standards for a technician level responder.

Student Performance Objectives
- Complete the student performance objectives in each unit.
- Complete the quizzes at the end of each unit.
- Complete hands-on exercises in indicated units.

Practical Exercises
Unit 2 – Field survey instruments
Unit 4 – Personal protective equipment (PPE)
Unit 5 – Containers

Unit 7 – Decontamination
Unit 9 – Chemical identification

Duration
24 hours (3 - 8 hour days)

Method of Instruction
Classroom / Practical

Instructor Ratio
Classroom 1:15
Hands on exercise 1:5

Resource List
- 4 different direct reading instruments
- pH paper
- Chemicals for demonstration and testing
- Pen / Pencil
- Scratch paper for notes

Required Reading
There is no required reading for this course but familiarization of previous lower-tiered courses, such as Ohio HazMat Operations and Ohio WMD Performance Level A courses, would be beneficial to the student.

Prerequisites
Students must satisfactorily complete HazMat Operations and WMD Performance Level A (Defensive) training.

Resource List
- Classroom (sufficient to support the number of students)
- LCD Projector
- Computer with Microsoft PowerPoint
- Marking board
- HazMat Technician student manual
- Writing instrument
- ERG
- PPE of all levels
- Decontamination equipment
- SCBA equipment
- Hand tools
- Other unit-specific resources.

Evaluation Strategy

- Unit quizzes
- IFSAC approved skill sheets
- Written final exam
- Course evaluation
- Instructor comments

References

- Handbook for Responding to a Radiological Dispersal Device, Conference of Radiation Control Program Directors, Inc.
- The University of Findlay Technician Manual
- NFPA 472
- OSHA 1910.120
- EPA 40 CFR 311
- ODP Guidelines for First Responders
- Ohio Fire Academy HazMat Technician
- State of Ohio Security Task Force Strategic Plan
- Ohio HazMat Operations / Performance Level B Manual
- NIOSH Pocket Guide
- National Fire Academy HazMat Basic Concepts
- National Fire Academy Concept Implementation
- CDC Website
- National Response Plan
- OSHA ICS Forms
- READY.gov
- FEMA.gov
- Ohio Department of Health

x

OHIO HAZMAT & WMD TECHNICIAN
LEVEL TRAINING
40-HOUR AGENDA

DAY 1

8:00 a.m.	Introductions and Course Outline for Module 1
9:15 a.m.	Unit 1 Implementing the Emergency Response Plan

10:00 a.m.	Unit 2 Field Survey Instruments
	    Exercise Module 1 Unit 2
	    Hands-on with Air Monitors

Noon	Lunch
1:00 p.m.	Unit 3 The Incident Command System

2:00 p.m.	Unit 4 Personal Protective Equipment
	    Exercise Module 1 Unit 4
	    Suit dress-outs
	        Level A, Level B, Level B over fire gear
	    In-suit exercises
	        Air Monitoring
	        Patch and Plug
	        Physical Exercises

5:00 p.m.	Adjourn

OHIO HAZMAT & WMD TECHNICIAN
LEVEL TRAINING
40-HOUR AGENDA

DAY 2

8:00 a.m.	Unit 5 Hazard and Risk Assessment
9:00 a.m.	Unit 6 Control, Containment and Confinement
9:30 a.m.	Unit 7 Decontamination

10:00 a.m.	Exercise Module 1 Unit 5
	Container exercises
	    R & ID
	    Hands-on with vehicles
	    Damage Assessment
	    Determining pressure/amount of product

Noon	Lunch

1:00 p.m.	Exercise Module 1 Unit 6 & 7
	    Decon set-up and dress-out (in-suit and timed)
	    Patching and plugging exercises
	        Container exercises
	        Chlorine kits
	        Drum transfer (bonding and grounding)

5:00 p.m.	Adjourn

OHIO HAZMAT & WMD TECHNICIAN
LEVEL TRAINING
40-HOUR AGENDA

DAY 3

8:00 a.m. Unit 8 Termination Procedures

9:00 a.m. Unit 9 Basic Chemistry
- Exercise Module 1 Unit 9
- Chemical ID exercises
  - 3 unknowns
  - Vp, Flp, pH

Noon Lunch

End Module 1 – Hazardous Materials Technician (OSHA / NFPA) with final exercise unless Module 2 is being given as a continuous course.

Begin Module 2 – WMD Performance Level B (Offensive)

1:00 p.m. Course Outline for Module 2

1:30 p.m. Unit 1 Introduction & Review

2:00 p.m. Unit 2 Planning, Assessment &Analysis

3:00 p.m. Unit 3 Self Protection, Rescue, Decontamination & Medical

3:15 p.m. Unit 4 Specialized Functions
- Exercise Module 4 Unit 2
- Evacuation tabletop
  - CAMEO
  - ERG
- Plume modeling exercise
  - NARAC

5:00 p.m. Adjourn

OHIO HAZMAT & WMD TECHNICIAN
LEVEL TRAINING
40-HOUR AGENDA

DAY 4

8:00 a.m.	Unit 5 Incident Command/Unified Command Written action plan ICS 200 forms
9:00 a.m.	Unit 6 CBRNE
10:00 a.m.	Unit 7 Law Enforcement & Investigations
11:00 a.m.	Unit 8 Prevention, Intelligence & Deterrence
Noon	Lunch
1:00 p.m.	Exercise Module 2 Unit 6 Chemical agent monitoring exercises APD 2000 M-8, M-9, M256 ICAD Biological monitoring exercise Smart tickets Radiation monitoring exercise 700, 715, Ludlems
5:00 p.m.	Adjourn

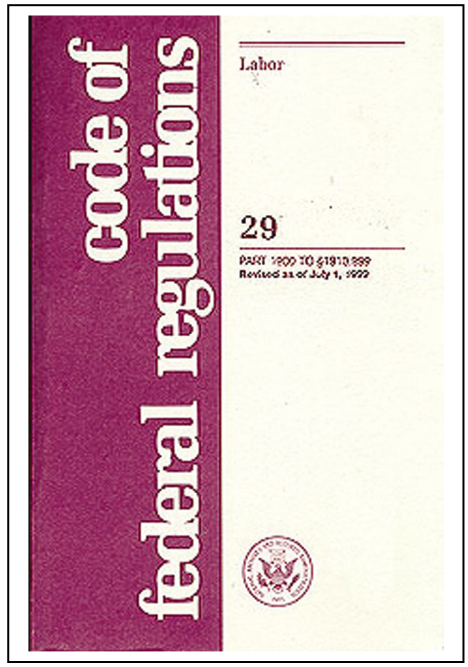
OHIO HAZMAT & WMD TECHNICIAN
LEVEL TRAINING
40-HOUR AGENDA

DAY 5

8:00 a.m.	Exercise “Rules of Conduct” and Tabletop preplan
9:30 a.m.	Full scale final exercise
2:00 p.m.	Debrief, critique and clean-up
3:30 p.m.	Course review
4:00 p.m.	Test
4:45 p.m.	Course evaluation
5:00 p.m.	Adjourn

Module 1 Description and Objectives

OSHA 29 CFR 1910.120(q)(6)(iii)



Hazardous Materials Technician. Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch or otherwise stop the release of a hazardous substance. Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(A) Know how to implement the employer's emergency response plan.

(B) Know the classification, identification and verification of known and unknown materials by using field survey instruments and equipment.

(C) Be able to function within an assigned role in the Incident Command System.

(D) Know how to select and use proper specialized chemical personal protective equipment provided to the hazardous materials technician.

(E) Understand hazard and risk assessment techniques.

(F) Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit.

(G) Understand and implement decontamination procedures.

(H) Understand termination procedures.

(I) Understand basic chemical and toxicological terminology and behavior.

Competencies from NFPA 472, Chapter 7

(Note: These are paraphrased, for ease of reading, to indicate the nature of the standard, but do not include all of the detail of the actual standard. The unit referred to may include exercises performed after each unit.)

NFPA	Description	Unit
7.1	**General**	
7.1.1	Special Definitions	
7.1.2	Additional Training	
7.1.3	Goal of NFPA standards	
7.1.3.1	Able to perform the following tasks: 1) Analyze the incident a) Survey for specialized containers and materials b) Collect and interpret information c) Describe the type and extent of damage to containers d) Predict the behavior of materials and containers e) Estimate the size of an endangered area 2) Plan the initial response a) Describe response objectives b) Describe potential response options c) Select the appropriate PPE d) Develop an Incident Action Plan 3) Implement the planned response a) Perform duties as assigned by the HazMat branch officer b) Don, work in, and doff PPE c) Perform control functions d) Perform decon functions 4) Evaluate the progress a) Evaluate the effectiveness of the control functions b) Evaluate the effectiveness of decon functions 5) Terminate the incident a) Debrief b) Critique c) Documentation	
7.2	**Competencies for analyzing the incident**	

NFPA	Description	Unit
7.2.1	Surveying the hazardous material/WMD incident	5
7.2.1.1	Identify containers by name and specification	5
7.2.1.1.1	Identify railcars by name and specification 1) Cryogenic liquid tank cars 2) Non-pressure tank cars 3) Pneumatically unloaded hopper car 4) Pressure tank cars	5
7.2.1.1.2	Identify intermodals by name and specification 1) Non-pressure a) IM-101 (IMO type 1) b) IM-102 (IMO type 2) 2) Pressure Spec. 51 (IMO type 5) 3) Specialized a) Cryogenic Spec. 51 (IMO type 7) b) Tube modules	5
7.2.1.1.3	Identify cargo tanks by name and specification 1) Compressed gas tube trailers 2) Corrosive liquid tanks 3) Cryogenic liquid tanks 4) Dry bulk cargo tanks 5) High-pressure tanks 6) Low-pressure chemical tanks 7) Non-pressure liquid tanks	5
7.2.1.1.4	Identify storage tanks by name and contents 1) Cryogenic liquid tanks 2) Non-pressure tanks 3) Pressure tanks	5
7.2.1.1.5	Identify non-bulk packaging by name and contents 1) Bags 2) Carboys 3) Cylinders 4) Drums	5
7.2.1.1.6	Identify radioactive containers by name and contents 1) Excepted 2) Industrial 3) Type A 4) Type B 5) Type C	5

NFPA	Description	Unit
7.2.1.2	Identify the capacity of containers	5
7.2.1.2.1	Using markings of a tank 1) Cargo tanks 2) Tank cars 3) Tank containers	5
7.2.1.2.2	Using markings of facility containers 1) Cryogenic 2) Non-pressure tank 3) Pressure tank	5
7.2.1.3	Identify or classify by hazard unknown chemicals	2
7.2.1.3.1	Identify the steps in an analysis process for solids and liquids	2
7.2.1.3.2	Identify the steps in an analysis process for gasses	2
7.2.1.3.3	Identify the monitoring technology used to determine: 1) Corrosivity 2) Flammability 3) Oxidation potential 4) Oxygen deficiency 5) Radioactivity 6) Toxicity 7) Pathogenicity	2
7.2.1.3.4	Identify capabilities and limitations of the following: 1) Biological immunoassay indicators 2) Chemical agent monitors 3) Colorimetric indicators 4) Combustible gas indicators 5) DNA Fluoroscopy 6) Electro-chemical cells 7) Flame ionizing detector 8) Gas chromatograph/mass spectrometer 9) Infrared spectroscopy 10) Ion mobility spectroscopy 11) Mass channel analyzer 12) Metal oxide sensor 13) Photo ionization detector 14) Polymerase chain reaction 15) Radiation detection and measurement instruments 16) Raman spectroscopy 17) Surface acoustical wave 18) Wet chemistry	2

NFPA	Description	Unit
7.2.1.3.5	Identify chemicals by appropriately using: 1) Carbon monoxide meter 2) Colorimetric tubes 3) Combustible gas indicator 4) Oxygen sensor 5) Passive dosimeters 6) pH indicators 7) Photo ionization and flame ionization detectors 8) Radiation detection instruments 9) Reagents 10) Test strips 11) WMD detectors 12) Other available equipment	2
7.2.1.3.6	Demonstrate field testing and maintenance for test strips and reagents	2
7.2.1.4	Identify type or category of label, contents, activity, transport index, and criticality safety index , and describe radiation dose associated with a properly shipped radioactive substance	5
7.2.1.5	Demonstrate a method for collecting: 1) Gasses 2) Liquids 3) Solids	2
7.2.2	Collect and interpret response information from data bases, technical resources and monitoring equipment	2 & 9
7.2.2.1	Identify and interpret the type of response information and explain the advantages and disadvantages of: 1) Hazardous materials databases 2) Monitoring equipment 3) Reference manuals 4) Technical information centers 5) Technical information specialists	2 & 9
7.2.2.2	Describe the following items and explain their significance in the analysis process: 1) Acid, caustic 2) Air reactive 3) Auto refrigeration 4) Biological agents and toxins 5) Blood agents 6) Boiling point 7) Catalyst 8) Chemical interactions	9

NFPA	Description	Unit
7.2.2.2	9) Chemical change 10) Compound mixture 11) Concentration 12) Dissociation/Corrosivity 13) Critical temperature and pressure 14) Dose 15) Dose-response relationship 16) Expansion ratio 17) Flammable range (LEL and UEL) 18) Fire point 19) Flash point 20) Half life 21) Halogenated hydrocarbon 22) Ignition temperature 23) Inhibitor 24) Instability 25) Ionic and covalent bonds 26) Irritants (Riot control agents) 27) Maximum safe storage temperature (MSST) 28) Melting point/freezing point 29) Miscibility 30) Nerve agents 31) Organic and inorganic 32) Oxidation potential 33) Persistence 34) pH 35) Physical state 36) Polymerization 37) Radioactivity 38) Riot control agents 39) Saturated, unsaturated and aromatic hydrocarbons 40) Self-accelerating decomposition temperature (SADT) 41) Solution, slurry 42) Specific gravity 43) Strength 44) Sublimation 45) Temperature of product 46) Toxic products of combustion 47) Vapor density 48) Vapor pressure 49) Vesicants (blood agents) 50) Viscosity	9

NFPA	Description	Unit
7.2.2.2	51) Reactivity 52) Solubility 53) Physical change	9
7.2.2.3	Describe the heat transfer process that occurs as a result of a cryogenic spill	9
7.2.2.4	Find signs and symptoms of exposure and target organs	9
7.2.2.5	Identify two methods of determining the pressure in a container	5
7.2.2.6	Identify a method of determining the amount of product left in a leaking container	5
7.2.3	Describe the condition of damaged containers	5
7.2.3.1	Identify basic design and construction of spec. containers	5

NFPA	Description	Unit

7.2.3.1.1	Identify basic design, construction features, and valving of:
	1) Cargo tanks
	    a) Compressed gas tube trailers
	    b) Corrosive liquid tanks
	    c) Cryogenic liquid tanks
	    d) High-pressure tanks
	    e) Low- pressure tanks
	    f) Non-pressure liquid tanks
	2) Fixed facility tanks
	    a) Cryogenic liquid tanks
	    b) Non-pressure tanks
	    c) Pressure tanks
	3) Intermediate bulk tanks (totes)
	4) Intermodal tanks
	    a) Non-pressure
	        i) IM-101
	        ii) IM-102
	    b) Pressure (Spec. 51)
	    c) Specialized
	        i) Cryogenic
	        ii) Tube
	5) One-ton containers
	6) Pipelines
	7) Railroad cars
	    a) Cryogenic liquid tank cars
	    b) Non-pressure tank cars
	    c) Pneumatically unloaded hopper cars
	    d) Pressure
		5

NFPA	Description	Unit
7.2.3.1.2	Identify basic design, construction features and closures of: 1) Bags 2) Carboys 3) Drums 4) Cylinders	5
7.2.3.1.3	Identify basic design features and testing requirements for the following radioactive packaging: 1) Excepted 2) Industrial 3) Type A 4) Type B 5) Type C	5
7.2.3.2	Describe how a petroleum pipeline can carry different products	5
7.2.3.3	Identify a pipeline's: A) Ownership 2) Procedure for checking gas migration 3) Procedure for shutting down or controlling a leak 4) Type of product	5
7.2.3.4	Identify container damage by name and assess it's level of risk	5
7.2.3.5	Using radiation monitors determine the extent of damage to a radiological container	2 & 5
7.2.4	Predict likely behaviors of materials and their containers	5
7.2.4.1	Identify three resources that indicate the effects of mixing various hazardous materials	9
7.2.4.2	Identify the impact of the following fire and safety features on the behavior of the product during an incident at a bulk liquid facility: 1) Fire protection systems 2) Monitoring and detection systems 3) Pressure and Vacuum relief devices 4) Spillage control (diking) 5) Tank spacing 6) Transfer operations	5
7.2.4.3	Identify the impact of the following fire and safety features on the behavior of the product during an incident at a bulk gas facility: 1) Fire protection systems 2) Monitoring and detection systems 3) Pressure relief protection 4) Transfer operations	5

NFPA	Description	Unit
7.2.5	Estimate the likely size of an endangered area	Mod 2 Unit 2
7.2.5.1	Identify resources available for dispersion pattern predictions	Mod 2 Unit 2
7.2.5.2	Determine the extent of physical safety and health hazards within the endangered area	Mod 2 Unit 2
7.2.5.2.1	Describe the following terms and their significance: 1) Counts and kilo counts per minute 2) Immediately Dangerous to Life & Health 3) Infectious dose 4) Incubation period 5) Lethal Concentration 6) Lethal Dose 7) Parts per billion 8) Parts per million 9) Permissible exposure limit 10) Radiation absorbed dose 11) Roentgen Equivalent Man (milli and micro) 12) Threshold limit value (time weighted average) 13) Threshold limit value (short-term exposure limit) 14) Threshold limit value (ceiling)	9
7.2.5.2.2	Identify two methods for predicting the areas of potential harm within the endangered area	Mod 2 Unit 2
7.2.5.3	Identify the steps for estimating the outcomes within an endangered area	Mod 2 Unit 2
7.2.5.4	Determine applicable public protective response options in areas to be protected	Mod 2 Unit 2
7.3	**Planning the response**	
7.3.1	Identify response objectives	6
7.3.1.1	Describe response objectives for each incident	6
7.3.1.2	Describe the steps for determining response objectives	6
7.3.2	Identify potential response options	6
7.3.2.1	Identify possible response options for each response objective	6
7.3.2.2	Identify a possible response option to accomplish a given response objective	6
7.3.3	Selecting personal protective equipment (PPE)	4

NFPA	Description	Unit
7.3.3.1	Identify 4 levels of PPE	4
7.3.3.2	Identify PPE for the following hazards: 1) Thermal 2) Radiological 3) Asphyxiating 4) Chemical (liquids and vapors) 5) Etiological 6) Mechanical	4
7.3.3.3	Identify the process to select respiratory protection	4
7.3.3.4	Identify the factors in selecting chemical protective clothing	4
7.3.3.4.1	Describe the follow terms and discuss their impact on chemical protective clothing: 1) Degradation 2) Penetration 3) Permeation	4
7.3.3.4.2	Identify three indications of material degradation	4
7.3.3.4.3	Identify the different designs of vapor and splash-protective clothing and describe the advantages and disadvantages of each	4
7.3.3.4.4	Identify the advantages and disadvantages of cooling systems: 1) Air cooled 2) Ice cooled 3) Water cooled 4) Phase change cooling technology	4
7.3.3.4.5	Identify the process of selecting protective clothing	4
7.3.3.4.6	Determine construction materials and use compatibility charts	4
7.3.3.4.7	Identify physiological and psychological stresses	4

NFPA	Description	Unit
7.3.3.4	Select decontamination procedures 1) Describe the advantages and limitations of: a) Absorption b) Adsorption c) Chemical degradation d) Dilution e) Disinfecting f) Evaporation g) Isolation and disposal h) Neutralization i) Sterilization j) Solidification k) Vacuuming l) Washing 2) Identify sources for applicable information	7
7.3.5	Develop an action plan	Mod 2 Unit 2
7.3.5.1	Describe the purpose of and the equipment needed to perform the following techniques: 1) Absorption 2) Adsorption 3) Blanketing 4) Covering 5) Damming 6) Diking 7) Dilution 8) Diversion 9) Dispersion 10) Fire suppression 11) Neutralization 12) Overpacking 13) Patching 14) Plugging 15) Pressure isolation and reduction 16) Retention 17) Solidification 18) Transfer 19) Vapor control	6
7.3.5.2	Develop a site safety and control plan. 1) Describe safety considerations 2) Identify points that should be made in a safety briefing	3
7.3.5.3	Identify atmospheric and physical safety hazards of confined spaces	5

NFPA	Description	Unit
7.3.5.4	Identify pre-entry activities to be performed	5
7.3.5.5	Identify the process for preserving and collecting evidence	Mod 2 Unit 2 Unit 3
7.4	**Implementing the planned response**	
7.4.1	Identify Incident command functions and perform roles	3
7.4.2	Don, doff and work in PPE 1) Describe three safety procedures 2) Describe three emergency procedures 3) Demonstrate ability to use respiratory protection systems 4) Demonstrate ability to use chemical protective clothing	4

NFPA	Description	Unit
7.4.3	Perform the following control functions: 1) Pressure vessel repairs a) Fusible plug b) Fusible plug threads c) Side wall of cylinders d) Valve blowout e) Valve gland f) Valve inlet threads g) Valve seat h) Valve stem assembly blowout 2) Demonstrate: a) Closing valves b) Replacing plugs c) Tightening plugs 3) Contain the following leaks from a 55 gallon drum a) Bung leak b) Chime leak c) Forklift puncture d) Nail puncture 4) Overpack a drum by: a) Rolling slide-in b) Slide-in c) Slip-over 5) Maintain and inspect equipment 6) Identify three considerations for assessing a spill or leak in a confined space 7) Identify three safety considerations for product transfer 8) Install a dome clamp on a MC306/DOT406 9) Identify precautions to use when fighting a fire in a MC306/DOT406 10) Describe methods for containing leaks in a MC306/DOT406, MC307/DOT407 and a M312/DOT412 11) Describe three product transfer considerations for an overturned MC306/DOT406, MC307/DOT407, MC312/DOT412, MC331 and MC338	6
7.4.4	Describe common methods for product transfers	6
7.4.5	Perform the following decontamination operations 1) Technical decon 2) Decon of ambulatory and non-ambulatory victims 3) Mass decon of ambulatory and non-ambulatory victims	7
7.5	**Evaluating the progress**	

NFPA	Description	Unit
7.5.1	Evaluate the effectiveness of control operations	6
7.5.2	Evaluate the effectiveness of the decontamination process	7
7.6	**Terminating the incident**	
7.6.1	Assist in debriefing 1) Describe three components of the debriefing process 2) Describe key topics to cover when debriefing 3) Describe when to debrief 4) Describe who should be debriefed	8
7.6.2	Assist in critiquing 1) Describe three components of the critiquing process 2) Describe who should be involved 3) Describe why we need to critique 4) Describe the documents that should be prepared following a critique	8
7.6.3	Complete reports and documentation of the incident: 1) Identify reports required by SOPs 2) Demonstrate completion of reports 3) Know the importance of personnel exposure records 4) Know the importance of debriefing records 5) Know the importance of critique records 6) Keep an activity and exposure log 7) Compile incident reports 8) Keep hot zone entry and exit logs 9) Keep PPE logs 10) Know filing requirements	8

Module 1 - Introduction

Review and Background

As first responders to emergencies involving the spill or release of hazardous materials (HazMat), we are required by federal law to be competent in handling those incidents appropriately. This requirement is based on the Superfund Amendments and Reauthorization Act of 1986 (SARA). SARA required OSHA and the US EPA to develop standards for the training of all responders to HazMat incidents. These OSHA standards were based on existing National Fire Protection Association (NFPA) standards.

There are five levels of responders:

First responder awareness level;

First responder operations level;

Hazardous materials technician;

Hazardous materials specialist; and,

On-scene incident commander.

In the Ohio HazMat & WMD Awareness for the First Responder course we learned that there are basic skills that every responder at the awareness level should be able to perform. Awareness level responders should be able to:

Recognize the clues of a potential HazMat or WMD release;

Identify the hazards of the incident and identify the product if possible;

Isolate by staying out of the area and keeping others away;

Protect lives by using information from the Emergency Response Guidebook;

Notify other responders to initiate a response sequence: and,

Initiate the Incident Command System.

HazMat/WMD Clues

In the awareness class we learned about the six primary clues for detecting the presence of hazardous materials. You will recall that these clues can also help you distinguish whether you are dealing with a HazMat or WMD incident.

- **Occupancy** or **location**
- **Markings** or **colors**
- **Container shape** and **sizes**
- **Placards** and **labels**
- **Shipping papers** and **MSDS**
- **Senses**

You also learned about the following types of harm caused by hazardous materials. This included harm caused by:

- **Thermal**
- **Radiation**
- **Asphyxiation**
- **Chemical Harm**
- **Etiological/biological**
- **Mechanical**
- **Psychological**

The book also covered the four ways hazardous materials could enter the body. These included **inhalation, ingestion, skin**/**eye absorption** and **injection.** At the awareness level you became proficient in using the Emergency Response Guidebook, and at realizing the need to notify additional responders to handle the situation.

In the operations course, we built on the awareness skills and knowledge. Operations level personnel have a greater understanding of the possible hazards at the incident. They do not just isolate and protect, but are expected to take defensive actions to favorably change the outcome of the incident. Operations level responders 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.** [OSHA 1910.120(q)(6)(ii)]

In the operations course we covered the following OSHA guidelines:

- **Knowledge of the basic hazard and risk assessment techniques;**
- **Knowledge of how to select and use proper personal protective equipment provided to the first responder operational level;**
- **An understanding of basic hazardous materials terms;**
- **Knowledge of how to perform basic control, containment and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit;**
- **Knowledge of how to implement basic decontamination procedures;** and,
- **An understanding of the relevant standard operating procedures and termination procedures.**

This HazMat technician course is designed to meet OSHA's third level of hazardous materials responders. It will also address the NFPA's standards for the Technician level.

OSHA's definition, found in 29CFR 1910.120(q)(6)(iii), states that:

> Hazardous materials technicians are individuals who respond to releases or potential releases **for the purpose of stopping the release**. They assume a more aggressive role than a first responder at the operations level in that **they will approach the point of release in order to plug, patch or otherwise stop the release of a hazardous substance**. Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:
>
> (A) Know how to implement the employer's emergency response plan.
>
> (B) Know the classification, identification and verification of known and unknown materials by using field survey instruments and equipment.

(C) Be able to function within an assigned role in the Incident Command System.

(D) Know how to select and use proper specialized chemical personal protective equipment provided to the hazardous materials technician.

(E) Understand hazard and risk assessment techniques.

(F) Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit.

(G) Understand and implement decontamination procedures.

(H) Understand termination procedures.

(I) Understand basic chemical and toxicological terminology and behavior.

In order to help you understand your role at the technician level, each of these requirements will be addressed in its own unit.

The requirements in OSHA 29 CFR 1910.120 are broad and general. This course will use requirements found in NFPA 472 to add specific detail to each module. The requirements in NFPA are hazard based and are meant to apply across all disciplines.

Module 1
Unit 1

Module 1
Unit 1 - Implementing the Emergency Response Plan

The purpose of this unit is to review the required elements of an Emergency Response Plan.

Learning Objectives

At the end of this unit of training each student will demonstrate the ability to implement the Emergency Response Plan.

Student Performance Objectives

- Must explain how their local jurisdiction responds to a known HazMat incident.
- Must demonstrate knowledge of the State of Ohio's Emergency Response Plan.
- Must be aware of the Federal Emergency Response Plan.
- Must be able to identify the 12 items that OSHA requires to be included in an Emergency Response Plan.
- Must be able to successfully complete competency evaluation 001.

Resource List

- Ohio's Emergency Response Plan
- The National Response Plan
- OSHA 29 CFR 1910.120(q)(2)
- Pen / Pencil / Highlighter
- Scratch paper for notes

Implementing the Emergency Response Plan

The first OSHA competency for the technician level is that the responder is to be able to implement the Emergency Response Plan (ERP). All jurisdictions in Ohio are part of a local ERP that is based on county responsibilities to coordinate emergency responders. The technician level responder needs to be aware of the local ERP, state ERP and the federal ERP. They should be aware of the role that they and their agency will play at a HazMat incident. The technician responder should know what resources are available and how to bring those resources to the incident site. Implementing the ERP can be as simple as notifying the dispatching center and requesting the resources needed for the situation, or as complex as requesting federal assets through the state's governor.

Local Emergency Response Plans

Technicians should be familiar with how their organization develops and implements a response to a HazMat incident. You should be knowledgeable in requesting the appropriate resources to handle any size of incident. Since this information varies by each jurisdiction it cannot be covered in this course, but must be gleaned from local documents and authorities. You must know how your jurisdiction responds to a HazMat incident including the county levels of response.

State Emergency Response Plans

The State of Ohio also has an ERP. This plan coordinates state assets when they are needed to supplement local responders. Ohio's Homeland Security and Emergency Management Agency is responsible for maintaining and coordinating this plan.

Technicians should be aware that if local HazMat resources are exhausted, additional resources can be obtained from mutual aid agencies through agreements already in place throughout the state.

The State of Ohio also has a HazMat Technical Advisory Committee (TAC) that assesses HazMat team types and response capabilities based upon accepted federal team typing standards. The standards assign teams to one of three levels of response:

> **Type III** teams are teams with basic equipment and training and are capable of handling known industrial chemicals;

Type II teams are trained and equipped to handle known and unknown industrial chemicals, and;

Type I teams are prepared to handle advanced chemical terrorist agents in addition to known and unknown industrial chemicals.

The TAC maintains the list and contact information for these teams and provides it to the Ohio Emergency Response Plan. A call to the state dispatch center is all an incident commander needs to do to bring additional HazMat personnel and equipment to an incident. The HazMat technician should have knowledge of their own team's typing level and the requirement of how to maintain this level.

Another state asset is the **52^{nd} Weapons of Mass Destruction Civil Support Team**. This National Guard team provides highly advanced equipment and trained personnel to assist local agencies with mass casualty terrorism incidents. Their mission is to identify the chemical, biological and/or radiological agent involved in an attack. They can be requested directly or through the State of Ohio. The 52^{nd} is also available for demonstrations and exercises.

Federal Emergency Response Plans

The federal ERP is known as the National Contingency Plan, and is found in federal document 40 CFR part 300. Technicians should be familiar with this plan and can learn about it and how it functions by taking the federal on-line course known as IS-800.

Federal assets must be requested by the governor of the state. When state assets are overwhelmed the governor with the assistance of the state EMA, can declare a state-of-emergency and request these federal assets.

Standard Operating Procedures

All agencies are required under 29 CFR 1910.120(q)(1) to develop emergency response plans, more commonly known as Standard Operating Procedures (SOPs). Your employer should have SOPs outlining how your team is expected to respond to HazMat incidents. The SOP should also include how you are to react and what actions you are expected to perform at the awareness, operations and/or HazMat technician level.

OSHA requires the following:

> **(q)(2)** Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following areas to the extent that

they are not addressed in any specific program required in this paragraph:

(q)(2)(i) Pre-emergency planning and coordination with outside parties

(q)(2)(ii) Personnel roles, lines of authority, training, and communication

(q)(2)(iii) Emergency recognition and prevention

(q)(2)(iv) Safe distances and places of refuge

(q)(2)(v) Site security and control

(q)(2)(vi) Evacuation routes and procedures

(q)(2)(vii) Decontamination

(q)(2)(viii) Emergency medical treatment and first aid

(q)(2)(ix) Emergency alerting and response procedures

(q)(2)(x) Critique of response and follow-up

(q)(2)(xi) PPE and emergency equipment

(q)(2)(xii) Emergency response organizations may use the local emergency response plan or the state emergency response plan or both, as part of their emergency response plan to avoid duplication. Those items of the emergency response plan that are being properly addressed by the SARA Title III plans may be substituted into their emergency plan or otherwise kept together for the employer and employee's use.

As a competent technician you must know and follow your organizations SOPs.

An example of a Standard Operating Procedure is attached:

HazMat Team Standard Operating Procedures (example)

Purpose

This Standard Operating Procedure provides general procedures for the safe operation of the Hazardous Materials Response Team (HMRT). It is designed to meet OSHA 29 CFR 1910.120 “Hazardous Waste Operations and Emergency Response” regulations paragraph (q) and addresses NFPA 472, and 473.

Chain of Command

- Traditional Fire Division chain of command shall prevail.
- The officer in charge of the HMRT shall brief with the on scene incident commander and on working incidents will normally become the hazardous materials branch officer.
- The hazardous materials branch officer shall be responsible for working with and assigning current technicians to the following positions:
  - Lead tender timer
  - Decon coordinator
  - Research officer
  - Entry teams
  - Backup teams
  - HazMat EMS group
  - HazMat safety officer

Personnel

The HMRT will consist of hazardous materials technicians with current HazMat physicals. The minimum level of qualified technicians shall be:

- For Type III teams – 10 personnel
- For Type II teams – 15 personnel
- For Type I teams – 20 personnel

Training

- A technician must first be trained to the Ohio HazMat and WMD Awareness level or a 6 hour equivalent.
- A technician must also be trained to the Ohio HazMat and WMD Operations level or a 16 hour equivalent.
- A technician must be trained to the Ohio HazMat and WMD Technician level or its 40 hour equivalent.
- HazMat technicians shall receive a minimum of 8 hours of refresher training per year.
- Officers assigned to the HMRT will attend training courses aimed at attaining NFPA standard 472 Chapter 10 “Hazardous Materials Officer” Competencies.

- HazMat technician officers shall also attend training aimed at attaining NFPA standard 472 Chapter 11 “Hazardous Materials Safety Officer” competencies.

Staffing
The minimum staffing for the HMRT at an incident shall be:
- 1 officer currently trained as a HazMat technician.
- 8 HazMat technicians to be assigned as:
    - Lead tender timer
    - Research officer
    - Decon officer
    - Entry team (2 members)
    - Backup team (2 members)
    - HazMat EMS officer

Physicals
All physicals for hazardous materials technicians shall follow the procedures as set forth in “OSHA 1910.120 (f)

Billing
- The HMRT will use the current procedures as outlined by the county EMA in which the incident occurs.
- The Officer in charge of the HMRT shall be responsible for submitting an itemized bill to the host EMA within 10 business days for any billable HazMat/WMD incident.
- The HMRT may bill for any and all supplies used-up or destroyed on a HazMat/WMD incident.
- The HMRT may bill for any personnel costs required to handle the HazMat/WMD incident at their current pay rate plus benefits.

Equipment and Supplies
The HMRT leader shall be responsible for the ordering and replacement of all equipment and supplies to maintain their current state team typing level.

Air Monitors
- The HMRT leader shall be responsible for all air monitors used by the HMRT.
- The HMRT shall calibrate all air monitors at least monthly.
- All use of air monitors shall be logged on an Air Monitoring Log assigned to each air monitor.
- All personnel using air monitors in potentially hazardous atmospheres must understand their proper use and limitations.

Response
The standard response for a hazardous materials incident shall be 2 engines, 1 ladder, 1 chief, 1 medic, and the HMRT.

Job Descriptions
Hazardous Materials Branch Officer (officer in charge of HMRT): Operates under the direction of the incident commander. Is responsible for:

- The coordination of the HazMat branch.
- The assignment of personnel roles within that branch.
- Safe entry and operations with in the hot and warm zones.
- Determining the safest level of chemical protective clothing ensembles to be used in the hot and warm zones.
- Recommendation to the incident commander for the safe mitigation of the incident.

Lead Tender Timer: Operates under the direction of the HazMat branch officer and follows the lead tender timer checklist and current dress-out procedures. Is responsible for:

- Proper setup of the dress-out area.
- Dressing out the Entry and Back-up teams in the prescribed chemical protective clothing ensemble.

Decon Coordinator: Operates under the direction of the HazMat branch officer and follows the decon checklist. Is responsible for:

- Coordination of the decon group.
- Setup of the decon area.
- Dressing the decon group in the prescribed chemical protective clothing ensemble.
- Assisting in deconning the entry teams.

Research Officer: Operates under the direction of the HazMat branch officer and follows the Research checklist. Is responsible for:

- Identification of the hazardous properties of the chemical(s) involved.
- Notification of outside agencies needed for assistance.

Entry Teams: Operates under the direction of the HazMat branch officer and is responsible for a safe entry into the hot zone for the purpose of Identifying, verifying and mitigating the HazMat incident.

Backup teams: Operates under the direction of the HazMat branch officer. Is responsible for assisting the entry team to meet entry goals and a safe and expedient rescue of a downed entry team member

HazMat EMS Group: Operates under the direction of the HazMat branch officer and follows the EMS checklist. Is responsible for:

- Pre-entry evaluations
- Post-entry evaluations
- Treatment of hazardous materials technicians exposed to hazardous chemicals.

HazMat Safety Officer: Operates under the direction of the scene safety officer and follows the safety officer's checklist. Ensures the safety of personnel in the hazardous materials branch and, in some instances, may make entry with the entry team to assure the entry team's safety.

Module 1 Unit 1
Unit Quiz

1. The 52 CST, Ohio EPA and ODH are part of…?
   a. The LEPC plan
   b. The State of Ohio response assets
   c. The ERP
   d. The NCP

2. Your local jurisdiction's ability to respond is part of the…?
   a. Local ERP
   b. NCP
   c. SERC
   d. GOG

3. A Type III team is…?
   a. The highest trained and best equipped team
   b. Capable of handling known industrial chemicals
   c. Trained for WMD incidents
   d. Not equipped with air monitoring devices

4. 40 CFR part 300 is where you can find the…?
   a. National Contingency Plan (NCP)
   b. Local Emergency Planning Committee (LEPC) plan
   c. FEMA guidelines for response
   d. Local SOP

5. Which of the following is part of OSHA's requirements for your emergency response plan?
   a. Site security
   b. Lines of authority
   c. Training requirements
   d. All of the above are requirements found in 29CFR1910.120(q)(2)

6. An organization can use all or part of the local emergency response plan as part of their own response plans.
   a. True
   b. False

7. Emergency recognition and prevention should be part of your emergency response plan.
   a. True
   b. False

8. Who can request federal assets?
    a. Anyone
    b. Incident commanders only
    c. Governors
    d. HazMat branch officers

9. Which of the below would be considered a federal level asset…?
    a. FEMA's Ohio Task Force 1
    b. 52nd CST
    c. Type I HazMat team
    d. Ohio Health Department

10. SOP stands for…?
    a. Standard Operating Procedure
    b. Suggested Operating Procedure
    c. Standard Operating Plan
    d. Suggested Operating Plan

Module 1
Unit 2

Module 1
Unit 2 - Field Survey Instruments

Scope of Unit

The purpose of this lesson is to train responders in the proper use of field survey instruments.

Learning Objectives

At the end of this unit of training each student will demonstrate knowledge and the ability to classify, identify, and verify known and unknown chemicals by using field survey instruments.

Student Performance Objectives

- Know the 9 DOT hazard classes.
- Know the 3 classes and 2 divisions of inherent safety tested instruments.
- Know the 6 types of direct reading instruments and give examples of each type.
- Demonstrate an ability to operate at least 4 different direct reading instruments.
- Must be able to successfully complete competency evaluations 005, 006, 007, 008, 009, 010, 011, 014, 016, 017, and/or 018.

Resource List

- 4 different direct reading instruments
- pH paper
- Chemicals for demonstration and testing
- Pen / Pencil
- Scratch paper for notes

References

- Handbook for Responding to a Radiological Dispersal Device, Conference of Radiation Control Program Directors, Inc.
- The University of Findlay Technician Manual

Field Survey Instruments

INTRODUCTION

According to OSHA, technicians must be able to "know the classification, identification and verification of known and unknown materials by using field survey instruments and equipment". Quite simply, a technician should be able to use their knowledge, skills and available equipment to classify or identify unknown chemicals or to verify the classification and hazards of a known substance.

To classify a substance you must remember that in both the Awareness and Operations courses you were given the nine classifications of hazardous materials according to the U.S. Department of Transportation. These classes are based upon a product's ability to cause harm. We will learn to classify and verify products by using basic field survey instruments. These instruments are more commonly known as air monitors or direct reading instruments.

Hazardous materials classes:

- Class 1 Explosives
- Class 2 Flammable, non-flammable or poisonous compressed gases
- Class 3 Flammable liquids
- Class 4 Flammable solids, spontaneous combustible materials or dangerous-when-wet materials
- Class 5 Oxidizers or organic peroxides
- Class 6 Toxic, poisonous and biological materials
- Class 7 Radioactive materials
- Class 8 Corrosives
- Class 9 Other regulated materials

Real-time air monitoring is essential to identify potential airborne hazards. Airborne contaminants can present a significant threat to human health. Identifying and quantifying these contaminants by air monitoring is an essential component of the health and safety program during a HazMat Incident. In addition to classifying and verifying the presence of hazardous materials, air-monitoring data can also be used for:

- Assessing the health risks to the public and workers;
- Selecting and verifying PPE levels;
- Delineating work zones and areas where protection levels are needed;
- Determining the extent and direction of dispersion; and,
- Selecting actions to mitigate hazards safely and effectively.

Direct-reading instruments were developed as early-warning devices for use in industrial settings where leaks or an accident could release a high concentration of a known chemical. Today, some direct-reading instruments can detect low concentrations of contaminants in the parts-per-million (ppm) range. Direct-reading instruments provide information at the time of sampling and do not require sending samples to a laboratory for subsequent analysis. This ability of direct-reading instruments to provide real-time data enables rapid decision-making for an incident.

CHARACTERISTICS OF AIR-MONITORING INSTRUMENTS

All equipment has uses and limitations and the same is true of air-monitoring instruments. During a HazMat response, the atmospheric conditions may even be aggressive to the monitoring equipment. Personnel in protective gear have limited dexterity and vision and so to be useful, air-monitoring instruments should be:

- Portable and rugged;
- Easy to operate with protective gear;
- Inherently safe; and,
- Able to generate reliable and useful results.

Portability - A prime consideration for field instruments is portability. Air-monitoring devices should have handles and straps to enhance portability. Select instruments that have reinforced shells or frames, shock-mounted electronic packages, and padded containers for transportation.

Exposure to the elements and to the test atmosphere itself is a concern for instruments repeatedly used in adverse conditions or as long-term monitors. Anodized or coated finishes, weather-resistant packaging, and remote sensors are effective in reducing downtime and increasing useful life as well as increasing portability of the instrument.

An internal power supply is important for portability; some instruments use replaceable or rechargeable batteries as the power source. An instrument should not be so heavy or bulky that it is difficult for a worker to carry.

Easy Operation - Because many of these instruments were designed for industrial use, allowances may not have been made for using the instrument while wearing protective equipment. One must consider how easy it is to use the instrument while wearing gloves or how difficult it is to read the meter while wearing a respirator. Also, how quickly a worker can learn to operate the instrument correctly should be considered.

Preparation time for use of the instrument should be short. Rapid warm-up, easy attachment of accessories, and quick instrument checks shorten preparation time and make the unit more user-friendly.

Inherent Safety - The portable instrumentation used to characterize HazMat sites must be safe to use. Electrical devices, including monitoring instruments, must be constructed so as to prevent the ignition of a combustible atmosphere where they may be used.

The NFPA has identified minimum design standards in its National Electrical Code (NEC). The code spells out the types of areas where hazardous atmospheres can be generated and the types of materials that generate these atmospheres. It also stipulates design safeguards acceptable for electrical equipment that is used in hazardous atmospheres.

Hazardous atmospheres are defined as a mixture of any flammable material in air with a concentration within the material's flammable range.

OSHA considers any atmosphere at or above 10% of a product's LEL as Immediately Dangerous to Life and Health (IDLH).

The NEC categories divide a hazardous atmosphere according to its Class, Group, and Division.

> ***Class and Group*** - Class is a category describing the type of flammable material that produces the hazardous atmosphere:

- **Class I:** Consists of flammable vapors and gases such as gasoline and hydrogen. Class I is further divided into Groups A, B, C, and D on the basis of similar flammability characteristics (Table 1).
- **Class II:** Consists of combustible dusts like coal or grain and is divided into Groups E, F, and G (Table 2).
- **Class III:** Consists of ignitable fibers such as produced by cotton milling.

***Division* -** Division is the term describing the "location" of generation and release of the flammable material.

- **Division 1:** A location where the generation and release are continuous, intermittent, or periodic into an open, unconfined area under normal conditions.
- **Division 2:** A location where the generation is only from a leak or failure from closed systems or containers.

TABLE 1 - SELECTED CLASS I CHEMICALS BY GROUPS

Group A Atmospheres: Acetylene
Group B Atmospheres (not sealed in conduit 1/2 inch or larger) 1, 3-Butadiene Ethylene oxide Formaldehyde (gas) Hydrogen Manufactured gas (containing greater than 30% H2 by volume) Propylene oxide Propyl nitrate Allyl glycidyl ether n-Butyl glycidyl ether

Group C Atmospheres (selected chemicals) Acetaldehyde Carbon monoxide Crotonaldehyde Dicyclopentadiene Diethyl ether Diisobutylamine Methyl acetylene Ethylene glycol Ether acetate	Epichlorohydrin Ethylene Ethyl mercaptan Hydrogen cyanide Hydrogen selenide Hydrogen sulfide Morpholine Nitropropane	Tetrahydrofuran Triethylamine Ethylene glycol Ethyl ether Hydrazine Tetraethyl lead (39 other)
Group D Atmospheres (selected chemicals) Ammonia Benzene Butane Di-isobutylene Ethane Ethyl alcohol Gasoline	Heptane Hexane Isobutyl acetate Isoprene Isopropyl ether Methane (natural gas) Methanol Methyl ethyl ketone Styrene	Toluene Vinyl acetate Vinyl chloride Xylene

TABLE 2 - SELECTED CLASS II CHEMICALS BY GROUPS

Group E Conductive Dusts Atmospheres containing metal dusts including aluminum, magnesium and their commercial alloys, and other metals of similarly hazardous characteristics.
Group F Semi-Volatile Dusts Atmospheres containing carbon black, coal, or coke dust with more than 8% volatile material.

Group G Nonconductive Dusts

Atmospheres containing flour; starch; grain; carbonaceous; chemical thermoplastic; thermosetting; or molding compounds.

Source*: Classification of Gases, Vapors and Dusts for Electrical Equipment in Hazardous (classified) Locations*, 1986 National Fire Protection Association ANSI/NFPA 497M.

Controls - The following three methods of construction exist to prevent a potential source from igniting a flammable atmosphere:

- ***Explosion-Proof*** - Explosion-proof instruments allow the flammable atmosphere to enter. If an arc is generated, the ensuing ignition is contained within the specially built enclosure of the instrument.
- ***Intrinsically Safe*** - An intrinsically safe device is not capable of releasing sufficient electrical or thermal energy to cause ignition of a hazardous atmosphere.
- ***Purged*** - The arcing or flame-producing device is buffered from the flammable atmosphere with an inert gas.

Certification - If a device is certified as explosion-proof, intrinsically safe, or purged for a given class, division, and group and is used, maintained, and serviced according to the manufacturer's instructions, it will not contribute to ignition. All certified devices must be marked to show class, division, and group. Testing is performed by such organizations as Underwriters' Laboratory Inc. (UL) or Factory Mutual Research Corp. (FM).

In an area designated as Division 1, there is a greater probability of generating a hazardous atmosphere than in a Division 2 atmosphere; therefore, the test protocols for Division 1 certification are more stringent than those for Division 2. Thus a device approved for Division 1 is also permitted for use in Division 2, but not vice versa. For most response work, this means devices approved for Class I (vapors, gases), Division 1 (areas of ignitable concentrations), Groups A, B, C, or D should be chosen whenever possible. At a minimum, an instrument should be approved for use in Division 2 locations.

Reliable and Useful Results - The response time, sensitivity, amplification, accuracy, precision, selectivity, and calibration of an instrument are important in evaluating the reliability and usefulness of the data the instrument generates.

Response time is the interval between an instrument "sensing" a contaminant and generating the data that is important in producing reliable and useful results in the field. Response times for direct-reading instruments may range from a few seconds to several minutes and depend on:

- Test(s) to be performed;
- Type of sensor;
- Length of hose the sample travels through;
- Required sampling time;
- Speed of data generation and display; and,
- The sensitivity of the instrument.

Sensitivity - Sensitivity is defined as the ability of an instrument to accurately measure changes in concentration. Sensitive instruments can detect small changes in concentration. Even slight concentration changes can sometimes be dangerous.

Sensitivity of the instrument is also a factor of the detection limit. The lower the detection limit, the more sensitive the instrument. The lower detection limit is defined as the lowest concentration to which the instrument will respond.

Amplification - A term often used synonymously (but incorrectly) with sensitivity, amplification is an instrument's ability to increase very small electronic signals from the detector to the readout. Changing the amplification of the detector does not change its sensitivity. Radio frequency, pulsed DC or AC power lines, transformers, generators, and radio-wave transmitters (walkie talkies) can affect instruments with amplified circuits.

Accuracy - The closeness of the true value and the instrument reading.

Precision - The reproducibility of the same value as measured by the meter. These factors can be indicated by the error factor. For example, some colorimetric detector tubes may have an error factor of +/- 35% of the true value, meaning the actual concentration of the chemical being measured is within a range of 35% higher or lower than the tube reading and therefore not very precise.

Selectivity - The ability of an instrument to detect and measure a specific chemical or group of similar chemicals. Additionally, selectivity is dependent on interfering compounds that may produce a similar response in the instrument, but not be the chemical or group of chemicals for which analysis is being conducted. Selectivity and sensitivity must be reviewed and interpreted together. Interference can affect the accuracy of the instrument reading, thus producing incorrect data.

Calibration and Relative Response - For an instrument to function properly, it should be calibrated prior to use. Calibration is the process of adjusting the instrument readout so it corresponds to the actual concentration. Calibration involves checking the instrument results with a known concentration of a gas or vapor to see whether the instrument gives the proper response.

Types of Direct-Reading Instruments

There are several types of instruments used to detect hazardous atmospheres. During investigation, the below sequence of air monitoring should be followed in order to provide safety to personnel and prevent damage to the instruments:

- Corrosive gas;
- Oxygen;
- Flammability/explosivity;
- Toxic;
- Radiological; and,
- Specialized monitoring/analysis devices.

The above sequence becomes an analysis process for identifying unknown solids, liquids and/or gasses.

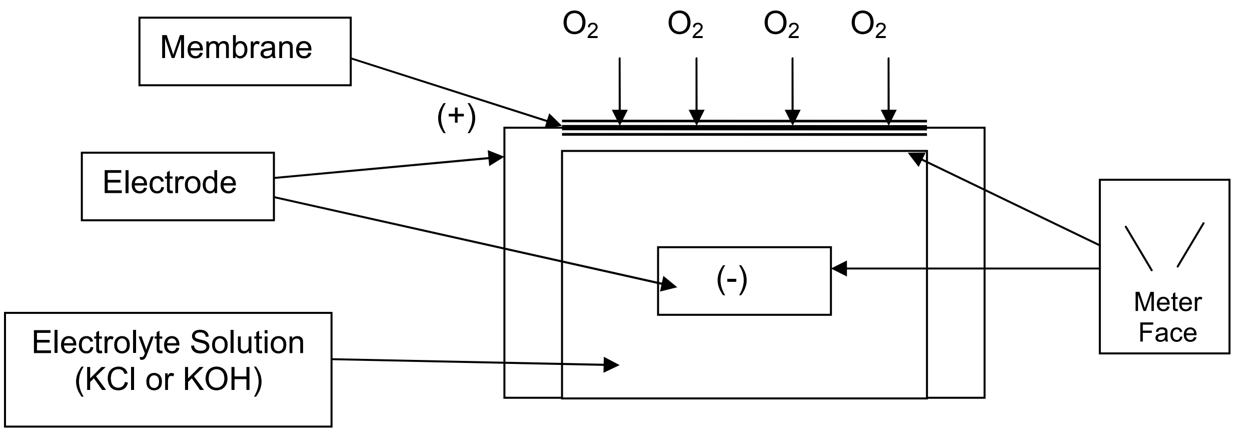
<u>Corrosive gas</u> – Attaching a 12” piece of pH paper to the end of a broom handle will provide an early warning that corrosive gasses are present in an atmosphere. The identification of corrosive gasses will help the responder to protect other instruments that might be destroyed by this type of atmosphere. pH paper will turn colors in the presence of an acid gas (red) or basic gas (green to blue). Wetting one end of the paper will allow a faster reaction with some corrosives. The presence of corrosive gasses also indicates to the responder the need for higher levels of chemical protection. pH paper can also be used to verify that a corrosive chemical with a high vapor pressure is present at a scene.

<u>Oxygen</u> - Oxygen indicators are used to evaluate an atmosphere for two reasons:

First is **oxygen content for respiratory health.** Normal air is 20.9% oxygen. By OSHA standards, oxygen levels **less than 19.5%** are considered to be oxygen-deficient and ventilation must be used to raise the oxygen level or a supplied air respirator must be worn; and, second, the **increased risk of combustion.**

OSHA considers oxygen levels above **23.5%** to be oxygen-enriched and thus increase the risk of combustion.

The most useful range of response for the instrument is from 0% to 25% oxygen-content. Decreases in the oxygen content of an area might indicate the presence of another substance.



SCHEMATIC OF OXYGEN SENSOR

Principle of Operation - Oxygen indicators have two principal components for operation: the oxygen sensor and the meter readout. In some units, air is drawn into the oxygen detector with an aspirator bulb or pump; in other units, the ambient air is allowed to diffuse to the sensor. The oxygen detector uses an electrochemical sensor to determine the oxygen concentration in air. A typical sensor consists of two electrodes, a housing containing a basic electrolytic solution, and a semi-permeable Teflon™ membrane.

Oxygen molecules (O2) diffuse through the membrane into the solution. Reactions between the oxygen, the solution, and the electrodes produce a minute electrical current proportional to the oxygen content. The current passes through the electronic circuit; the resulting signal is shown as a needle deflection on a meter or as a digital reading. Oxygen sensors must be replaced every 1 to 1.5 years, regardless of use.

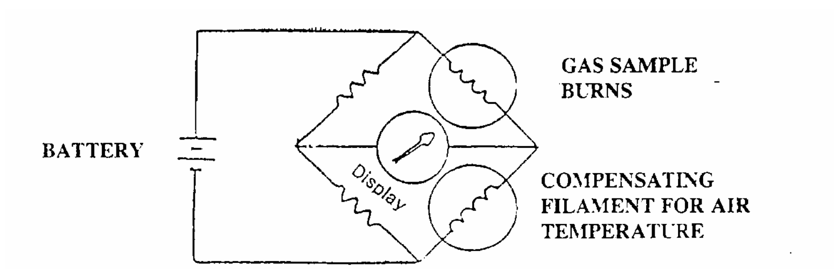
Limitations and Considerations - Readings will vary with the absolute atmospheric pressure and temperature of the original calibration.

The actual percentage of oxygen does not change with altitude. However, as pressure decreases with higher altitude, less O2 molecules are forced through the sensor cell. Consequently, an O2 indicator calibrated at sea level and operated at an altitude of several thousand feet will falsely i ndicate less oxygen than the actual amount. Therefore, it is necessary to calibrate at the altitude the instrument is used.

The temperature can affect the response of oxygen indicators. Their normal operating range is 32°F to 120°F. Response times slow as the temperature decreases. At low temperatures, the sensor may even be damaged if the solution freezes. The instrument should be calibrated at the temperature at which it will be used.

Combustible-Atmosphere Indicators - Combustible-gas indicators (CGIs) measure the concentration of a flammable vapor or gas in the air, indicating the results as a percentage of the lower explosive limit (LEL) compared to the calibration gas. Warning: explosivity or LEL meters require oxygen (19.5% or more) to operate correctly. Without proper oxygen, the instrument might provide the user with false information and the user may enter an unsafe atmosphere.

Principle of Operation - Combustible-gas indicators use a combustion chamber containing a filament that reacts with the flammable gas. To facilitate combustion, the filament is coated with a catalyst (like platinum or palladium) and operates as part of a balanced resistor circuit called a Wheatstone Bridge. The heated filament reacts with the gas on the immediate surface of the element, thus raising the temperature of the filament, which correspondingly raises the readout on the meter.



WHEATSTONE BRIDGE

Limitations and Considerations - The response of the instrument is temperature dependent, oxygen dependent, subject to being fouled by certain compounds and cannot discern what flammable chemical it is detecting.

If the temperature at which the instrument is zeroed differs from the sample temperature, the accuracy of the reading can be affected.

The instruments are intended for use only in normal oxygen atmospheres. Oxygen-deficient atmospheres can produce lowered readings. Also the safety guards that prevent the combustion source from igniting a flammable atmosphere are not designed to operate in an oxygen-enriched atmosphere.

Organic lead vapors (e.g., gasoline vapors), sulfur compounds, and silicone compounds will foul the filament. Most units have an optional filter that protects the sensor from leaded vapors. Acid gases (e.g., hydrogen chloride and hydrogen fluoride) can corrode the filament.

When a meter is calibrated to one particular gas or vapor, it cannot give an absolute value for a different chemical. This results in an inherent error during most monitoring activities. For a valid measurement, the instrument must be recalibrated to the new contaminant or the value converted mathematically. This is critical for Industry as they need exact readings to determine acceptable levels for entry into non-IDLH atmospheres. Response factors are of less concern in emergency response since any level of LEL should lead a responder to wear fire or flash protection if entry into the area is required.

TABLE 3 - RELATIVE RESPONSE FOR A COMBUSTIBLE-GAS INDICATOR CALIBRATED TO PENTANE

Chemical	Concentration (% LEL)	Meter Response (% LEL)	Relative Response Factor
Methane	50	85	1.7
Acetylene	50	60	1.2
Pentane	50	50	1
1,4,-Dioxane	50	37	.74
Xylene	50	27	.54

Source: *Portable Gas Indicator, Model 250 & 260, Response Curves*, Mine Safety *Appliances Company, Pittsburgh, PA.*

The response factor gives a numerical correlation between the actual concentration and the numerical display on the meter. It is a factor that is used to convert the instrument readings to a more accurate number.

CGIs can be used to verify that a flammable gas or liquid has been released or to classify the unknown product as a flammable gas or liquid.

Toxic-Atmosphere Monitors - There is a need to determine if toxic vapors are present and to identify them. Since toxic meters are not all intrinsically safe, they are used after explosive hazards are determined to not be present. Toxic atmospheric monitoring is performed to:

- Identify airborne concentrations that could pose a toxic risk to response workers and the public;
- Evaluate risk;
- Determine the need for and type of PPE; and,

- Establish work zones or areas where contaminants are or are not present.

Typically carbon monoxide and hydrogen sulfide sensors are used in a multi-gas detector to cover the area of toxicity. They are usually a chemical sensor and read in parts-per-million (ppm). There are, however, several different types of sensors and instruments that can be used to determine toxicity, from a specific chemical sensor to colorimetric devices.

<u>Radiological</u> - In situations where you suspect radiation initial entry should be made with radiation monitors. Radiation monitors can be used to verify that a radioactive product is present, or to classify the unknown product as being a radioactive material.

Much equipment is available for detecting radiation, from the still useful fifty-year-old detection devices of the old civil defense organizations to more modern electronic devices that can even identify the Isotope.

CDV 700 and 715s, radiation pagers, and isotope identifiers are all examples of radiological indicators.

Some units are designed to survey an area for the presence of Gamma radiation; others are for determining the presence of contamination

Radiation pagers are a combination dose and rate meter that can be used to alert the wearer to changes in background radiation levels and the accumulated dose he or she has received since entering the area.

Dose is the general term for the quantity of radiation absorbed. Rate is the amount of dose delivered per unit of time, usually expressed as rem per hour.

HazMat technicians should limit their total accumulative dose to 5000mrem over the course of the incident unless entry is for life safety (rescue) or protecting critical property. Then dose amounts should not exceed 50,000mrem or 10,000mrem respectably. A Rate of 1000mrem/hr would give the responder 5000mrem in 5 hours time.

Specialized Monitoring/Analysis Devices – There are 18 different types or technologies of monitoring equipment listed in NFPA 472's technician level guidelines. These range from the inexpensive clip-on personal detector to the expensive gas chromatograph or mass spectrometry unit that can identify certain unknown substances. We have already discussed some of these and will briefly discuss a few more; however, the technician must become familiar with the equipment their team uses. They must be aware of the operational deficiencies of their particular detectors as well as the limitations of use.

NFPA 8.2.1.3.4	Identify capabilities and limitations of the following: 1) Biological immunoassay indicators 2) Chemical agent monitors 3) Colorimetric indicators 4) Combustible gas indicators 5) DNA fluoroscopy 6) Electro chemical cells 7) Flame ionizing detector 8) Gas chromatograph/mass spectrometer 9) Infrared spectroscopy 10) Ion mobility spectroscopy 11) Mass channel analyzer 12) Metal oxide sensor 13) Photo ionization detector 14) Polymerase chain reaction 15) Radiation detection and measurement instruments 16) Raman spectroscopy 17) Surface acoustical wave 18) Wet chemistry

Colorimetric Indicator Tubes (Detector Tubes)

Principle of operation: colorimetric indicator tubes consist of a glass tube with an indicating chemical. The tube is connected to a piston or bellows type pump. A known volume of contaminated air is pulled through the tube by the pump at a predetermined rate. The contaminant reacts with the indicator chemical in the tube, producing a change in color. The length of the material in the tube that has changed color is proportionate to the contaminant concentration.

Colorimetric Indicator Tubes
Source: http://www.envisupply.com

Detector tubes are normally chemical-specific. There are different tubes for different gases. Concentration ranges on the tubes may be in the ppm or percent range.

Detector tubes have the disadvantage of poor accuracy and poor precision. However, the selection of different tubes is high so the tubes are useful to determine which contaminant is present.

The chemical reactions involved in the use of the tubes are affected by temperature. Cold weather slows the reactions and thus the response time. Hot temperatures can break down the reaction chemicals within the tube. The tubes should be stored at a moderate temperature or even refrigerated during storage prior to use.

The manufacturer's instructions usually indicate if humidity is a problem and list any correction factors to use if the tube is affected by humidity.

The chemical used in the tubes deteriorates over time. Thus the tubes are assigned a shelf life that varies from 1 to 3 years. Shelf life can be extended by refrigeration but the tube should equilibrate to ambient temperature before use.

One advantage detector tubes posses is that you can select a tube that is specific to a chemical. However, some tubes will respond to interfering compounds. Fortunately, the manufacturer provides information with the tubes on interfering gases and vapors.

Interpretation of results can also be a problem. Since the tube's length of color change indicates the contaminant concentration, the user must be able to see the end of the stain. Some stains are diffused, or have uneven endpoints making it difficult to read. When in doubt, use the highest value that would be obtained from reading the different aspects of the tube.

The total volume to be drawn through the tube varies with the tubes. The volume needed is given as the number of pump strokes needed for that particular tube, i.e., the number of times the piston or bellows is manipulated. Also, the air does not instantaneously go through the tube. It may take 1 to 2 minutes for each volume (stroke) to be completely drawn. Therefore, sampling times can vary from 1 to 30 minutes per tube. This can make the use of detector tubes time-consuming.

Photo Ionization Detector (PID) - This instrument detects concentrations of ionizable gases and vapors in air by using an ultraviolet light (UV) source to ionize the airborne contaminant. Once the gas or vapor is ionized in the instrument, it can be detected and measured.

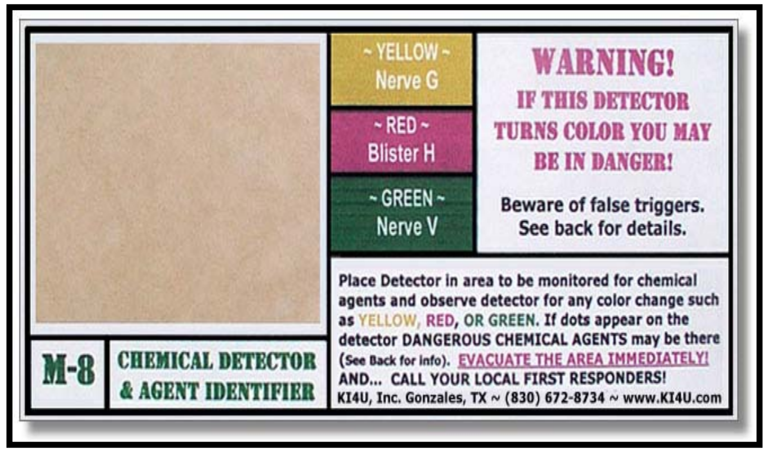
A fan or pump draws air into the detector of the instrument. The contaminants are exposed to a high-frequency radiation light source, such as UV light, and the resulting negatively charged particles (ions) are collected and measured on a charged plate to produce a current. The measured current is proportional to the number of ionized molecules or concentration of the contaminants in air.

All atoms and molecules are composed of particles: electrons, protons, and neutrons. The energy required to remove the outermost electron from the molecule is called the ionization potential (IP) and is specific for any compound or atomic species. IPs are measured in electron volts (eV). (See Table 4 below for a list of chemicals and their IP.) The NIOSH pocket guide is one source of information on the Ionizing potential for many chemicals.

The advantage of a PID is that smaller amounts of certain products can be detected (as low as 1 ppm). The disadvantage is that it cannot detect a chemical with an ionizing potential above the PID's lamp size.

TABLE 4 – PHOTO IONIZATION POTENTIALS OF SELECTED CHEMICALS

Chemical	Ionization Potential (eV)
Hydrogen cyanide	13.9
Carbon dioxide	13.8
Methane	13.0
Hydrogen chloride	12.5
Water	12.6
Oxygen	12.1
Chlorine	11.5
Propane	11.1
Hydrogen sulfide	10.5
Hexane	10.2
Ammonia	10.1
Vinyl chloride	10.0
Acetone	9.7
Benzene	9.2
Phenol	8.5
Ethyl amine	8.0

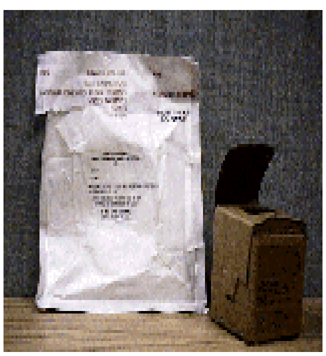


M-8 Chemical Paper
Source: http://www.ki4u.com

M-8 Chemical Agent Detector Paper

One of the first items that might be used in a terrorism event is chemical detector (M-8) paper. M-8 paper provides a qualitative detection (color change) in the presence of liquid nerve or blister agents. It will not detect vapors. The color change is compared to the color printed on the inside cover to presumptively identify the agent; however, the paper will respond to a number of other chemicals, mainly organic solvents.

M-8 paper is best used during initial reconnaissance, or even the initial rescue missions into the incident site, to screen suspicious liquids. If no color change is indicated, nerve and blister agents can probably be eliminated. A positive response should be combined with other information before a conclusion that an agent is actually present is reached.



M-9 Paper

M-9 Chemical Agent Detector Paper[1]

M-9 paper will change color to red in the presence of liquid chemical agent droplets. It has a sticky back so that it can be fastened to protective garments and equipment to disclose contamination. It has the ability to "wick" very small droplets to make visible spots where none would appear on M-8 paper.

M-9 paper is also less sensitive to other chemicals than the M-8 paper, but does not differentiate between nerve and blister agents.

Both M-8 & M-9 detect liquids only.

[1] M-9 Paper Photo Source: http://www.carson.army.mil/Moblas/NBC/CBRN%20101-2_files/image011.gif Retrieved August 15, 2007.

M256A1 Chemical Agent Detector Kit[2]

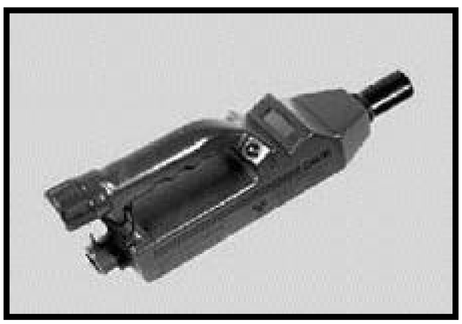
M256A1 Kit

This kit has the capability to detect nerve, blood, and blister agents. It will detect nerve and blood agents below the IDLH level, and mustard agents below the incapacitating dose. It will also detect CX. It does not detect choking agents.

While designed for use in full military protective clothing, the M256A1 Chemical Agent Detection Kit does require some practice to manipulate. It is the most widely used military detection kit and is best used during the initial recon of a site to determine the class of agent involved. It takes about 15 minutes from start to finish performing the whole series of tests.

Training kits are also available (M28/M29).

ICAM



ICAM

The Chemical Agent Monitor, or CAM, is a hand-held, battery-operated, post attack device for monitoring chemical agent contamination on personnel or equipment. It detects vapors of chemical agents and discriminates between nerve (G-, VX) and mustard agents (H, HD, HN). It is designed for use by individuals in full protection and is used to sort contaminated personnel and equipment from clean. The ICAM (Improved Chemical Agent Monitor) is a newer model which simplifies maintenance.

A semi-quantitative indication of the amount of an agent's presence is provided by the number of bars which appear on the LCD screen (0-8 bars).

One limitation of the CAM is that certain organic solvents can produce a false positive response, so the operator needs to be trained to determine what may be in the area that could cause a false response.

[2] M256A1 Photo Source http://www.carson.army.mil/Moblas/NBC/CBRN%20101-2_files/image009.jpg, Retrieved August 8, 2007

APD 2000

APD 2000

The Advanced Portable Detector (APD) simultaneously detects nerve and blister agents, recognizes pepper spray and mace and identifies hazardous compounds. It is also available with a radiation dosimeter. It can detect GA, GB, GD, VX, HD, HN, and L pepper spray and mace. This unit is a point source detector used to identify visual amounts of an unknown liquid.

SAW-MINICAD[3]

SAW MiniCAD MK II

The SAW-MINICAD is capable of detecting concentrations of G and H-agents in vapor form. It is not as sensitive as the CAM/ ICAM or APD 2000. The device uses surface acoustic wave technology for detection. It weighs slightly over one pound.

Gas Chromatograph/Mass Spectrometer GC/MS

Another field-deployable instrument is the (gas chromatograph/mass spectrometer) GC/MS. It is packaged in a suitcase-sized box and can be used by trained personnel in a field location to quantitatively identify chemical agents in soil, vapor or liquid samples. It can detect chemical agents below TWA/AEL levels. Technology advances continue to shrink the size of these units.

Field Portable GC/MS

[3] SAW MiniCAD MK II Photo Source http://media.msanet.com/NA/USA/PortableInstruments/ToxicGasandOxygenIndicators/MiniCADmkII/SawMiniCAD.jpg, Retrieved August 10, 2007

RAMP Biodetection System

Biological Detection and Identification

The selection of identification equipment for biological agents is much smaller and there are currently a limited number of items which can be used to detect and identify biological agents in the field. False positives and false negatives still plague these detectors.

The technology is improving regularly on the field test kits that are available. (See photo at left[4] and article on the next page with reference to the RAMP® Biodetection System.)

[4] Response Biomedical Corporation, RAMP Biodetection System, http://www.responsebio.com/products_biodefense_ramp_starter_kit.asp?menu=3&submenu=4 , Retrieved August 15, 2007

Association of Analytical Communities (AOAC) Article[5]

AOAC News

Initiative Yields Effective Methods for Anthrax Detection; RAMP and MIDI, Inc., Methods Approved

AOAC INTERNATIONAL, and its subsidiary AOAC Research Institute, announced the approval of two biodefense methods for the detection of *Bacillus anthracis* (commonly known as anthrax). One method, commonly referred to as MIDI, is for the confirmatory identification of pure cultures of *B. anthracis*. The second method, a hand-held assay (HHA), is intended for the presumptive detection of *B. anthracis* spores. Soon, scientists will begin field-testing to confirm the effectiveness of the approved HHA method for use by "first responders," such as trained HazMat technicians, who may be called upon to respond to an emergency situation.

The comprehensive initiative conducted by AOAC INTERNATIONAL and funded by the Department of Homeland Security (DHS) and Department of Defense began in June 2003. Its purpose was to identify reliable analytical methods to enable security, defense, and other federal agencies to make science-based decisions in the event of biological attacks. Additionally, first responders, public health agencies, defense, and security needed validated field-usable methods for detecting agents.

"AOAC has taken the lead in the evaluation and validation of detection methods for biological and chemical threat agents," said James Bradford, executive director of AOAC INTERNATIONAL.

The DHS-sponsored project has established an infrastructure to support the development of standards and evaluation of biological and/or chemical threat agent detectors. AOAC INTERNATIONAL and DHS are working jointly to determine which detectors and methods for other chemical and biological agents should be evaluated next.

"The cooperation of many federal agencies, the biodetector industry, the academic and the first responder communities—all working in concert with AOAC—was critical in executing this project," said Bradford.

At this stage, AOAC has just awarded *Official Methods*SM status to two methods for use in the laboratory—RAMP Anthrax Test Cartridge by the Response Biomedical Corp. of Canada and MIDI Sherlock Microbial Identification System of Newark, Delaware, USA.

Previously, in February 2004, AOAC had granted *Official Methods of Analysis*SM status to a confirmation procedure used by the Centers for Disease Control and Prevention (CDC) and the Laboratory Response Network (LRN).

RAMP Anthrax Test Cartridge

The RAMP test was one of five HHAs that underwent an exhaustive AOAC collaborative study in 12 different laboratories. As a rapid screening method, the RAMP test was found to be reliable in detecting anthrax spores at levels of 1 million or more in visible powders. Field-testing studies, still in the planning stage, will determine if any operational parameters related to the use of the RAMP Anthrax Test Cartridge in the field would affect the analytical performance of the assay.

In studies designed by AOAC scientists and implemented at U.S. Army Dugway Proving Grounds in Utah, the RAMP was demonstrated to reliably detect *Bacillus anthracis* isolates representing a wide variety of geographic sources and physical variants. The specificity of the RAMP was also demonstrated in evaluations to confirm that it would not cross react with non-*Bacillus anthracis* bacteria. To judge the accuracy of the data generated, AOAC organized 12 laboratories nationwide to assess the RAMP's performance using identical samples. The RAMP test performed well in the collaborative study, and little variation was seen in the data produced by the 12 laboratories.

> **"The cooperation of many federal agencies, the biodetector industry, the academic and the first responder communities—all working in concert with AOAC—was critical in executing this project."**
>
> **—James Bradford, AOAC's Executive Director**

MIDI Sherlock Microbial Identification System

The second method approved in November by AOAC is a laboratory-only method, commonly referred to as MIDI Sherlock Microbial Identification System, which includes the MIDI BIOTER database version 2.0. The MIDI method was subjected to exhaustive testing of many strains of *B. anthracis* and of related strains to determine its ability to differentiate among them. The 11 laboratories involved in the study reported an acceptable overall sensitivity for *B. anthracis* identification of 96.3%. ■

For more information, contact James Bradford at jbradford@aoac.org or +1-301-924-7077 ext. 102.

[5] Association of Analytical Communities, Newsletter November / December 2004, http://www.aoac.org/DHS_release.pdf, Retrieved August 15, 2007

EXERCISE MODULE 1 UNIT 2
HANDS-ON WITH AIR MONITORS

Time Allotted: 60 minutes

Equipment needed:
(2) 4 gas air monitors
P.I.D.
pH paper
Calibration gas

Supplies needed:
Acetone
Acetic acid (vinegar)
Hydrochloric acid (The Works toilet bowl cleaner)
Ammonia (window cleaner)
4 small containers with lids or covers
Calibration gas

Methodology: The instructor will give you a scenario that is based on the student performance objectives in this unit.

NOTES:

Module 1 Unit 2
Unit Quiz

1. The alarm level for an oxygen deficient atmosphere is…?
    a. 20.9%
    b. 15%
    c. 19.5%
    d. 23.5%

2. The alarm level for an oxygen enriched atmosphere is…?
    a. 20.9%
    b. 15%
    c. 19.5%
    d. 23.5%

3. The alarm level for the IDLH level of a flammable vapor or gas is…?
    a. 10% of the product in the air
    b. 10% of the product's L.E.L
    c. 10% of the product's U.E.L.
    d. 10% of the product's flash point

4. When in contact with acidic vapors, pH paper turns…?
    a. Green
    b. Blue
    c. Gray
    d. Red

5. If a monitor is tested and certified for Class II Division 1 atmospheres it is considered…?
    a. Intrinsically safe
    b. Inherently sound
    c. Inevitably sad
    d. Explosion resistant

6. Low oxygen levels can cause…?
    a. Low oxygen readings on an air monitor
    b. Incorrect readings on an LEL sensor
    c. High CO readings
    d. Both a and b are correct

7. In order for a PID to detect a substance its lamps I.P. must be…?
    a. More then the products I.P.
    b. Less then the products I.P.
    c. The same as a products I.P.
    d. 10.7 e.v.

8. M-8 and M-9 detect?
    a. Products of combustion
    b. Chemical warfare agents
    c. Alpha and Beta only
    d. Hydrocarbons only

9. The LEL reading on an air monitor is accurate for all combustible gasses.
    a. True
    b. False

10. As you monitor an area around and unknown product you get no color change to the pH paper, the oxygen level drops from 20.9 to 20.8 and your LEL is reading 2%. This would lead you to identify the product as…?
    a. An oxydizer
    b. A corrosive
    c. A flammable
    d. Acetone

Module 1
Unit 3

Module 1

Unit 3 - The Incident Command System

Scope of Unit

The purpose of this lesson is to review the use of the Incident Command System (ICS) at a HazMat incident.

Learning Objectives

At the end of this unit of training each student will demonstrate the ability to function in an assigned role of the ICS.

Student Performance Objectives

- List the 10 OSHA procedures for handling the emergency response.
- List the 8 positions of the HazMat branch.
- Properly complete the checklist of each position in the HazMat branch.
- Properly complete ICS 200 forms.
- Must be able to successfully complete competency evaluation 004.

Resource List

- Ohio HAZMAT / WMD Technician Manual
- HazMat branch forms
- ICS-200 forms
- Pen / Pencil
- Scratch paper for notes

References

- OSHA 1910.120

The Incident Command System

The HazMat technician must be able to function within an assigned role in the incident command system (ICS). Incident command was taught in the Awareness course and refreshed in the Operations training. In this unit we will focus on the typical assigned roles in a HazMat/WMD incident.

Under OSHA 1910.120(q)(3) the following 10 items are required to be addressed at each HazMat incident.:

> **(q)(3)** Procedures for handling emergency response.
>
> **(q)(3)(i)** The senior emergency response official responding to an emergency shall become the individual in charge of a site-specific Incident Command System (ICS). All emergency responders and their communications shall be coordinated and controlled through the individual in charge of the ICS assisted by the senior official present for each employer.
>
> NOTE TO (q)(3)(i). - The "senior official" at an emergency response is the most senior official on the site who has the responsibility for controlling the operations at the site. Initially it is the senior officer on the first-due piece of responding emergency apparatus to arrive on the incident scene. As more senior officers arrive (i.e. , battalion chief, fire chief, state law enforcement official, site coordinator, etc.) the position is passed up the line of authority which has been previously established.
>
> **(q)(3)(ii)** The individual in charge of the ICS shall identify, to the extent possible, all hazardous substances or conditions present and shall address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance handling procedures, and use of any new technologies.
>
> **(q)(3)(iii)** Based on the hazardous substances and/or conditions present, the individual in charge of the ICS shall implement appropriate emergency operations, and assure that the personal protective equipment worn is appropriate for the hazards to be encountered. However, personal protective equipment shall meet, at a minimum, the criteria contained in 29 CFR 1910.156(e) when worn while performing fire fighting operations beyond the incipient stage for any incident.

(q)(3)(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.

(q)(3)(v) The individual in charge of the ICS shall limit the number of emergency response personnel at the emergency site, in those areas of potential or actual exposure to incident or site hazards, to those who are actively performing emergency operations. However, operations in hazardous areas shall be performed using the buddy system in groups of two or more.

(q)(3)(vi) Back-up personnel shall be standing by with equipment ready to provide assistance or rescue. Qualified basic life support personnel, as a minimum, shall also be standing by with medical equipment and transportation capability.

(q)(3)(vii) The individual in charge of the ICS shall designate a safety officer, who is knowledgeable in the operations being implemented at the emergency response site, with specific responsibility to identify and evaluate hazards and to provide direction with respect to the safety of operations for the emergency at hand.

(q)(3)(viii) When activities are judged by the safety officer to be an IDLH and/or to involve an imminent danger condition, the safety officer shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be taken to correct these hazards at the emergency scene.

(q)(3)(ix) After emergency operations have terminated, the individual in charge of the ICS shall implement appropriate decontamination procedures.

(q)(3)(x) When deemed necessary for meeting the tasks at hand, approved self-contained compressed air breathing apparatus may be used with approved cylinders from other approved self-contained compressed air breathing apparatus provided that such cylinders are of the same capacity and pressure rating. All compressed air cylinders used with self-contained breathing apparatus shall meet U.S. Department of Transportation and National Institute for Occupational Safety and Health criteria.

Incident Command Positions

The technician should be familiar with the ICS/NIMS process. In this section we will concentrate on the positions within the HazMat branch.

HazMat Branch Officer – The person designated by the incident commander to head the HazMat branch. He/she will be responsible for all of the operations of the HazMat branch.

Research Officer – The individual or leader of the group who is responsible for gathering the information on the chemical properties of the product, the container involved and the environment effected by the release.

HazMat Medical Officer – The individual or leader of the group who is responsible for the health of the entry and back-up team members.

Lead Tender Timer – The individual responsible for the proper dress-out of the entry and back-up teams.

HazMat Safety Officer – The individual or leader of the group working directly under the incident safety officer to maintain health and safety in the HazMat branch. Under OSHA this person must be knowledgeable in HazMat operations. The HazMat safety officer is responsible to develop the OSHA site safety plan.

Entry Team member – A HazMat technician assigned to don proper personal protective equipment and enter the hot zone to perform a given task.

Back-up Team member – A HazMat technician assigned to don proper personal protective equipment and assist the entry team and/or rescue a downed entry team member.

Decon Officer – The individual or leader of the group responsible for the set-up and staffing of the decontamination area.

Checklists can assist any member in better performing their assigned role. For use in this course checklists for all of the above roles have been included. Technicians should become familiar with their own team's forms and response positions.

Incident Specific Health and Safety Planning

Federal law, along with good safety practices, requires that the IC prepare a site-specific health and safety plan for complex or long term responses. The plan may be a fill-in-the-blank form, such as the ICS-200 forms, or a more customized document. Either format may be used as long as all the information required to protect personnel is provided. Incident command forms are also part of this plan.

Preliminary Evaluation - A preliminary evaluation must be performed to determine the health and safety hazards that may immediately impact the operation. This evaluation must be done rapidly during the initial stages of the emergency response. The initial evaluation must obtain information to determine the health and safety issues. The decision to send an entry crew into a chemical-release area should be made based on employee health and safety. After site entry has occurred, a more thorough evaluation may be possible.

The preliminary evaluation should determine:

- Incident nature and location;
- Task hazard analysis;
- Duration of planned activities;
- Site accessibility;
- Amount of chemical present and its spill potential;
- Physical and chemical health hazards present;
- Chemical nature, characteristics, and toxicological properties;
- Dispersion pathways;
- PPE requirements;
- Monitoring requirements;
- Exposed populations;
- Other chemicals in the area and the potential for their release;
- Potential for fire or explosion;
- Weather forecasts; and,
- Facility records.

Incident Safety Plan (ISP) - The safety and security of response personnel and others in the area of an emergency response should be of primary concern to the IC. A comprehensive ISP should include the following:

- Health and safety hazards - The plan shall address all site hazards for each phase of operation and include requirements and procedures for employee protection.
- Chemical hazards:
  - Type of chemical: corrosives, solvents, pesticides, radioactive materials, explosives, etc.;

- PELs, odor threshold, etc.;
- Acute and chronic symptoms, adverse health effects, and modes of entry into the body; and,
- Flammability, reactivity, and other important physical characteristics.

- Physical hazards.
- Electrical hazards: Power lines, extension cords, power tools, etc.
- Water hazards: Employees working over or near water where danger of drowning exists shall be provided with USCG-approved lifejackets or buoyant work vests. These vests must be inspected prior to each use. Ring buoys with at least 90 feet of line shall be provided and readily available in the work area. At least one lifesaving skiff shall be immediately available (29 CFR, Part 1926.106).
- Heavy equipment: Personnel should always stay out of the area where heavy equipment is being operated. Always make eye contact with the operator before approaching the equipment.
- Excavation: The depth, soil type, and weather conditions are major factors to consider for excavation safety. All trenches should be backfilled as soon as possible. Personnel should be kept a distance from open trenches equal to the angle of repose. (This last statement is a recommendation from OSHA, not a law.) The need for sloping and/or shoring is to be determined by a "competent person" per OSHA requirements.
- Slips, trips, and falls: These are the major causes of injuries.
- Structural stability of buildings: Some operations require personnel to enter buildings or buildings that have been involved in explosions or fires. If there is any doubt at all as to the structural integrity of a building, structural engineers should be consulted.
- Environmental hazards.
- Heat/cold stress: The plan should state how these problems would be dealt with (frequent breaks, health monitoring, crew changes, etc.)
- Weather: This can be a major factor in hazardous waste site operations. At the approach of any electrical storm, all outside site activities should cease. Snow, dust, and rain could make sites too dangerous to work. Extreme changes in temperature can have adverse effects on vapor concentration levels that invalidate previous air-monitoring data.
- A site map or sketch - A map or sketch of the response operations and area should be drawn or prepared. The map can be used for planning purposes and to document the setup and staging areas for resources. The following should be depicted on the map:
  - Hot, warm, and cold zones;

- Equipment-staging areas;
- Personnel deployment;
- Safety equipment locations/deluge showers; and,
- Command-post location.

- Use of the buddy system - All response operations that involve entry into contaminated areas must be conducted in groups of two or more people.
- Site communications - On-site and off-site communications systems designated in the site-safety plan must be implemented prior to site entry.
- Command post - The designation of the command post should be identified on the site map and in the ISP. A primary and secondary location may be addressed in the ERP.
- Personnel Protective Equipment (PPE) - The level of protection required for each task should be detailed. This includes the type of respiratory protection and clothing. The specific types of garments, gloves, etc. and their permeation rates should be recorded. The guidelines for either upgrading or downgrading the various levels of protection should also be addressed. Guidelines for upgrading and downgrading levels of protection include:
  - New information indicating the situation is more or less hazardous than was originally thought;
  - Changes in site conditions that could increase/decease the hazard;
  - Changes in work tasks; and
  - PPE dress-out procedures may be developed as part of the ERP SOPs. Any modification to these SOPs based on site-specific conditions should be documented and approved by the site-safety officer.
- Decontamination procedures - Detailed decontamination procedures should be listed in the ERP SOPs for both personnel and equipment. This should include specific procedures for setup, doffing procedures, washing and/or shower requirements, etc.
- Emergency decontamination/medical decontamination procedures should also be addressed. Any changes to the decontamination plan developed in the ERP should be documented in the ISP.
- Emergency response procedures - The ISP should explain the procedures to be followed in the event of emergencies at the site. Emergencies may include fire, explosions, gas releases, spills, or medical problems. The ERP should already include this information as SOPs and does not have to be repeated if the procedures are in place. The following should be planned:
  - Actions to take in the event of a fire, explosions, or spills;

    - Emergency medical response and equipment;
    - Emergency signals;
    - Emergency evacuation procedures and refuge points;
    - Emergency equipment; and,
    - Security.
- Air monitoring - The frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used are to be addressed in this section of the ISP. Also document the methods of maintenance and calibration of the air-monitoring instruments to ensure the reliability of monitoring. The locations where air-monitoring data is collected should be documented. The site-safety officer and IC must have access to this information. Airborne contaminants are a major threat to all workers, both on site and in the support areas. Identification and quantification of these contaminants are essential. This data will provide information to assist in:
    - Selecting the proper PPE;
    - Establishing and modifying the extent of the work;
    - Determining the potential health hazards and future monitoring requirements; and,
    - Determining the need for special medical-monitoring requirements.
- Medical assistance and triage area – Plan in advance for an area to evacuate personnel to in the event of an emergency. Additionally, the employer must provide a medical examination as soon as possible upon notification that:
    - An employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards; and,
    - An unprotected employee has been exposed in an emergency situation.

Module 1 Unit 3
Unit Quiz

1. The position responsible for the HazMat branch is…?
   a. HazMat branch officer
   b. HazMat section leader
   c. HazMat group supervisor
   d. HazMat support leader

2. 29 CFR 1910.120(q) states that there are three things the safety officer should do when an activity is judged to be IDLH. They are…?
   a. Stop, drop and roll
   b. Terminate, stop and cease the activity
   c. Alter, suspend or terminate the activity
   d. First notify the I.C.

3. If an emergency change is made to an activity by the safety officer, their next move is to….?
   a. Report to the HazMat branch officer
   b. Reassign the project
   c. Reassign the position
   d. Notify the I.C.

4. The position responsible for the proper dress-out of the entry and back-up teams is the…?
   a. Lead tender timer
   b. Dress-out officer
   c. Fashion specialist
   d. Permeation officer

5. The document that is prepared for site specific health and safety is the…?
   a. National Contingency Plan (NCP)
   b. Joint Information Plan (JIP)
   c. Incident Safety Plan (ISP)
   d. Incident Control Plan (ICP)

6. The position responsible for gathering information on the chemical properties of a product is the…?
   a. Information officer
   b. Research officer
   c. Delta team leader
   d. HazMat safety officer

7. Who is responsible for the set-up and staffing of the decontamination area?
    a. Decon officer
    b. Decon coordinator
    c. Back-up team member
    d. Lead tender timer

8. Scene safety is primarily the responsibility of…?
    a. Everyone
    b. HazMat safety officer
    c. Scene safety officer
    d. PIO

9. Which item below would not normally be found on a site map?
    a. The command post location
    b. Hot zone
    c. Decontamination zone
    d. Suit compatibility

10. Which is/are the major cause(s) of injuries on HazMat incidents?
    a. Thermal stress
    b. Suit incompatibility
    c. Slip, trips and falls
    d. Heat cramps

HazMat Branch Officer Checklist

___ Obtain briefing from incident commander

___ Brief team

___ Make sure zones are set up

___ Determine if this is a working incident

→ If yes, notify local EMA, EPA and Health departments

___ Determine level of PPE for entry, back-up and decon

___ Determine decon needs

___ Identify and evaluate hazards and possible solutions

___ Determine entry goals
(See HAZMAT GOALS AND OBJECTIVES sheet for options)

___ Assemble needed equipment

PRIOR TO ANY ENTRY

___ Brief entry team

___ Confirm decon is ready

___ Review emergency hand signals

___ Review emergency evacuation signals

AFTER COMPLETION

___ Get report information

___ Replace equipment

___ Debrief and critique

RESEARCH OFFICER DATA SHEET

Name of research officer ____

Date____________ Time___ ___Address__________________________________

Given name of chemical____

synonyms____

____

____Contact local **Poison control** at ???-???? and give basic details.

____Contact **PUCO** at (614) 644 5479 if this is a "transportation" incident

DOT UN # ___________ Hazard class _______ CAS # _________-________-______

NFPA 704 Health ______ Flammability ______ Reactivity _______ SP ______

Quantity involved__________________Amount released____________________

I Physical Properties		source pg
Normal Physical State	solid liquid gas	__________
Vapor density	__________________	__________
Specific gravity	__________________	__________
Solubility	__________________	__________
Boiling Point	__________________	__________
Melting/freezing point	__________________	__________
Vapor pressure	__________________	__________
other	__________________	__________

II Toxic Properties

source pg

Inhalation Hazard yes no ________

Ingestion Hazard yes no ________

Absorption Hazard skin: yes no ________

eyes: yes no ________

IDLH ______________ ________

Signs and symptoms ______________________________

____

____

III Flammability Properties

source pg

Flash Point ______________ ________

Autoignition Temp ______________ ________

LEL/LFL ______________ ________

UEL/UFL ______________ ________

Toxic bi-products... ______________________________

____

notes ______________________________________

____

IV Reactivity Properties

source pg

Water Reactive yes no ________

Product reacts violently with...______________________________

____

V Corrosive Properties source pg

ph_____ acid base __________

Neutralizing Agents____

____

VI Radioactive Properties source pg

Alpha _________________ __________

Beta _________________ __________

Gamma _________________ __________

Type of release gas liquid solid

Product is releasing into the air water ground

Recommended level of initial entry Level A Level B

Level A w/flash Level B w/firegear Other

Hot zone____

____

Warm zone____

____

Cold zone____

____

Actions taken____

____

MEDICAL EVALUATION SHEET

Technician's Name ____Age _____

Incident Location ____

Date___/___/_____Function_______________________________

Initial Evaluation	Post Evaluation
Time _____:_____	Time _____:_____
B/P _____/_____	B/P _____/_____
Rate ___________	Rate ___________
Respirations ___________	Respirations ___________
EKG Yes No	EKG Yes No
Recent Illnesses Yes No If yes discuss with safety officer	Chemical(s) involved __________ ______________________________ ______________________________ ______________________________
Comments ___________________ ______________________________ ______________________________ ______________________________	Possible Contamination None Slight Heavy
Approval for entry Yes No	Area Contaminated _____________
Name of evaluator ______________________________	Was member Tx. Yes No
	To? ___________________________
	Name of evaluator _______________________________

Entry Team Lead Tender Timer

Name____

Incident Location____

Date__/__/__ Time_______ Incident #_____________

Chemicals____

____

Level of Dress-out _________________________

Suit Type _______________________________ Break-thru time ______

Glove Type ______________________________ Break-thru time ______

WORK TIME

Minimum SCBA pressure______ X 1 minute p/100 lbs =______Mins.

minus safety time of 5 minutes. - 5 Mins.

Maximum time in suit. =______Mins.

minus estimated decon time. -______Mins.

Maximum time in hot zone. =______Mins.

minus travel time from work area to decon area. -______Mins.

Maximum work time, "on air" to exiting work area=______Mins.

Time On Air ____:____ Time To exit work Area ____:____

Entry/Back-up Team

Suit no.	Name	Tender	Work Time	On air Time/pres.	Off air Time/pres.

Decon Team Leader Checklist

Name of decon tech______________________

Names of personnel assigned for decon per the I.C.

______________________ ____________________ _____________________

______________________ ____________________ _____________________

1-5 gal bucket w/soap	3 trashcans w/liners	Visqueen
2 Decon Decks w/bladders	2 scrub brushes	2 hoses w/wands
Manifold	Lights(optional)	Tarp (optional)
duct tape (optional)		

___ Confirm type and extent of decon with HazMat branch officer

___ Confirm selected decon area (upwind, uphill, flat surface)

___ Light area if at night

___ Place canvas tarps down if on rough ground (gravel)

___ Lay out plastic minimum size 20' x 50'

___ Roll up sides and tape (optional)

___ Lay 1 1/2 hose from an engine attach decon manifold and 2 garden hoses

___ Place zoning tape around perimeter and mark entrance and exit

___ Place decon decks with bladders attached in position

___ Place 5 gal bucket with soapy water and brushes for washing

___ Review decon plan with HazMat branch officer

___ Confirm dress out level for decon personnel

___ Assign tenders and dress decon personnel as per dress-out procedures

Standard Decon Procedures

___ Exit hot zone and enter decon area

___ Leave all tools, equipment, and monitors at tool drop

___ One entry team member at a time

  ___Step onto decon deck, wash, scrub and rinse outer suit

  ___Step off decon deck

  ___Remove outer suit, boots and gloves while remaining on air

  ___Place outer suit and gloves in trashcan

  ___Step onto second decon deck

  ___Rinse inner suit

  ___Step off second decon deck

  ___Remove SCBA and inner suit and gloves

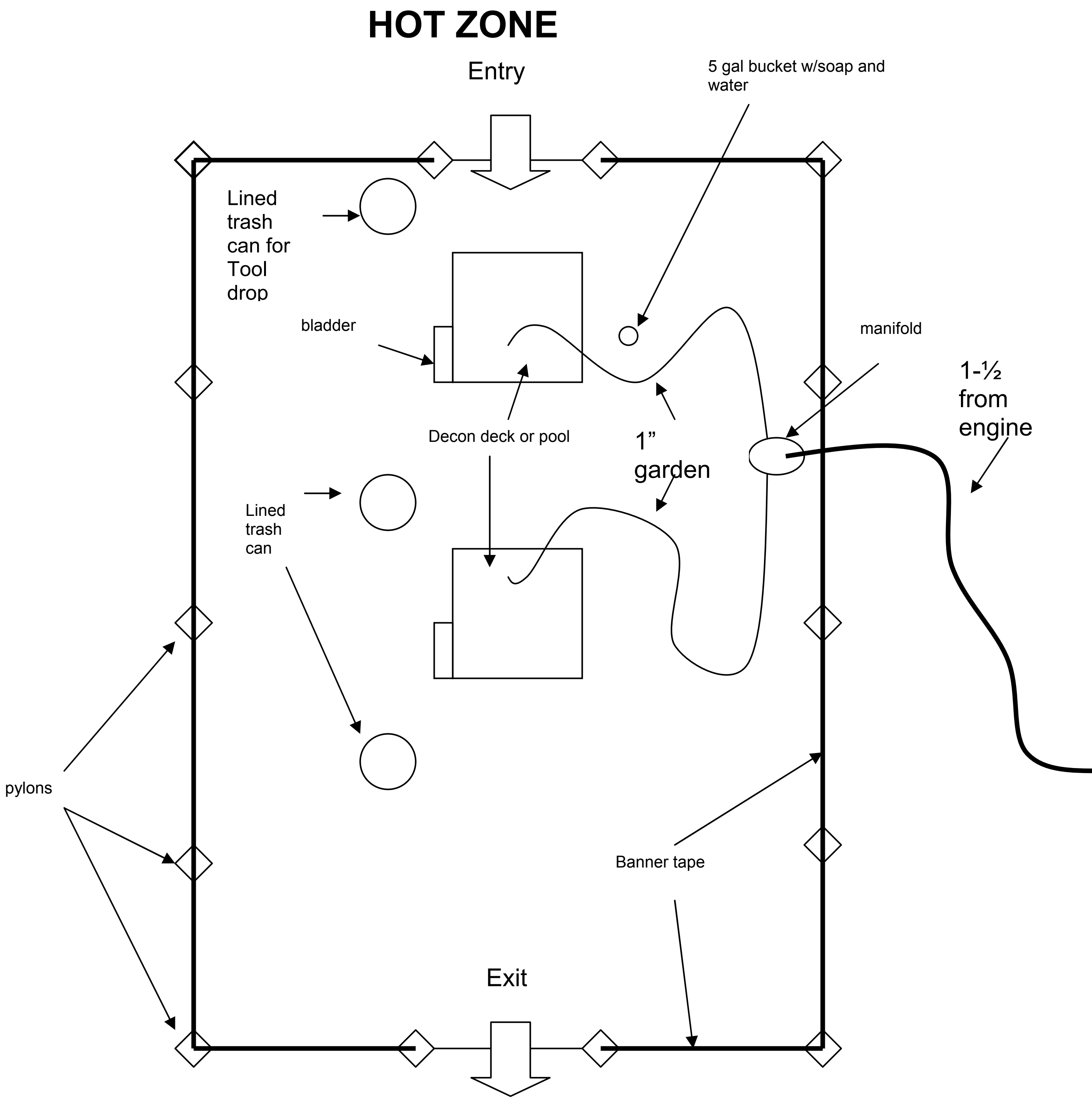
  ___Place inner suit and gloves in trashcan

___ Repeat above steps for each entry team member

___ Have decon team clean and/or wipe off all equipment

___ Rinse off decon team members prior to exit

Standard Decon Diagram



HazMat Safety Officer Checklist

CHECK LIST

___ Obtain briefing from incident commander

___ Assign safety assistants as needed

___ Identify and evaluate hazards

___ Alter, suspend or terminate any activity judged to be IDLH

___ Hot, warm & cold zone proper size?

___ Assess apparatus placement

___ Fill out site safety plan (ICS 208)

PRIOR TO ANY ENTRY

___ Chemical compatibility checked

___ Proper level of protection chosen

___ Decon properly set up

___ Review emergency hand signals

___ Review emergency evacuation signals

___ SCBA and suits properly donned. PASS devices activated.

___ Maintain LIst of all units within hot zone

SITE SAFETY AND CONTROL PLAN ICS 208 HM	1. Incident Name:	2. Date Prepared:	3. Operational Period: Time:

Section I. Site Information

4. Incident Location:

Section II. Organization

5. Incident Commander:	6. HM Group Supervisor:	7. Tech. Specialist - HM Reference:
8. Safety Officer:	9. Entry Leader:	10. Site Access Control Leader:
11. Asst. Safety Officer - HM:	12. Decontamination Leader:	13. Safe Refuge Area Mgr:
14. Environmental Health:	15.	16.

17. Entry Team: (Buddy System) Name:	PPE Level	18. Decontamination Element: Name:	PPE Level
Entry 1		Decon 1	
Entry 2		Decon 2	
Entry 3		Decon 3	
Entry 4		Decon 4	

Section III. Hazard/Risk Analysis

19. Material:	Container type	Qty.	Phys. State	pH	IDLH	F.P.	I.T.	V.P.	V.D.	S.G.	LEL	UEL

Comment:

Section IV. Hazard Monitoring

20. LEL Instrument(s):	21. O_2 Instrument(s):
22. Toxicity/PPM Instrument(s):	23. Radiological Instrument(s):

Comment:

Section V. Decontamination Procedures

24. Standard Decontamination Procedures:	YES:	NO:

Comment:

Section VI. Site Communications

25. Command Frequency:	26. Tactical Frequency:	27. Entry Frequency:

Section VII. Medical Assistance

28. Medical Monitoring:	YES:	NO:	29. Medical Treatment and Transport In-place:	YES:	NO:

Comment:

Section VIII. Site Map
30. Site Map:
Weather ❑ Command Post ❑ Zones ❑ Assembly Areas ❑ Escape Routes ❑ Other ❑

Section IX. Entry Objectives
31. Entry Objectives:

Section X. SOP S and Safe Work Practices		
32. Modifications to Documented SOP s or Work Practices:	YES:	NO:
Comment:		

Section XI. Emergency Procedures
33. Emergency Procedures:

Section XII. Safety Briefing	
34. Asst. Safety Officer - HM Signature:	Safety Briefing Completed (Time):
35. HM Group Supervisor Signature:	36. Incident Commander Signature:

ICS 208

INSTRUCTIONS FOR COMPLETING THE SITE SAFETY AND CONTROL PLAN
ICS 208 HM

A Site Safety and Control Plan must be completed by the Hazardous Materials Group Supervisor and reviewed by all within the Hazardous Materials Group prior to operations commencing within the Exclusion Zone.

Item Number	Item Title	Instructions
1.	Incident Name/Number	Print name and/or incident number.
2.	Date and Time	Enter date and time prepared.
3.	Operational Period	Enter the time interval for which the form applies.
4.	Incident Location	Enter the address and or map coordinates of the incident.
5 - 16.	Organization	Enter names of all individuals assigned to ICS positions. (Entries 5 & 8 mandatory). Use Boxes 15 and 16 for other functions: i.e. Medical Monitoring.
17 - 18.	Entry Team/Decon Element	Enter names and level of PPE of Entry & Decon personnel. (Entries 1 - 4 mandatory buddy system and back-up.)
19.	Material	Enter names and pertinent information of all known chemical products. Enter UNK if material is not known. Include any which apply to chemical properties. (Definitions: ph = Potential for Hydrogen (Corrosivity), IDLH = Immediately Dangerous to Life and Health, F.P. = Flash Point, I.T. = Ignition Temperature, V.P. = Vapor Pressure, V.D. = Vapor Density, S.G. = Specific Gravity, LEL = Lower Explosive Limit, UEL = Upper Explosive Limit)
20 - 23.	Hazard Monitoring	List the instruments which will be used to monitor for chemical.
24.	Decontamination Procedures	Check NO if modifications are made to standard decontamination procedures and make appropriate Comments including type of solutions.
25 - 27.	Site Communications	Enter the radio frequency(ies) which apply.
28 - 29.	Medical Assistance	Enter comments if NO is checked.
30.	Site Map	Sketch or attach a site map which defines all locations and layouts of operational zones. (Check boxes are mandatory to be identified.)
31.	Entry Objectives	List all objectives to be performed by the Entry Team in the Exclusion Zone and any parameters which will alter or stop entry operations.
32 - 33.	SOP s, Safe Work Practices, and Emergency Procedures	List in Comments if any modifications to SOP s and any emergency procedures which will be affected if an emergency occurs while personnel are within the Exclusion Zone.
34 - 36.	Safety Briefing	Have the appropriate individual place their signature in the box once the Site Safety and Control Plan is reviewed. Note the time in box 34 when the safety briefing has been completed.

Module 1
Unit 4

Module 1
Unit 4 - Personal Protective Equipment

Scope of Unit

The purpose of this lesson is to train the technician in selecting and using specialized chemical personal protective equipment (PPE).

Learning Objectives

At the end of this unit of training each student will demonstrate the ability to select and use specialized chemical protective equipment.

Student Performance Objectives

- Know the two major types of respiratory protection and the advantages and disadvantages of each type.
- List the 8 items that must be known in order to safely wear an air purifying respirator.
- List the 4 levels of chemical protective ensembles and give the advantages and disadvantages to each level. Given pictures or descriptions of each ensemble, correctly identify the EPA level.
- List the 3 terms that identify the chemical resistance of an ensemble.
- Identify the signs and symptoms of the 4 heat stresses.
- Correctly and proficiently don and doff Level A, Level B and Level C ensembles.
- Must be able to successfully complete competency evaluation 002, 003, 019 and 020.

Resource List

- Ohio HAZMAT / WMD Technician Manual
- Level A, Level B and Level C ensembles
- Dress-out checklists
- Pen / Pencil
- Scratch paper for notes

References

- The University of Findlay Technician Manual

Personal Protective Equipment

Technicians are required to properly select and use the specialized chemical personal protective equipment (PPE) provided to them by their employer. Your employer should provide you with PPE based upon the role that you will be expected to perform at an incident.

NOTE: The selection and use of PPE requires**:**

- Training;
- Medical evaluation; and,
- Fit testing.

No personnel should use any type of PPE unless they have been specifically trained in the selection, use, donning, doffing, emergency procedures and limitations of the PPE, and have participated in their employer's medical evaluation program.

This course will provide you with generic donning and doffing procedures; however, specific training for your own entities' ensembles is still required.

Specialized chemical PPE typically consists of an ensemble of some type of respiratory protection and a chemical protective suit. Although this information was introduced at the operations level, the technician needs to have a greater knowledge and understanding of PPE.

Respiratory Protection

There are two basic types of respiratory protection. The first type removes contaminants from the air and is therefore known as an "Air Purifying Respirator" (APR). The second type provides the wearer with a source of clean air under pressure and is known as a "Supplied Air Respirator" (SAR). There are several styles of each of these two basic types that we will detail below.

Full Face APR

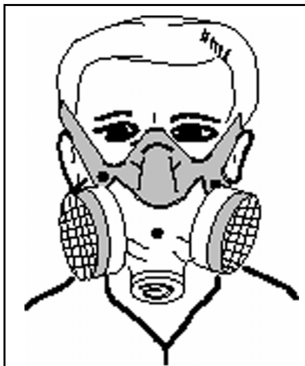
<u>Air Purifying Respirators (APRs)</u>

APRs are respirators with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element. An APR does not provide the wearer with oxygen.

Most APRs are classified as negative-pressure devices. During inhalation, the pressure inside the mask is lower than the outside atmospheric pressure, which then draws the air through the cartridges. Unfortunately, this also allows inward leakage of contamination, if the face-to-face-piece seal is broken.

Types of APRs:

Quarter-face respirators cover the nose and mouth; the lower sealing surface rests between the chin and the mouth. They do not provide protection for the eyes or the rest of the face. They are easily dislodged and are not recommended for use by first responder personnel.


Half Face APR

Half-face respirators cover the chin, mouth, and nose. They do not provide protection for the eyes or the rest of the face. These masks are widely used in industry and chemical cleanup operations. They have very limited use in first responder work.

Full-face respirators cover the whole face from the hairline to below the chin. They normally seal well and are hard to dislodge. They provide better protection than half-face APRs. These masks are widely used for chemical cleanup work and have limited application in emergency response.


Powered Air Purifying Respirator

Powered APRs (PAPRs) provide protection by supplying filtered air under a slightly positive pressure. These units will normally have a battery-operated pump. They are commonly used in the lead and asbestos abatement industry. Hooded PAPRs are widely used by hospitals in their emergency decontamination program.

Mouthpiece respirators consist of a mouthpiece held in the teeth (the wearer's lips seal around the mouthpiece) and a clamp that fits tightly over the nostrils to keep the nostrils closed. There is a cartridge mounted to the mouthpiece. This stile of respirator eliminates communications, may cause fatigue, and provides little if any protection for the face or eyes. These types of APRs are used as escape-only respirators.

Limitations of APRs

First responders rarely use APRs due to the many limitations that are placed upon them by the OSHA. The following items must be known before you can safely wear an APR:

Known contaminants: APRs cannot be used for vapors or gases unless the contaminants have been identified.

Known concentration: APRs cannot be used for vapors or gases unless the actual concentration of the contaminant in the hazard area is known.

Oxygen deficiency: APRs can be used only if the **oxygen content is greater than 19.5%.**

Immediately dangerous to life and health (IDLH) conditions: APRs cannot be used in IDLH atmospheres.

Carcinogens: APRs are not recommended for cleanup or emergencies involving known human carcinogens.

Organic vapors: Most APRs cartridges are not recommended for use if the total organic vapor concentration is above 1,000 ppm.

Reactivity: Some contaminants may react with the cartridge media and make the media ineffective.

Cartridge limitations: All cartridges have some use limits for the contaminant amount. The manufacturer sets maximum use limits for the specific cartridge and chemical involved. This data must be reviewed prior to wearing the APR.

Benefits of APRs

These respirators are relatively simple to use and maintain. There are no cylinders, pressure gauges, or airlines with which to contend. They allow the wearer a high degree of mobility. Personnel with a minimum amount of training and equipment can service APRs. APRs are relatively inexpensive.

Components of APR's

Cartridges and canisters: A respirator cartridge or canister is the filter or component that removes contaminants from the air. Canisters have a larger sorbent volume and may be chin-, front-, or back-mounted. They allow for a longer period of use prior to changing. Cartridges are slightly smaller and may be used as a single or in pairs, depending on the design and manufacture of the mask. Different cartridges and canisters are designed to remove different contaminants.

Mechanical filters: This type of filter element offers respiratory protection against airborne particulate matter including dusts, mists, metal fumes, and radon daughters. They do not provide protection against gases or vapors. The most efficient of these is a high-efficiency particulate air (HEPA) filter that is 99.97% efficient in removing particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

Chemical filters: These filters protect against various concentrations of certain gases and vapors by adsorbing or neutralizing them. Examples include filters for mercury, acid gases, and ammonia.

Combination filters: These are a combination mechanical filter and chemical filter to remove multiple contaminants, vapors, gases, and particulates.

Cartridge identification: A different color code or color striping system is used to identify the type of cartridge or canister based on the contaminants it is designed to eliminate.

Cartridge service life: The service life of a respirator cartridge depends on several factors, including cartridge design and exposure conditions. Cartridge design includes the quality and amount of chemical or mechanical filter agent, packing uniformity, and density. Manufacturers have quality-control programs to monitor these factors. Exposure conditions include contaminant concentration, breathing rate, temperature, and humidity. Accordingly, high concentrations, rapid breathing, and humid conditions will shorten the effective service life. NIOSH requires that cartridges resist breakthrough for at least 3 minutes at or below IDLH concentrations.

Cartridge replacement: APR cartridges will eventually become saturated and/or blocked. The user must recognize when this happens and immediately exit the hazard area to replace cartridges. End-of-service-life indicator (ESLI) is a system that warns the respirator user of the approach of the end of adequate respiratory protection; e.g., that the sorbent is approaching saturation or is no longer effective. The employer may set a time limit for the service life of a particular cartridge in a known environment. The time limit is established to ensure cartridges are replaced routinely. In accordance with 29 CFR, Part 1910.134(d)(3)(B)(2), employers must comply as follows:

> “If there is no ESLI appropriate for conditions in the employer’s workplace, the employer implements a change schedule for canisters and cartridges

that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life."

This data should include the type of contaminant, concentration of the contaminant, including the average and expected highest levels, and volume of air that will be breathed by the worker performing their assigned tasks. Difficulty in breathing is a sign a cartridge is getting overloaded or clogged. If specific symptoms of exposure occur or dizziness, nausea, or other generic symptoms occur, the worker should leave the work area, remove gear, and breathe fresh air. If an unusual odor, taste, or eye, nose, or throat irritation occurs, this is indication the cartridge is expended or the seal has been broken. In either event, the worker must leave the area. This is also known as "breakthrough".

Supplied Air Respirators (SAR)

SARs are respirators that supply the user with breathing air from a source independent of the ambient atmosphere.

SARs provide the highest level of respiratory protection. The respirators are available in different designs and can be categorized by the type of airflow supplied to the face piece or hood.

Pressure-demand respirators introduce air into the face piece only when the wearer creates a slightly negative pressure by inhalation but maintains a positive pressure in the face piece during both inhalation and exhalation. If a leak develops, such as a momentary break in the face-to-face piece seal, airflow will be outward.

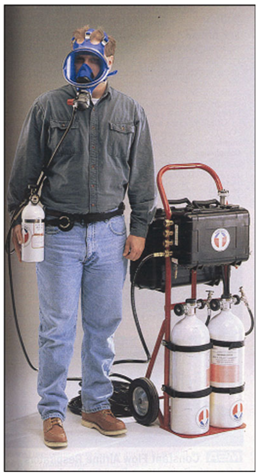
The two primary types of SARs are the self-contained breathing apparatus (SCBA) and line air with escape cylinder. Both systems consist of:

- Regulators to adjust high-pressure air to safe breathing pressures;
- Gauges to determine the remaining air volume;
- Masks or hoods to cover the face;
- Alarm systems to warn of low air;
- Hoses to deliver the air; and,
- Clean air supply.

A third type of SAR is the oxygen generation system.

Self-Contained Breathing Apparatus (SCBA) consists of an air tank mounted on a backpack. The wearer takes the air supply into the contaminated or oxygen-deficient area. These units will provide 30 to 60 minutes of air.

SCBAs provide the highest level of respiratory protection available and allow the wearer almost free movement over an unlimited area; however, they do have some limitations. SCBA limitations include their **weight**, they restrict movement, reduce efficiency, and cause fatigue, **work time**, usually limited to 20 to 40 minutes per bottle of air, **repairs**, only certified technicians can repair damaged or malfunctioning units and **cost**, they are costly to purchase and maintain.



Line Air with Escape Cylinder

Line Air with Escape Cylinder is a unit designed so that the wearer does not carry the air source into the work area. The wearer is connected to the air source by hoses. The unit consists of a full-face mask and a separate emergency-escape bottle. The air source is a bank of compressed breathing-air cylinders or an air compressor with a filtration system. Up to 300 feet of airline can be used with this system.

Line air units also provide the highest level of respiratory protection. Line air units have the benefit of being lighter in weight and offer longer work times than an SCBA. Their limitations include the restriction of 300' of airline and keeping track of that airline. They are equally as expensive and just as costly to maintain as an SCBA.

Oxygen Generation Units are systems that "scrub" out carbon dioxide from the user's exhaled air, supplement this air with oxygen and then allow the user to re-breathe it. They can provide work times up to 4 hours; however, they are not widely used for HazMat incidents since they produce heat in the "scrubbing" process.

Chemical Protective Clothing (CPC)

OSHA and the EPA established guidelines and terminology to address a PPE ensemble. The combination of gear worn (respiratory protection device and type of clothing) establishes the level of protection.

Protection level for all levels can be encapsulating (worn on the outside of the respiratory system) or non-encapsulating (worn underneath the respiratory system). PPE can be gas-tight (designed to provide resistance from gasses and vapors) or as simple as a rain suit designed to protect from a liquid splash. The seams can be sewn (which produces tiny holes for the product to penetrate), sewn and sealed with tape or even "welded" together. Zippers can be of simple plastic or may be of an exotic neoprene with splash covers.

Level D

CPC ensembles are divided into four categories, Level A, B, C, and D.

Level D – No or Limited Chemical Protective Clothing

Level D consists of minimum protection and is generally a work uniform used for nuisance contamination only. Level D protection should be used when the work area is characterized as having no airborne exposure and work functions preclude splashes or the potential for unexpected contact with hazardous levels of any chemicals.

Level C

Level C – Splash Protective Garment and APR

Level C ensembles consist of an Air Purifying Respirator (APR) and appropriate skin protection. Level C protection may be used whenever chemicals will not absorb into the skin sufficiently to cause a hazard from vapors, gases, liquid splashes, or particulates. They can be used only when the types of air contaminants have been identified, the concentrations are measured, and an air-purifying respirator is available that can remove the contaminants and all criteria for the use of air-purifying respirators are met.

Level C consist of an APR, splash suit, gloves and boots.

Level B – Splash Protective Garment and Supplied Air Respirator

Level B

Level B ensembles consist of a supplied air respirator and a liquid splash protection garment. It should be used when the type and atmospheric concentration of substances have been identified as requiring a high level of respiratory protection but the chemicals involved are not highly corrosive or injurious to the skin.

Level B is the minimum level of protection for an IDLH condition, and is the minimum level of protection to enter an unknown site during an emergency response. OSHA and EPA require a minimum of Level B if the atmosphere contains less than 19.5% oxygen, or if there is the presence of incompletely identified vapors or gases as indicated by a direct-reading organic vapor-detection instrument, but the vapors and gases are not suspected of containing high levels of chemicals capable of being absorbed through the skin.

Level B ensembles consist of an SAR, splash suit, inner and outer gloves and boots.

Level B ensembles are also available in encapsulating versions (The SCBA is worn inside the suit). This version has the advantage of protecting the respiratory equipment from being damaged from the chemical splash. The disadvantage of an encapsulating Level B is its bulkiness. This suit can be just as hard to work in as a Level A ensemble.

Level A – Vapor-Tight Garment and Supplied Air Respirator


Level A

Level A ensembles consist of a SAR (usually SCBA) in combination with a vapor-tight suit. Level A is the highest level of chemical protection. It should be used whenever the situation requires the best protection for skin, eyes, and the respiratory system. This includes operations that involve a high potential for splash, immersion, or exposure to vapors, gases, or particulates that are harmful to skin and/or can be absorbed through the skin.

Vapor-tight, chemical-protective suits shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape. You must also wear Level A when operations must be conducted in poorly ventilated areas with unknown conditions or chemicals present.

Level A ensembles consist of a vapor tight suit, inner and outer gloves, SAR, and boots.

CAUTION

Note: Combinations of PPE other than those described for Levels A, B, C, and D protection may be more appropriate for a specific hazard and may be used to provide the proper level of protection.

Combinations

Level B or C over SFPC

An excellent level of protection for many HazMat incidents is a Level B protective ensemble worn over Structural Firefighting Protective Clothing (SFPC). This combination gives a good protection from flammable products and a layer of splash protection to the expensive fire gear. The level is excellent for entering unknown atmospheres for recon activities. This combination can also be worn with an APR instead of an SAR to achieve Level C protection.

Selection of PPE

Choosing PPE is one of the most difficult decisions a HazMat technician can make. This decision should be based upon the likely route of entry of the chemical into the body, the signs and symptoms of any victims and if they are getting better or continuing to get worse (even after removal from the area and decontaminated), the degree of contact anticipated with the chemical, the specific task to be performed by the wearer and the anticipated duration of exposure. Very few chemicals produce vapors that can be quickly absorbed into the body and produce severe injury. The decision on what level of ensemble should be balanced against the physical hazards inherent to each suit. Technicians have a greater chance of slips, trips, and falls in Level A suits than in Level B. Level C would be the easiest of the three to work in.

OSHA says that prior to wearing PPE, **engineering controls** and **work practices** should be instituted to reduce exposure to the chemical. Engineering controls include ventilation, applying foam, remotely shutting valves, allowing a cylinder to empty and/or just delaying entry until the atmosphere is safer. Work practices includes; limiting personnel from the area, operating up wind and not kneeling in the products.

Chemical Resistance

The ability of a suit to withstand the nature of the work and the chemical or physical agent that it will contact is very important. The importance of performance factors in the selection process is based on the site conditions and activity of the wearer.

Chemical resistance is the ability of the garment to withstand the migration of a chemical through or around its material. Ideally, the chosen garment's material(s) must resist permeation, degradation, and penetration by the respective chemicals.

Permeation is a process by which a chemical passes into or through a protective film on a molecular level. In some cases, the permeated material appears unchanged to the human eye. Chemical permeation can be described in simple terms by comparing it to what happens to the helium in an inflated balloon after several hours. Although there are no holes or defects and the balloon is tightly sealed, the helium gradually goes through (permeates) the balloon's walls and escapes. In this simple example, we are using gas permeation, but the principle is the same with liquids passing through some type of film or coating by liquid permeation.

Permeation breakthrough time is the most common data used to assess a material's chemical compatibility. The rate of permeation is a function of several factors such as chemical concentration, material thickness, humidity, temperature, and pressure.

Most material testing is done with 100% chemical liquid or vapor contact over a measured time-period. The time it takes the chemical to permeate through the material is the breakthrough time. An acceptable material is one where the breakthrough time exceeds the expected period of garment use. However, temperature and pressure effects may enhance permeation and reduce the magnitude of this safety factor. For example, small increases in ambient temperature can significantly reduce breakthrough time and the protective barrier properties of a protective clothing material.

Degradation is a reduction in one or more physical properties of a glove or protective clothing due to contact with a chemical. Exposed products may get harder, stiffer and/or brittle, or they may get softer, weaker, and swell to several times their original size. Although degradation resistance testing alone is not enough, it is essential to worker safety.

Penetration is the flow of a chemical through zippers, stitched seams, pores, or imperfections in the material. In selecting chemical-resistant clothing, it is important to choose styles that are designed to resist penetration in these critical areas. Gloves and clothing that can be penetrated are designed only to prevent cuts, abrasions, thermal burns, and other similar hazards and are not suitable for use with hazardous chemicals.

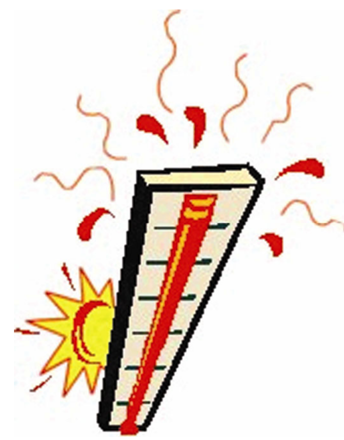
It is important to note that no material protects against all chemicals or combinations of chemicals, and that no currently available material is an effective barrier for any prolonged chemical exposure.

PPE Safety

As previously stated, it is important to understand that the use of PPE is not risk-free. There are certain risks associated with wearing any protective clothing ensemble. The greatest of these risks is heat stress.

Heat stress can cause serious medical problems, including heat rash, heat cramps, heat exhaustion and heat stroke. Personnel working in CPC should rehab frequently. Responders should know the symptoms of the two more serious forms of heat stress.

The symptoms of **heat exhaustion** include profuse sweating, cool clammy skin, fatigue, increased heart and respiratory rate, decreased blood pressure and sometimes a change in level of consciousness and/or nausea. Treatment for heat exhaustion includes: moving the victim to a cooler location, hydrating with water (by mouth if the patient is alert) and treating for shock.



The symptoms of heat stroke differ from heat exhaustion. **Heat stroke** can be rapidly fatal if not treated. In heat stroke, the body's temperature regulating mechanism has failed and the core temperature will be rising rapidly. The skin will be flushed, the respiratory and pulse rates will elevate, the blood pressure will be normal or increase, but the patient will not be producing any new sweat. If the victim was wearing PPE, their clothes may be wet with previous sweat inside the suit, but their skin will likely be dry. Treatment for heat stroke involves moving the patient to a cooler area, removing PPE and rapidly covering the patient's exposed skin with wet sheets or towels to allow evaporation. They should receive IV fluid replacement and be transported to the hospital.

The best idea is to prevent heat stress by drinking plenty of water, reducing work periods during high temperature or humidity, frequently rotating work crews and minimizing waiting time in PPE.

Cooling vests can also be used to reduce heat stress. Various types and manufacturers are available including:

- Air cooled;
- Ice cooled;
- Water cooled; and,
- Phase change cooling.

Certain factors can increase an individual's likelihood of developing heat stress injuries. These include:

- Age (older individuals tolerate heat less well than younger people);
- Physical condition (the better your physical condition the better you will tolerate heat);
- Medications (some prescription and non-prescription meds increase the likelihood of heat stress);
- Acclimation (those acclimated to the heat have less heat stress);
- Prior activities (prior emergencies or physical activity increase heat stress);
- Hydration (you must drink water to avoid heat stress, thirst is a poor indicator); and,
- Humidity (the higher the humidity, the more the heat stress).

Exercise Module 1 Unit 4
Hands-On Container Exercise

Time Allotted: 150 minutes

Equipment needed:
Lead tender timer checklist
Level A suits and dress-out checklists
Level B suits and dress-out checklists
Level B w/fire gear and dress out checklist
Air monitors

Supplies needed:
Dress out checklist and equipment
Acetone
Acetic acid (vinegar)
Hydrochloric acid (The Works toilet bowl cleaner)
Ammonia (window cleaner)
55 gallon drum with holes
Overpack drum
Patching kit
Physical exercise area and equipment

Methodology: The instructor will give you the scenario and you will have to work through solutions based on the information that you have learned in this unit.

NOTES:

Module 1 Unit 4
Unit Quiz

1. What are the two major types of respiratory protection?
    a. Gas mask and SCBA
    b. APR and SAR
    c. SCBA and in-line air
    d. SCUBA and SCBA

2. Which of the following is an advantage of using an SCBA?
    a. Unlimited air supply
    b. Lighter then in-line air
    c. Higher protection level then an APR
    d. Fire safety

3. Which of the following is one of the seven items that must be known before you wear an APR?
    a. Oxygen content of the atmosphere
    b. Name of chemical
    c. Cartridge limitations
    d. All of the above are one of the seven

4. Which one of the below is an advantage of a Level B ensemble over a Level A ensemble?
    a. Level B is easier to work in
    b. Level B is a higher level of protection
    c. Level B has better degradation properties
    d. Level B is usually hotter to wear

5. Which one of the below is an advantage of a Level C ensemble over a Level B ensemble?
    a. Level C will provide you with longer work times
    b. Level C provides you with hotter working conditions
    c. Level C is brighter in color
    d. Level C can be worn in oxygen deficient atmosphere

6. Break-thru time measures...?
    a. Permeation
    b. Degradation
    c. Penetration
    d. Detoxification

7. If the chemical is capably of actual dissolving the chemical suit…this is know as?
    a. Permeation
    b. Degradation
    c. Penetration
    d. Detoxification

8. Dry hot skin could be a sign for?
    a. The heartbreak of psoriasis
    b. Heat cramps
    c. Toxemia
    d. Heat Stroke

9. Glove compatibility is the direct responsibility of…?
    a. Incident Command
    b. Lead Tender Timer
    c. Decon Team Leader
    d. Research Officer

10. The highest level of respiratory protection and the highest level of skin protection describes…?
    a. Level A
    b. Level B
    c. Level C
    d. Level D

Tender/Timer Checklist Level "A"

Dressing Tarp	Stools	Cooling Vest	EMS gloves
1 Hr SCBAs	Duct tape		Flashlights
Chemical Boots	Level "A" suits		Tyvek suits
Radios	Personal effects bag		Towel

___ Suit compatibility checked with lead tender

___ Medical evaluations performed

___ Personal effects and fatigue shirt removed and secured

___ Put on cooling vest if needed

___ Tyvek suit donned

___ EMS gloves donned and taped

___ SCBA donned without mask

___ Towel and radio secured and on proper channel (channel _____)

___ Record cylinder psi and determine work-time with lead tender

___ Review emergency procedures, and monitoring guidelines

___ Confirm decon is set up and review decon procedures

___ Level "A" suit partially donned

___ Chemical boots donned

___ Review action plan with command

___ Don facepiece, put hood up on tyvek suit, don helmet and/or ear protection if needed

___ Turn on air for entry team, hook up facepiece, record time

___ Activate PASS device, seal suit, check zipper

___ Visually inspect suit and evaluate personnel, take flashlight

Tender/Timer Checklist Level "A" with flash protection

Dressing Tarp	Stools	Cooling Vest	EMS gloves
1 Hr SCBAs	Duct tape		Poly boots
Chemical Boots	Level "A" suits		Tyvek suits
Radios	Personal effects bag		Towel
Flash suits	Flashlights		

___ Suit compatibility checked with lead tender

___ Medical evaluations performed

___ Personal effects and fatigue shirt removed and secured

___ Cooling vest donned if needed

___ Tyvek suit donned

___ EMS gloves donned and taped

___ SCBA donned without mask

___ Towel and radio secured and on proper channel (channel _____)

___ Record cylinder psi and determine work-time with lead tender

___ Review emergency procedures, and monitoring guidelines

___ Confirm decon is set up and review decon procedures

___ Level "A" suit and flash suit partially donned,

___ Chemical and/or flash boots donned

___ Review action plan with command

___ Don facepiece, put hood up on Tyvek suit, don helmet and/or ear protection (if needed)

___ Turn on air for entry team, hook up facepiece, record time

___ Seal level "A" suit, check zipper, finish donning flash suit with gloves

___ Visually inspect suit and evaluate personnel

Tender/Timer Checklist Level "B"

Dressing Tarp	Stools	Cooling Vests	EMS gloves	1 Hr SCBAs
Duct tape	Flashlights	Chemical Boots		Level "B" suits
Tyvek suits	Radios	personal effects bag		Chemical gloves

___ Suit and glove compatibility checked with lead tender

___ Medical evaluations performed

___ Personal effects removed and secured

___ Tyvek suit partially donned

___ Put on cooling vest if needed

___ Level "B" suit partially donned, chemical boots donned

___ EMS gloves donned

___ Finish donning Tyvek suit

___ 2nd pair of EMS gloves donned and taped

___ Finish donning Level "B" suit

___ Silver shield gloves donned and taped

___ Chemical gloves donned

___ SCBA donned without mask

___ Record cylinder psi and determine work-time with lead tender

___ Radio secured and on proper channel (channel _____)

___ Review emergency procedures, and monitoring guidelines

___ Confirm decon is set up and review decon procedures

___ Review action plan with command

___ Don facepiece, put hoods up, don helmet and/or ear protection if needed

___ Turn on air for entry team, hook up facepiece, record time, visually inspect suit and evaluate personnel, activate PASS

Tender/Timer Checklist Level "B" with fire gear

Dressing Tarp	Stools	Cooling vests	EMS gloves
1 Hr SCBAs	Duct tape	Flashlights	Chemical Boots
Level "B" suits	Turn-out gear	Radios	Chemical gloves
Personal effects bag			

___ Suit and glove compatibility checked with lead tender

___ Medical evaluations performed

___ Personal effects removed and secured

___ Put on cooling vest if needed

___ Don full turn-outs including hood, (No FF gloves or boots).

___ Level "B" suit partially donned, chemical boots donned

___ EMS gloves donned

___ Finish donning level "B" suit

___ Silver shield gloves donned and taped

___ Nomex gloves donned

___ SCBA donned without mask

___ Record cylinder psi and determine work-time with lead tender

___ Radio secured and on proper channel (channel _____)

___ Review emergency procedures, and monitoring guidelines

___ Confirm decon is set up and review decon procedures

___ Review action plan with command

___ Don facepiece, put hoods up, don helmet and/or ear protection if needed

___ Turn on air for entry team, hook up facepiece, record time, visually inspect suit and evaluate personnel, activate PASS

Module 1
Unit 5

Module 1
Unit 5 - Hazard and Risk Assessment

Scope of Unit

The purpose of this lesson is to review the clues of hazardous materials recognition and identification. The technician must use these clues to perform hazard and risk assessment at an incident.

Learning Objectives

At the end of this unit of training each student will demonstrate the ability to conduct hazard and risk assessment.

Student Performance Objectives

- Survey a scene and list the 3 items of information that must be assessed on a HazMat incident.
- Correctly identify by name bulk and non-bulk containers, give examples of products found in the container, identify the materials that the container is typically made of and identify the pressure that each container is designed to safely contain/withstand.
- Assess a damaged container to determine its stressors, potential breaches, potential release event and dispersion pattern.
- Survey a scene and correctly identify the chemicals present.
- Use an MSDS to identify characteristics of a product.
- Understand the role of the environment on chemical spills and list the four areas of release.

Resource List

- Ohio HAZMAT / WMD Technician Manual
- Pen / Pencil
- Scratch paper for notes

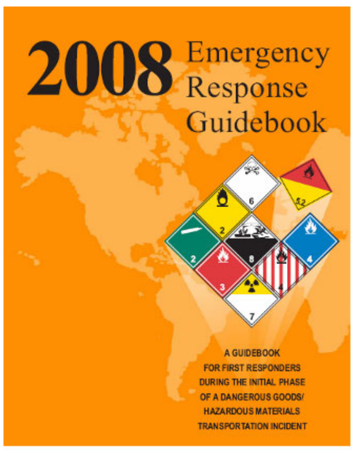
References

- The University of Findlay Technician Manual
- Product MSDSs

Hazard and Risk Assessment

As first responders at the Operations level, we are trained to conduct basic hazard and risk assessment at every HazMat/WMD response; we do this in two ways.

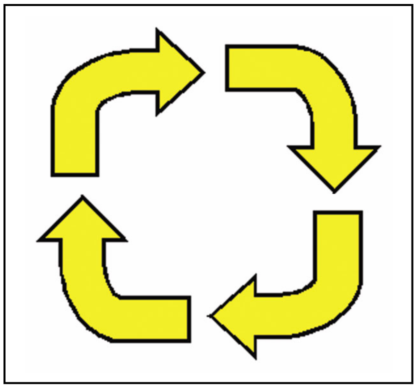
First, we gather information at the scene. This can be done by observing the incident for clues to the presence of HazMat or WMD, and/or by observing harm that is already occurring to victims, property and/or the environment. This is more commonly called **size-up,** scene assessment, or scene survey. Under NFPA's competencies this is known as "analyzing the incident".



Second, we gather information from technical resources. The Emergency Response Guidebook (ERG), Material Safety Data Sheets (MSDS), Computer Aided Management of Emergency Operations (CAMEO) database or CHEMTREC are examples of these resources. Resources can warn us about hazards, which are not so obvious, such as flammability, radioactivity, toxicity or the reactivity of the substance.

These methods of gathering information will help you determine the hazards presented by a specific situation, and ways to reduce the risks to you, the public and other responders.

At the Technician level this hazard and risk assessment process will continue in greater detail. Technicians need to spend additional time looking deeper into the hazards and assessing the incident from a more technical background. Operations level responders risk their lives to save "people, property, and the environment", technicians risk their lives to stop the release. Stopping the release is more for the protection of property and the environment than for life safety since all life safety should have been addressed by the first responder at the operations level.



Surveying the Scene

Three things need to be assessed and/or re-assessed as we further survey the scene: the container(s); the product(s); and, the environment. It is important to gather information on each of these.

We need to know what the **container** is made of, what pressure it is designed to withstand, if it has been damaged, if it is structurally sound, if it has relief devices, and how much it holds.

We want to know the **product's** chemical and physical properties, the hazards, and the routes of exposure, how much is there and how it will travel to other areas of the scene.

We want to know about the **environment** around the incident, including: weather conditions; topography; surrounding populations; conduits; exposures; and, other unique hazards such as booby traps and secondary devices

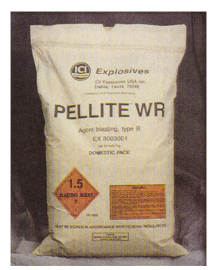
Containers

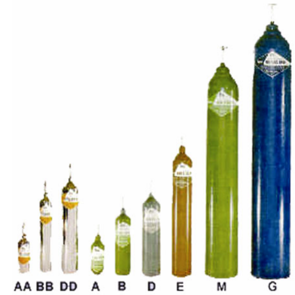
In the Awareness level training, we asked you to recognize HazMat container shapes and sizes. At the Operations level, we asked you to give examples of a product found in each type of container, and to demonstrate an understanding of the hazards commonly associated with that container. Now at the Technician level you should be able to identify basic design, construction features, and the valves used with specific types of containers. By consulting federal regulations (49 CFR parts 100 to 185) and design manuals, a technician can glean information about how certain specification packages are made. All of this information will help you to estimate the potential course and harm of the ongoing incident. It will assist you in providing the I.C. with an accurate damage assessment and determination of what might happen next.

Hazardous materials are found in all types and sizes of containers. In this course we will again discuss, but in greater detail, bulk and non-bulk containers. We will group these containers into non-pressure (less than 4 psi), low pressure (up to 25 psi), medium pressure (25 to 100 psi), and high pressure (over 100 psi).

Non-Bulk Containers

Non-bulk containers hold up to 119 gallons of solids, liquids or gases, and can be constructed of different types of materials. Non-bulk containers include:

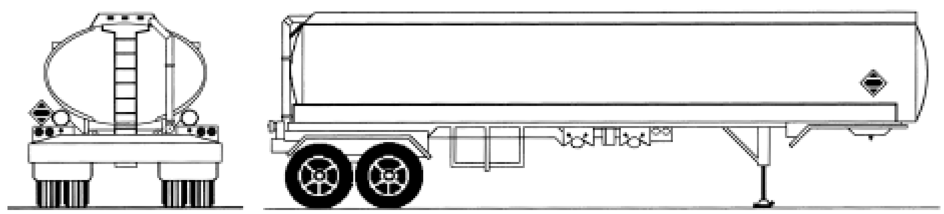
Drums	▪ Metal, fiberboard or plastic ▪ 8 – 95 gallons ▪ Drums can be used to transport many of the UN hazards classes ▪ Non-pressure container	
Pails	▪ Steel, fiberboard or poly materials ▪ 1-5 gallons of flammable liquids or solids, poisons, organic peroxides, oxidizers or ORM's ▪ Non-pressure container	
Bags or Sacks	▪ Paper or plastic ▪ Holds dry corrosives, blasting agents, explosives, flammable solids, oxidizers, organic peroxides, poisons or ORM's ▪ Non-pressure container	
Boxes or Crates	▪ Wooden or fiberboard ▪ Transports every hazard class except compressed gases ▪ Non-pressure container	

Carboys	▪ Plastic, metal or glass ▪ Usually transport corrosives ▪ Non-pressure container	
Cylinders	▪ Low, medium and high pressure ▪ Compressed gases, flammable or combustible liquids, poisons, radioactive materials or corrosives	
Bottles and Jars	▪ Plastic or glass ▪ Solvents, flammable liquids, poisons, oxidizers, corrosives ▪ Non-pressure container	
Dewars	▪ Specialty insulated container ▪ Stores cryogenic materials, liquid nitrogen, liquid oxygen, liquid helium, liquid argon ▪ Low and medium pressures	
Intermediate Bulk Containers (IBC)	▪ Also known as "totes" ▪ Poly, steel or aluminum containers which liquids, such as flammables, solvents, poisons and mild corrosives ▪ Non-pressure container	

Bulk Containers

Bulk containers hold more than 119 gallons of product and are used to transport and/or store large quantities of hazardous materials. These can be pressure or non-pressure containers. They can hold solids, liquids or gases and are used in highway transportation, rail transportation, marine transportation and for storage at a fixed site.

DOT 406/MC 306 Non Pressure Liquid Tank

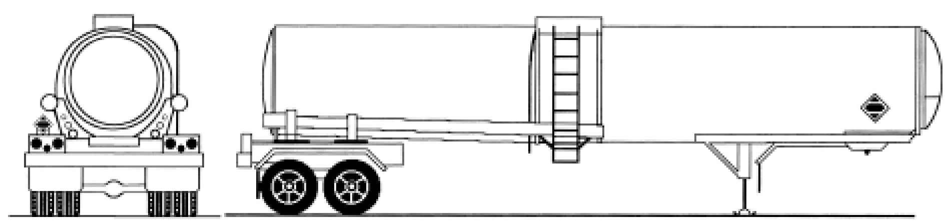


DOT 406/MC-306 ATMOSPHERIC PRESSURE TANK TRUCK
9,000 GALLONS CAPACTIY
GENERAL PURPOSE CARGO

OPS Pressure Less Than 3 PSI
Typical Maximum Capacity 9,000 Gallons
New Tanks Aluminum
Older Tanks Steel
Oval Shape/Multiple Compartments
Recessed Manholes/Rollover Protection
Bottom Valves
Will Likely have Vapor Recovery.

Gasoline
Fuel Oil
Alcohol
Other Flammable/Combustible Liquids
Liquids
Liquid Fuel Products
(In Non-Coded Tankers)

DOT 407/MC 307 Low Pressure Chemical Tank

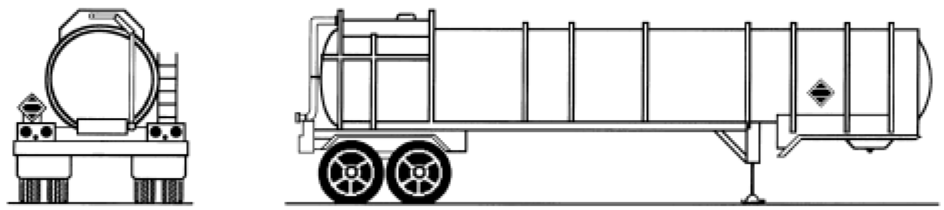


DOT 407/MC-307 LOW PRESSURE TANK TRUCK
6,000-7,000 GALLONS CAPACTIY
TRANSPORTS CHEMICALS, FLAMMABLE AND COMBUSTIBLE LIQUIDS

OPS @ 25-40 PSI
Typical Maximum Capacity 6,000 Gallons
May Be Rubber Lined/Steel
Single or Double Top Manhole
Single Outlet Discharge for Each
Compartment At Bottom (Midship Or Rear)
Typically Double Shell
Stiffening Rings
Rollover Protection
May Be Multiple Compartments
Horseshoe Or Round Shaped
Unit Pictured Is Insulated And Covered With Smooth Metal Skin
Tank Has Several Stiffing Rings

Flammable Liquids
Combustible Liquids
Acids
Caustics
Poisons

MC-312 Corrosive Liquid Tank

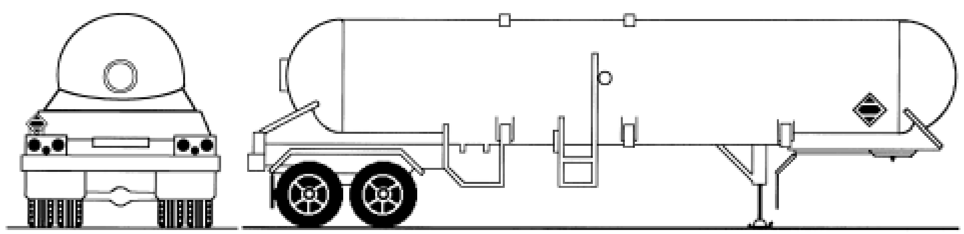


MC-312 CORROSIVE LIQUID TANK

OPS Pressure Less Than 75 PSI
Typical Maximum Capacity 6,000 Gallons
May Be Rubber Lined/Steel
Stiffening Rings And Rollover Protection
Splash Guard Provides Rollover Protection
Top Loading At Rear Or Center
Loading Area Typically Coated With Corrosive Resistant Material
Small Diameter For Length (Tube Shaped)
Typical Single Compartment

Corrosive Liquids
Typically Acids

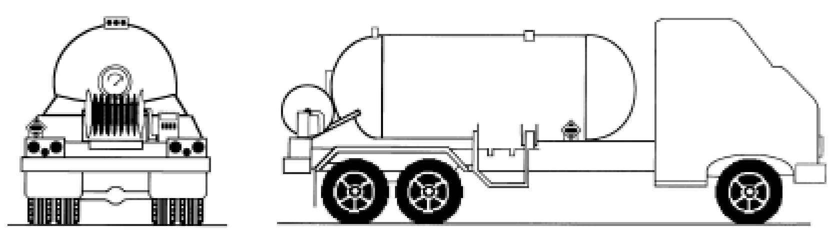
MC-331 High Pressure Tank



MC-331 HIGH PRESSURE TANK TRUCK
11,500 GALLONS CAPACITY
TRANSPORTS LP GAS AND ANHYDROUS AMMONIA

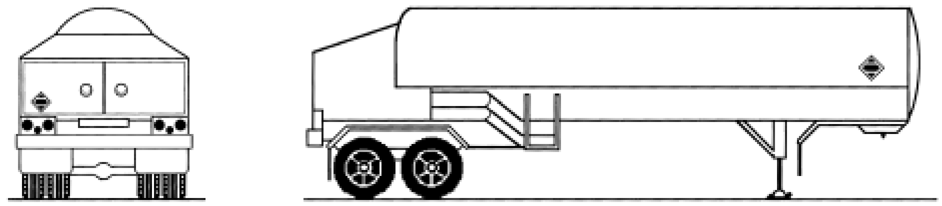
OPS Pressure UP To 300 PSI
Typical Maximum Capacity 11,500 Gallons
Single Steel Compartment/Non Insulated
Bolted Manhole At Front or Rear
Internal and Rear Outlet Valves
Typically Painted White Or Other Reflective Color
May Be Marked Flammable Gas and Compressed Gas
Round/Dome Shaped Ends

Pressurized Gases & Liquids
Anhydrous Ammonia
Propane
Butane
Other Gases That Have Been Liquefied Under Pressure



BOBTAIL TANK -- LOCAL DELIVERY OF LP GAS AND ANHYDROUS AMMONIA

MC-338 Cryogenic Liquid Tank

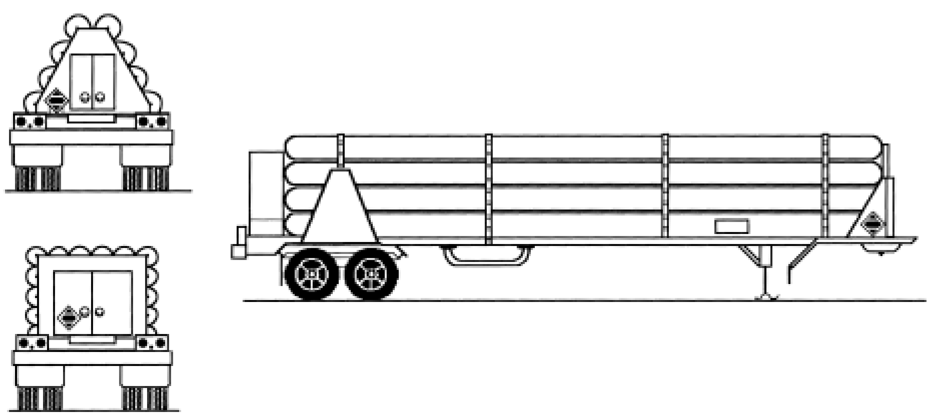


MC-338 CRYOGENIC LIQUID TANK TRUCK
WELL-INSULATED 'THERMOS BOTTLE' DESIGN
TRANSPORTS LIQUID NITROGEN, OXYGEN CARBON DIOXIDE, ETC.

OPS AT Less THAN 22 PSI
Well Insulated Thermos Bottle Like Steel Tank
May Have Vapor Discharging from Relief Valves
Loading/Unloading Valves Enclosed at Rear
May Be Marked "Refrigerated Liquid"
Round Tank with Same Type of Cabinet at Rear

Liquid Oxygen
Liquid Nitrogen
Liquid Carbon Dioxide
Liquid Hydrogen
Other Gases That Have Been Liquefied by Lowering Their Temperature

Compressed Gas/Tube Trailer

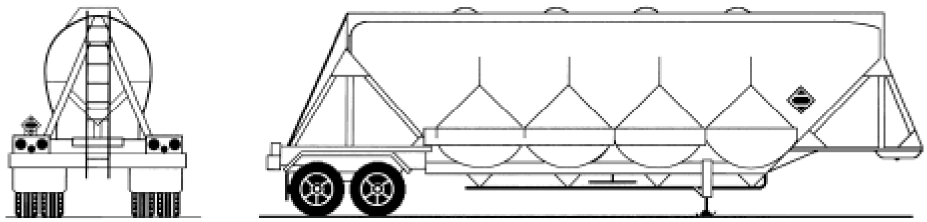


COMPRESSED GAS TRAILER
3,000-5,000 PSI
TRANSPORTS COMPRESSED GAS

OPS at 3,000-5,000 PSI (Gas Only)
Individual Steel Cylinders Stacked and Banded Together
Typically will have Over Pressure Device for each cylinder
Bolted Manhole At Front or Rear
Valving at Rear (Protected)
Manufacturer Name May Be on cylinders, i.e. AIRCO, Liquid Air, Liquid Carbonic, etc
Flat Truck with Multiple Cylinder Stacked in Modular or Nested Shape

Helium
Hydrogen
Methane
Oxygen
Other Gases

Dry Bulk Cargo Tanker



DRY BULK CARGO TANKER

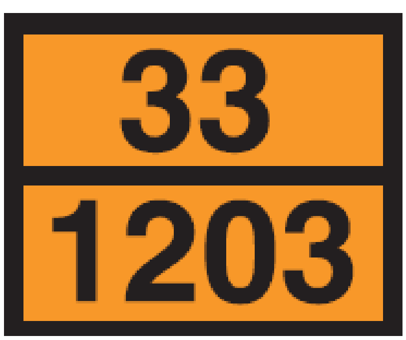
OPS AT Less THAN 22 PSI
Typically Not Under Pressure
Over the Road
Top Side Manholes
Bottom Valves/Air Assisted
Loading/Unloading
Shapes Vary, But Will Have Hoppers

Calcium Carbide
Oxidizers
Corrosive Solids
Cement
Plastic Pellets
Fertilizers

Intermodal Shipping Containers

Intermodal containers are used to ship products in multiple forms of transportation. They can be used for marine transportation, storage at the port, rail transportation to another city, storage in the rail yard, highway transportation to a fixed site and then fixed site storage and use at the facility, or any variation thereof.

Intermodal containers are often used for international shipments and may have marking in several languages. There is an international intermodal hazard marking system, in addition to UN numbers. This was discussed in the Awareness level training. You can review this system in the front of the ERG.



Non-pressure intermodal tanks – steel, aluminum or fiberglass (IM 101 and 102):

- Typically transports flammable solvents, mild corrosives and poison liquids;
- Cylindrical tank with round flat ends protected by a steel frame;
- Usually single compartment with one product; and,
- 2,000-6,340 gallon capacity.

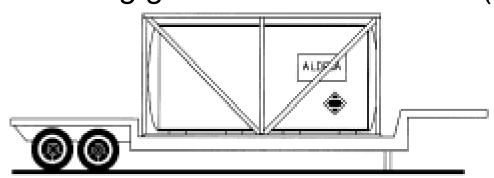
Intermodal box – steel:

- Transports all classes of hazardous materials, usually in smaller containers, such as 55 gallon drums, 5 gallon pails or fiberboard boxes; and’

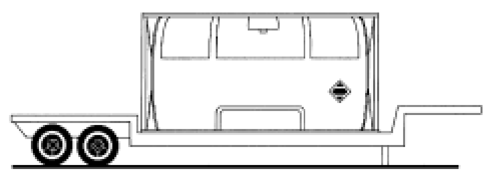
- Similar to a box trailer but without wheels. Doors are on one end.

Pressure intermodal tanks (Spec 51) (IMO type 5):
- Transports liquefied gases which are liquefied by pressure such as chlorine, anhydrous ammonia and propane;
- Rounded ends due to pressures of 100-500 psi;
- White or reflective color on upper two thirds to reflect radiant heat from sunlight; and,
- Most have pressure relief devices.

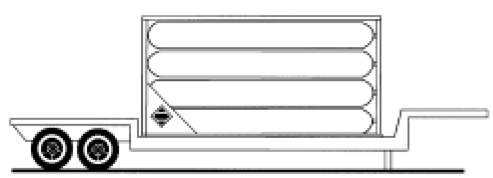
Specialized intermodal tanks are also available. These are similar in design to highway cargo tanks and transport cryogenic materials as refrigerated liquefied gases, or tube modules containing gases like tube trailers. (Spec 51)(IMO type 7)



NON-PRESSURE OR PRESSURE TANK



CRYOGENIC TANK



HIGH PRESSURE

Rail Containers

Rail tank cars have reporting marks. Reporting marks are located on the sides of the tank cars (left side as you view it) and indicate the owner of the car, as well as a unique number assigned to that rail tank car. When contacting the railroad or CHEMTREC, these reporting numbers can be very helpful in identifying the contents of the car, as well as where help may be sought in dealing with a release.

Many (but not all) hazardous material rail tank cars will also have the proper shipping name of the product "stenciled" onto the side of the car (right side as you view it). This is used on dedicated cars and can help you identify the material.

Specification markings (DOT and AAR) can help HazMat technicians and railroad personnel identify the construction and features of the tank cars. If these numbers can be safely obtained, they can provide much useful information.

a-3 -- class 105

dot 105j100w
thermal protection.
head protection.
safety valve (75 psi).

ethylene oxide
liquefied petroleum gas
liquefied hydrocarbon gas

dot 105j200w
thermal protection.
head protection.
safety valve (150 psi).

sulfur dioxide
vinyl chloride
liquefied petroleum gas

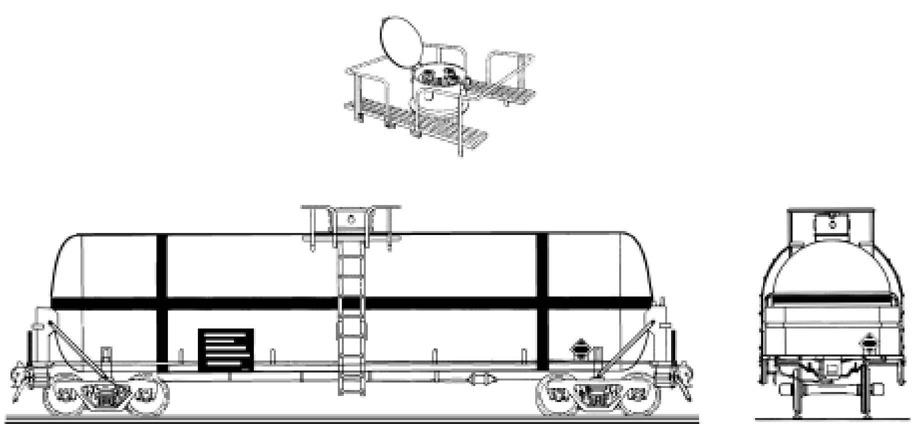
dot 105j300w
thermal protection.
head protection.
safety valves (225 psi).

anhydrous hydrofluoric acid
anhydrous ammonia
metallic sodium
chlorine
liquefied petroleum gas
liquefied hydrocarbon gas
motor fuel anti-knock compound
vinyl chloride

dot 105j400w
thermal protection.
head protection.
safety valves (300 psi).

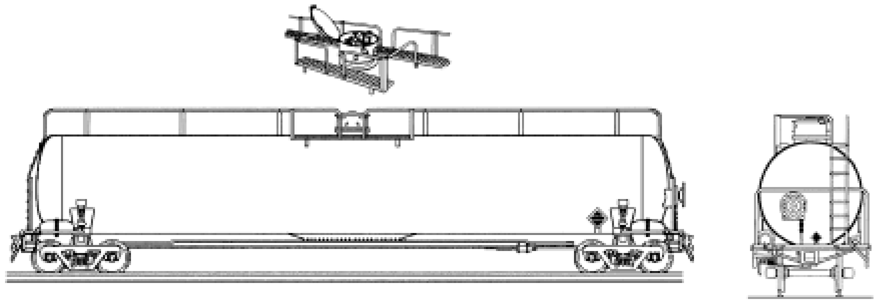
liquefied petroleum gas
liquefied hydrocarbon gas

dot 105a500w - hydrogen cyanide (hydrocyanic acid), hcn "candystripe car"



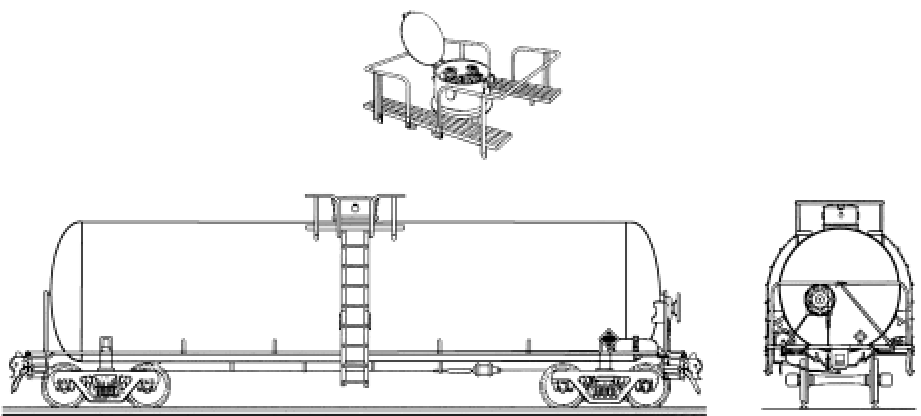
hydrogen cyanide is shipped in specially built cars. pictured is a 105a500w 20,500-gallon capacity. other cars used are the 105a600w and the 105j600w. for safety purposes, the cars may be stenciled as 300w, but have the higher-pressure safety valves. these cars have a 1-1/8" thick inner shell, 4" of cork insulation and a 1/4" outer shell. **HCN cars may be painted white with the red bands or "candystripes."**

dot 105a500w insulated - carbon dioxide service



20,000 gallon capacity - insulated
dot 105a500w
for carbon dioxide service
(pre 1983)

dot 105a500w insulated - chlorine service



b-end 90 ton capacity - insulated
dot 105a500w
for chlorine service
(post 1982)

insulated. safety valve (375 psi) (350 psi on carbon dioxide cars).	chlorine carbon dioxide anhydrous hydrofluoric acid
dot 105j500w thermal protection. head protection. safety valve (375 psi).	liquefied petroleum gas liquefied hydrocarbon gas
dot 105a600w insulated. safety valve (450 psi) (400 psi on carbon dioxide cars).	carbon dioxide
dot 105j600w thermal protection. head protection. safety valve (450 psi).	liquefied petroleum gas liquefied hydrocarbon gas
dot 105a100alw insulated. safety valve (75 psi).	fertilizer ammoniating solution (ammonium nitrate solution)

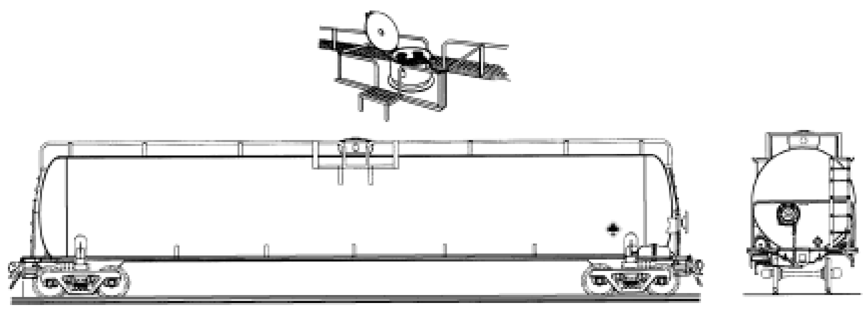
dot 112t340w
same as dot 112a340w except equipped with head protection and a non-jacket thermal protection system. no reflective paint required.

dot 112a400w
non-insulated (upper 2/3 of tank must be painted with light-reflective paint). safety valve (300 psi). alternate setting 330 psi for certain commodities

dot 112s440w
same as dot 112t400w except equipped with head protection.

anhydrous ammonia

dot 112j400w



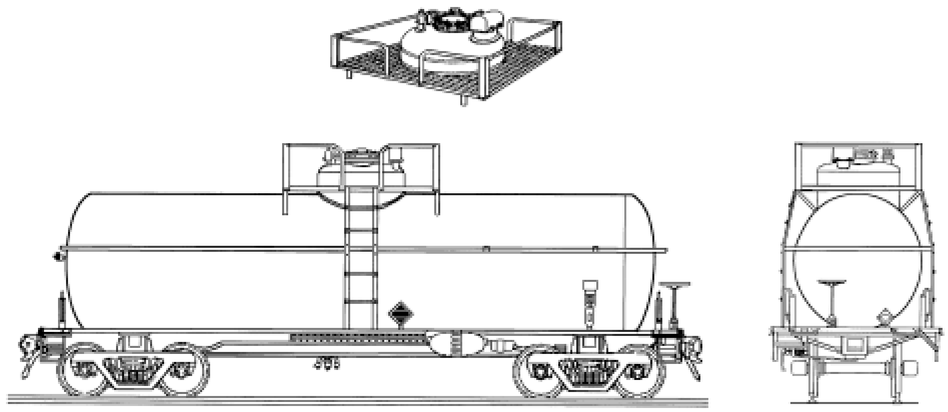
b-end

33,500 gallon capacity - noninsulated
dot 112j400w
for propylene, liquefied petroleum gas
and anhydrous ammonia service

Railroad Tank Cars – Non-Pressure

A-1 -- Class 103

DOT 103W



B-END 10,000 GALLON CAPACITY - INSULATED
FOR GENERAL SERVICE COMMODITIES

Non-Insulated or Insulated.
General Service.
Safety valves (35* psi) or Safety Vent (60 psi).

Phosphorus, Benzene, Gasoline, Vegetable Oil, Caustic Soda, Fuel Oil, Alcohol

DOT 103AW

Non-Insulated or Insulated.
Acid Service.
Safety Valves (35* psi) or Safety Vent (60 psi).

Sulfuric Acid
Oleum
Aqueous Hydrofluoric Acid 60% to 80%
Titanium Tetrachloride

DOT 103ANW

Non-Insulated or Insulated.
Safety Valves (35* psi) or Safety Vent (60 psi).

Phosphorous Oxychloride
Phosphorus Trichloride
Benzyl Chloride
Chloroacetyl Chloride

DOT 103ALW

Non-Insulated or Insulated.
Safety Valves (35* psi) or Safety Vent (60 psi).

Acetic Acid, Acetic Anhydride,
Acrylonitrile, Ethylene Glycol,
Glycerine, Butraldehyde,
Hydrogen Peroxide (Under 52% by weight), Fatty Acids

DOT 103A-ALW

Non-Insulated or Insulated.
Safety Valves (35* psi) or Safety Vent (60 psi).

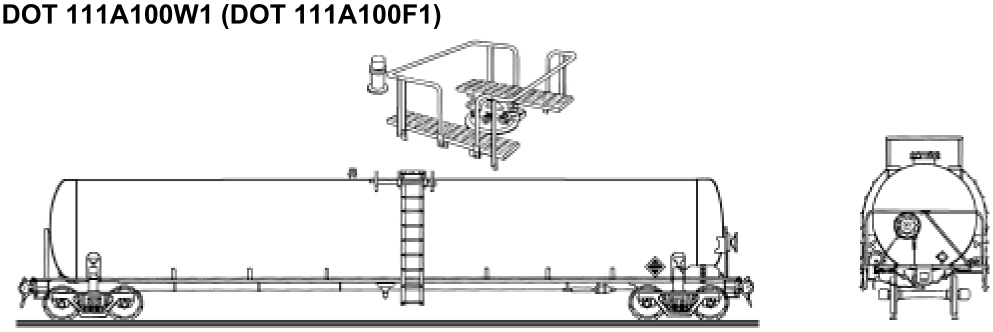
Hydrogen Peroxide
Hydrazine
Nitric Acid (80% or more)

DOT 103BW

Non-Insulated or Insulated.
Rubber Lined Tank.
Safety Vent (60 psi).

Hydrochloric Acid not over 38% by weight
Zinc Chloride
Phosphoric Acid
Ferric Chloride
Aluminum Sulfate

DOT 103CW Non-Insulated or Insulated. Safety Valve (35** psi).	Nitric Acid Hydrazine Chlorosulfonic Acid Formic Acid
DOT 103DW Non-Insulated or Insulated. Safety Valve (35* psi) or Safety Vent (60 psi).	Acetic Acid, Whiskey Ethyl Alcohol, Caramel Fruit Juices, Vegetable Juices
DOT 103EW Non-Insulated or Insulated. Safety Valve (35* psi) or Safety Vent (60 psi).	Phosphoric Acid Chlorosulfonic Acid Diisooctyl Acid Phosphate
A-2 -- Class 104	
DOT 104W Insulated. Safety Valves (35* psi) or Safety Vent (60 psi).	Ethyl Ether Casinghead Gasoline Refined Vegetable Oils
A-8 -- Class DOT111A	
DOT 111A60W1 (DOT 111A60F1) Non-Insulated or Insulated. Safety Valve (35 psi) or Safety Vent (60 psi).	Benzene Gasoline Alcohol Caustic Soda Fuel Oil
DOT 111A60W2 Non-Insulated or Insulated. Safety Valve (35 psi) (Required on Certain Commodities) or Safety Vent (60 psi).	Aqueous Hydrofluoric Acid, 60% to 80% Mixed Acid Sulfuric Acid Titanium Tetrachloride
DOT 111A60W5 Non-Insulated or Insulated. Rubber Lined Tank. Safety Vent (60 psi).	Hydrochloric Acid not over 38% by weight Phosphoric Acid Aluminum Sulfate
DOT 111A60W7 Non-Insulated or Insulated. Safety Valve (35 psi) or Safety Vent (60 psi).	Oluem
DOT 111A60ALW1 Non-Insulated or Insulated. Safety Valve (35 psi) or Safety Vent (60 psi).	Acetic Acid, Acetic Anhydride, Acrylonitrile, Fatty Acids, Ethylene Glycol, Glycerine, Butraldehyde, Hydrogen Peroxide (under 52% by Weight)
DOT 111A100W1 (DOT 111A100F1)	

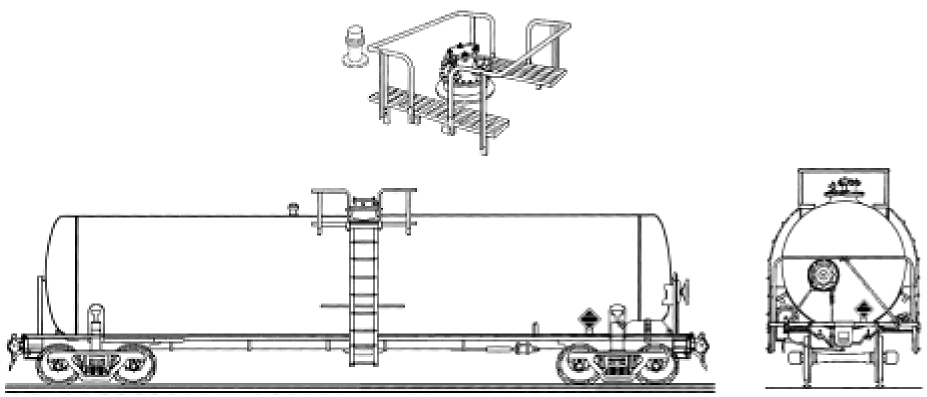


B-END 26,000 GALLON CAPACITY - NONINSULATED
DOT 111A100W1
FOR GENERAL SERVICE COMMODITIES
.2181"/FT TOP & BOTTOM SLOPE

Non-Insulated or Insulated.
Safety Valve (75 psi) or Safety Vent (100 psi). Kerosene, Gasoline, Fuel Oil, Vegetable Oils, Phosphorus

* Cars built prior to January 1, 1959, may be equipped with (2) 25 psi safety valves.
** Cars built prior to January 1, 1959, may be equipped with 45 psi safety valve.

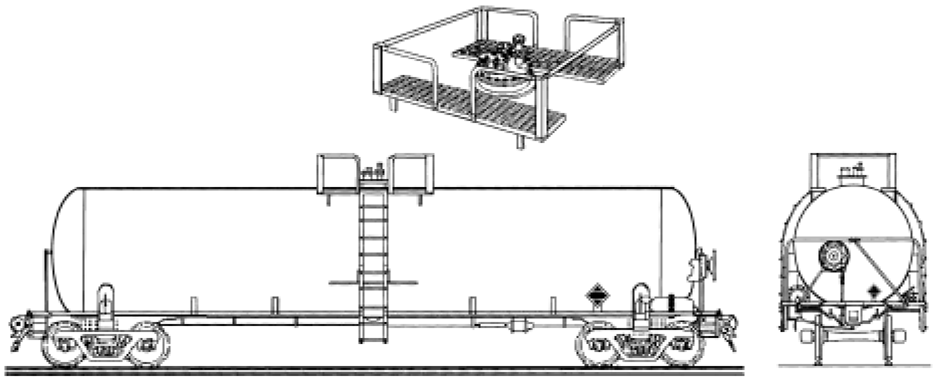
DOT 111A100W1 (DOT 111A100F1)



B-END 13,600 GALLON CAPACITY - NONINSULATED
DOT 111A100W2
FOR SULFURIC ACID SERVICE
POST 1982

Safety Valve (75 psi) or Safety Vent (100 psi). Non-Insulated or Insulated. Safety Valve (75 psi) (Required on Certain Commodities) or Safety Vent (100 psi).	Vegetable Oils, Phosphorus, Aqueous Hydrofluoric Acid (60% to 80%), Mixed Acid, Sulfuric Acid
DOT 111A100W3 Insulated. Safety Valve (75 psi) or Safety Vent (100 psi).	Casinghead Gasoline, Ethyl Ether
DOT 111A100W4 Insulated. Safety Valve (75 psi).	Aqua Ammonia Solution containing Anhydrous Ammonia

DOT 111A100W5

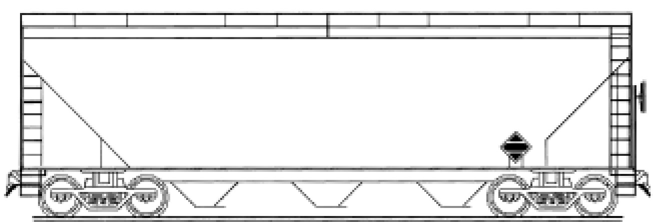


B-END 20,000 GALLON CAPACITY - NONINSULATED
DOT 111A100W5
FOR HYDROCHLORIC ACID SERVICE
PRE 1983

Non-Insulated or Insulated.
Rubber Lined Tank.
Safety Vent (100 psi).

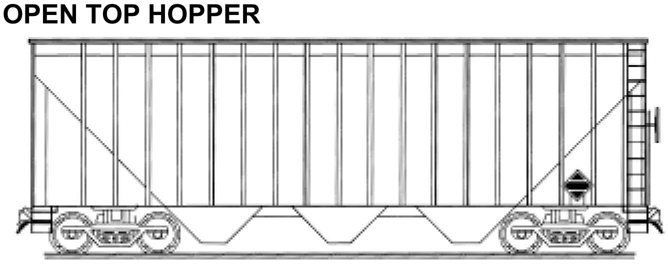
Hydrochloric Acid not over 38% by weight, Phosphoric Acid, Aluminum Sulfate

COVERED HOPPER



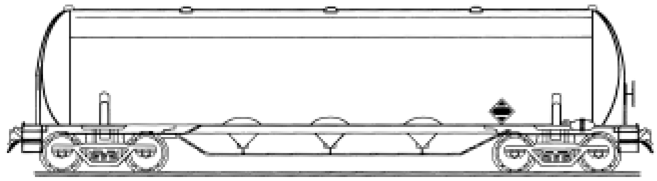
COVERED HOPPER
CARRIES CALCIUM CARBIDE, CEMENT, GRAIN

OPEN TOP HOPPER



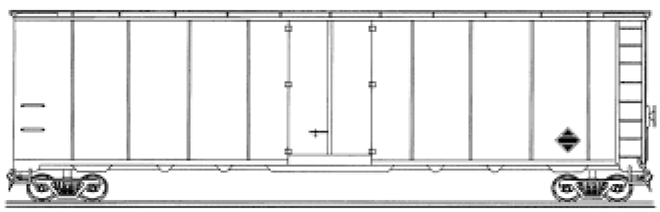
OPEN TOP HOPPER
CARRIES COAL, ROCK, SAND

PNEUMATIC HOPPER



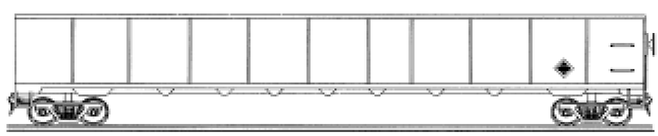
PNEUMATIC HOPPER
CARRIES PLASTIC PELLETS, FLOUR, OTHER FINE-POWDERED MATERIALS

BOX CAR



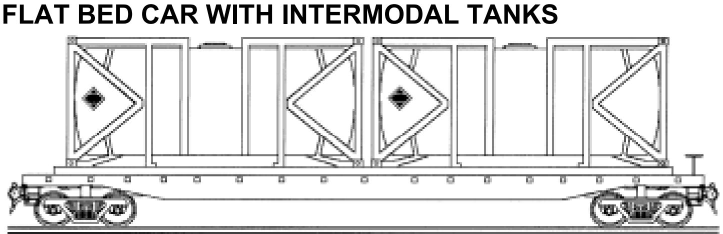
BOX CAR
CARRIES ALL TYPES OF MATERIAL AND FINISHED GOODS

GONDOLA



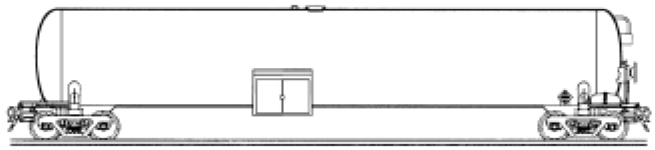
GONDOLA
CARRIES SAND, ROLLED STEEL AND OTHER PRODUCTS AND MATERIALS THAT DO NOT REQUIRE PROTECTION FROM THE WEATHER

FLAT BED CAR WITH INTERMODAL TANKS



FLAT BED CAR WITH INTERMODAL TANKS
CARRIES VARIOUS PRODUCTS IN CONTAINERS, I.E., ONE-TON CHLORINE CYLINDERS, INTERMODAL CONTAINERS (SHOWN), LARGE VEHICLES, OTHER COMMODITIES THAT DO NOT REQUIRE PROTECTION FROM THE WEATHER

CRYOGENIC CAR



CRYOGENIC CAR
CARRIES LIQUID OXYGEN, LIQUID NITROGEN, LIQUID CARBON DIOXIDE, LIQUID HYDROGEN, OTHER GASES THAT HAVE BEEN LIQUEFIED BY LOWERING THEIR TEMPERATURE

Fixed Site Containers

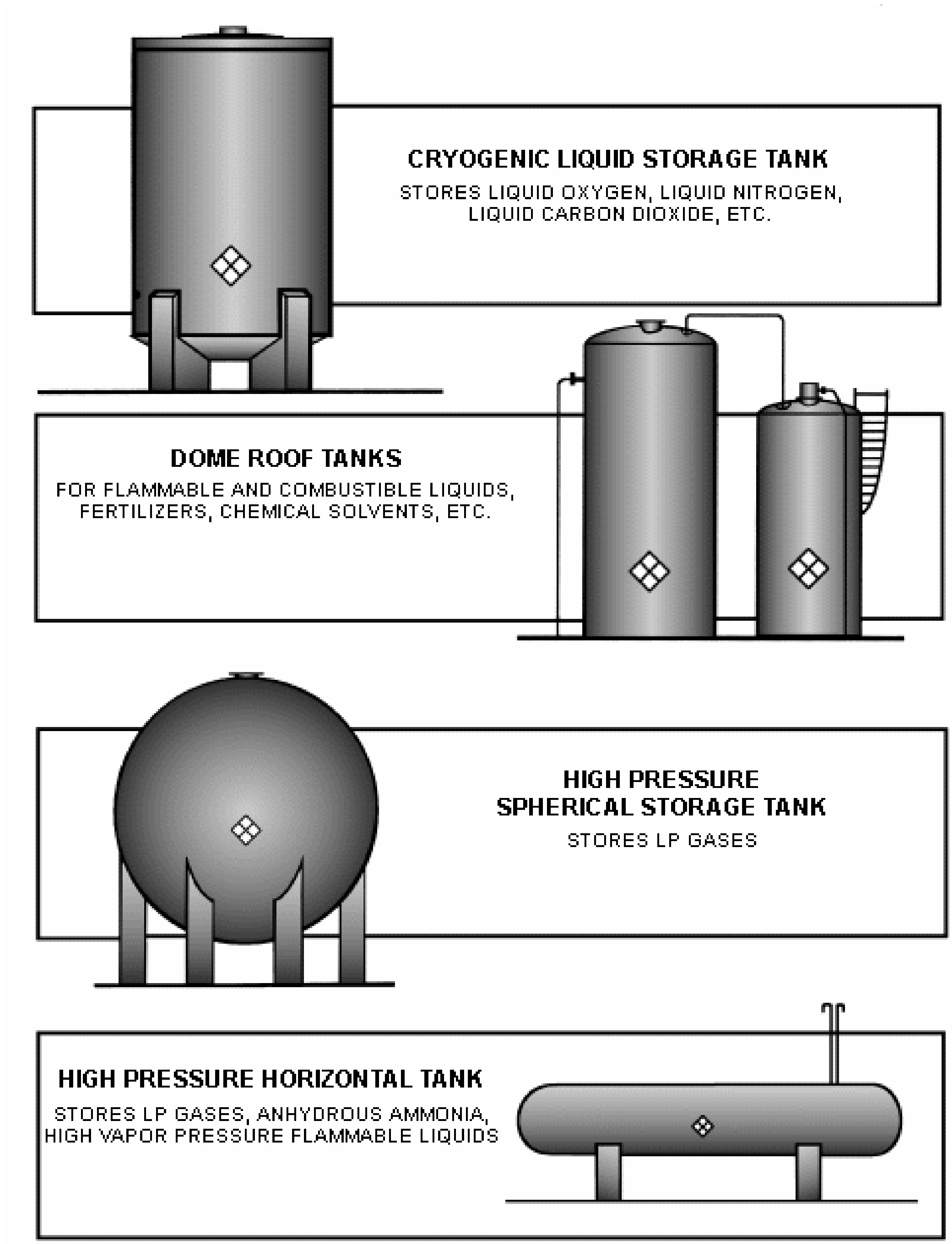
Containers found at fixed sites, such as storage facilities, bulk plants, manufacturing facilities, hospitals and airports, are known as “fixed site containers”. These containers can range from a few hundred gallons to huge bulk storage tanks of over a million gallons.

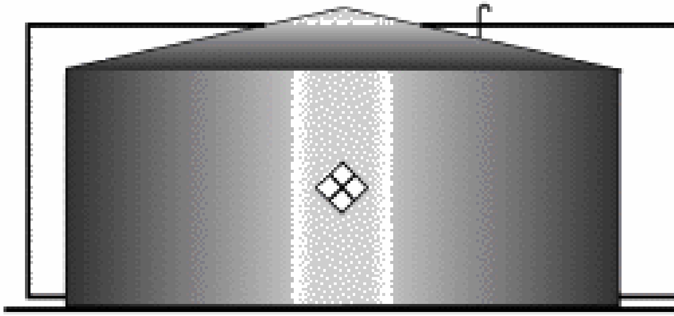
Non-Pressure Tank
Non-pressure containers store products that are liquids at atmospheric pressures. They are usually above ground storage tanks, but some products (such as gasoline) may be stored in an underground storage tank (UST).

Pressure Tank
Pressure tanks store liquefied gases (such as propane or chlorine). These containers are typically horizontal and have rounded ends. Most have pressure relief devices.

Cryogenic Liquid Tank
Containers used to store extremely cold liquefied gases (cryogenics) are stored in pressure tanks with heavy insulation. These containers are typically vertical and often have frost build-ups around exposed piping and valves. Like other pressure tanks, most of these also have pressure relief devices.

Many fixed site storage containers will have dikes or embankments built around the tanks to contain any leakage which might occur. In addition, many flammable liquid storage tanks have fixed fire suppression systems or water deluge systems in place.


CRYOGENIC LIQUID STORAGE TANK
STORES LIQUID OXYGEN, LIQUID NITROGEN, LIQUID CARBON DIOXIDE, ETC.
DOME ROOF TANKS
FOR FLAMMABLE AND COMBUSTIBLE LIQUIDS, FERTILIZERS, CHEMICAL SOLVENTS, ETC.
HIGH PRESSURE SPHERICAL STORAGE TANK
STORES LP GASES
HIGH PRESSURE HORIZONTAL TANK
STORES LP GASES, ANHYDROUS AMMONIA, HIGH VAPOR PRESSURE FLAMMABLE LIQUIDS

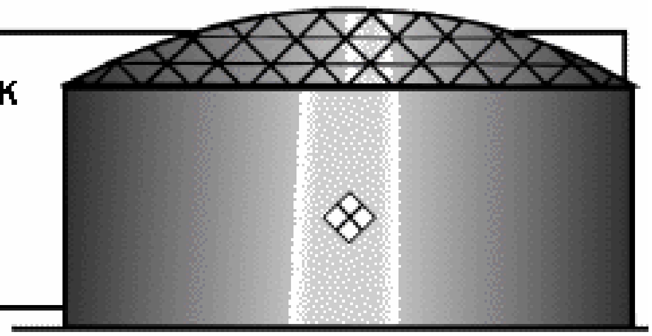


CONE ROOF TANK

FOR FLAMMABLE, COMBUSTIBLE, AND CORROSIVE STORAGE

COVERED TOP FLOATING ROOF TANK WITH GEODESIC DOME

FOR FLAMMABLE LIQUID STORAGE

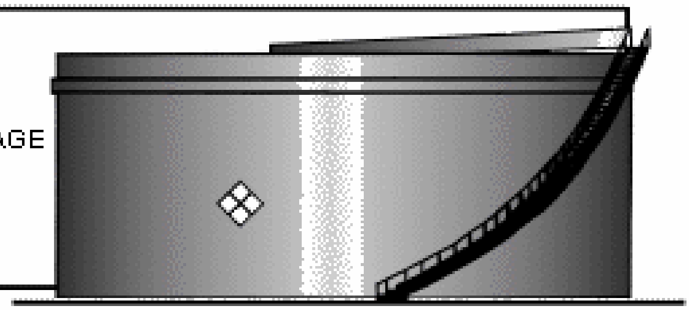


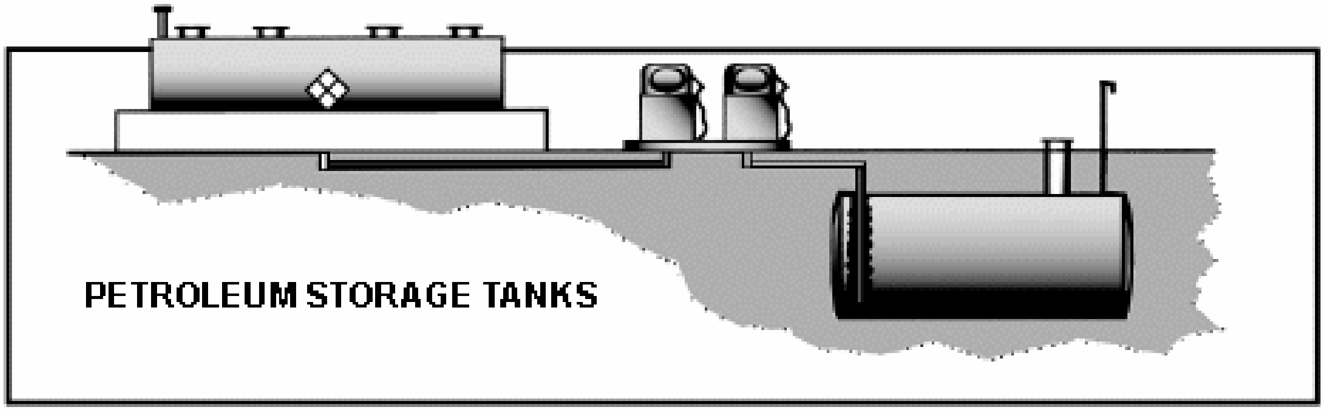
COVERED TOP FLOATING ROOF TANK

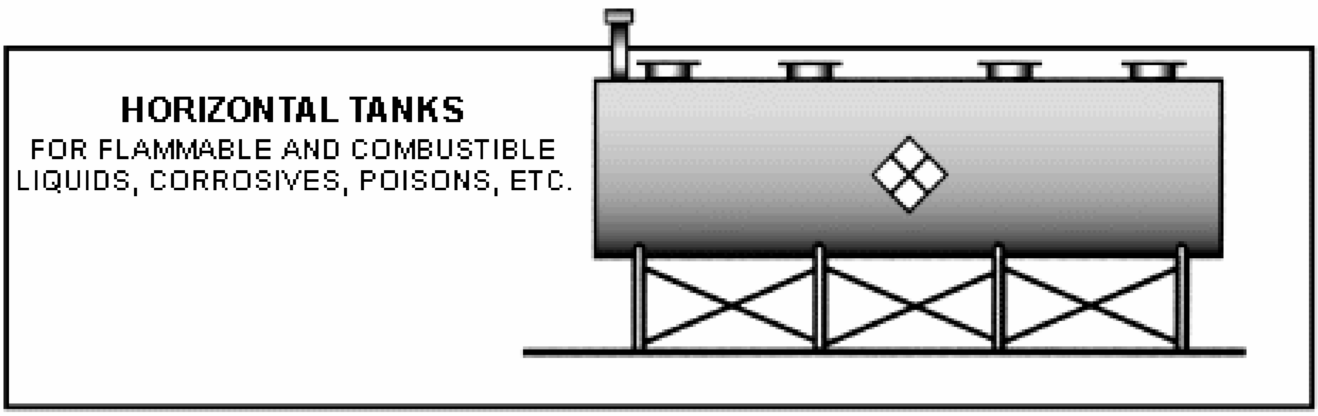
FOR FLAMMABLE AND COMBUSTIBLE STORAGE

OPEN TOP FLOATING ROOF TANK

FOR FLAMMABLE AND COMBUSTIBLE STORAGE




PETROLEUM STORAGE TANKS

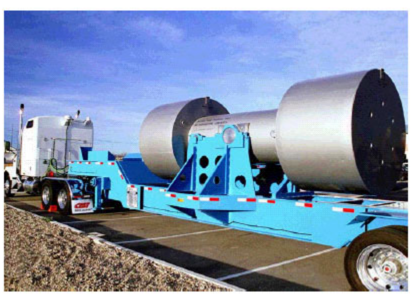

HORIZONTAL TANKS
FOR FLAMMABLE AND COMBUSTIBLE
LIQUIDS, CORROSIVES, POISONS, ETC.

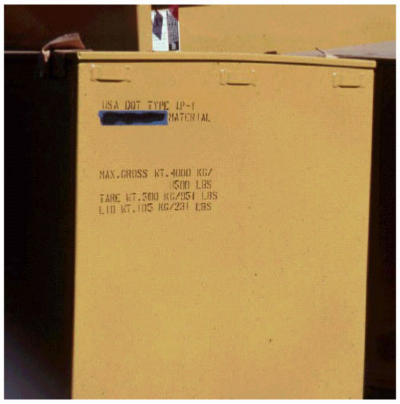
Radioactive Material Containers

The three basic types of packages include strong tight containers (STCs) or excepted, Type A containers, and Type B containers. While the characteristics of STCs are not specified by regulation, types A and B have very specific requirements listed in the Department of Transportation regulations. There are also three types listed for international shipments; Industrial I; Industrial II; and' Industrial III.

<table>
<tr>
<td>Excepted

</td>
<td>Excepted packaging is used to transport radioactive materials that present a minimal hazard due to either their low concentration or limited quantity. There are no specific test requirements for excepted packages except that there can be no release of radioactive material during transportation. If the material being shipped meets “limited quantity” requirements, it is shipped as an “excepted package”. Strong tight packaging is suitable for most excepted package requirements. Radiation levels at the surface must be ≤0.5 mrem/hr (0.005 mSv/hr), and ≤2 mrem/hr (0.02 mSv/hr) is shipped exclusive use. HOWEVER, the package surface radiation level may reach 1,000 mrem/hr (10 mSv/hr) if the material is not “limited quantity” and the shipment is exclusive use.</td>
</tr>
</table>

Type A 	Type A packaging is used for shipping small quantities of radioactive material with higher concentrations than in accepted packaging. Type A packaging must be able to pass tests that demonstrate they would retain their contents and shielding under NORMAL TRANSPORTATION CONDITIONS. Package tests include water spray (simulating 2 inches of rainfall for one hour), free drop (dependent upon weight of package), corner drop (1 foot for packages over 110 pounds), penetration (13 pound weight at 1 meter), and compression (24 hour test with load of 5 times the weight of the package). Additional tests for liquids and gases include a second free drop test at 9 meters (30 ft) and penetration test at 1.7 meters (5.5 ft).
Type B 	Type B packaging is designed to transport larger quantities of radioactive material or quantities that have high levels of radioactivity. They must pass tests, which have been designed to produce damage equivalent to that observed in the most severe transport accidents. The package designers must demonstrate that it would withstand both normal and ACCIDENT CONDITIONS without the loss of radioactive contents, no significant increase in external radiation levels, and no reduction in the effectiveness of the packaging during use. Package tests include water immersion (8 hours), free drop onto an unyielding surface (30 ft), puncture (40 inches onto a 6 inch diameter pin), and thermal (30 minutes at 1475 degrees F). Type B (U) packages are suitable for international shipments with stowage provisions for heat dissipation. Type B (M) packages are also suitable for international shipments and require approval of conditions for shipment. It is designed for a maximum normal operating pressure of >100 psig or may have a relief device, which would allow the release of radioactive material under hypothetical accident conditions.

Industrial Package I 	IP-I, IP-II, and IP-III are packaging systems required for international shipment but may be used domestically. They may be used for certain shipments of Low Specific Activity (LSA) and Surface Contaminated Object (SCO) materials, which are usually categorized as nuclear waste. IP-1 packaging is essentially equivalent to an excepted package.
Industrial Package II 	IP-II is an excepted package meeting some of the specified Type A packaging tests.

Industrial Package III 	IP-III packaging must meet the requirements of IP-I and IP-II packaging and nearly all of the Type A packaging requirements. Some commonly encountered containers such as IM-101 and IM-102 portable tanks, and Series 1 freight containers may meet IP-II and IP-III packaging requirements. IP-I, IP-II, and IP-III Packaging is authorized for shipping Low Specific Activity (LSA) in addition to accepted and Type A packaging.

<u>Radioactive Markings</u>

Markings on packages, labeling, and placarding on transportation vehicles are also important aspects of the transport of radioactive materials. Markings are designed to provide an explanation of the contents of a package by using standard terms and codes.

Labels are used to visually indicate the type of hazard and the level of hazard contained in a package. Labels rely principally on symbols to indicate the hazard.

Although the package required for transporting radioactive material is based on the activity **INSIDE** the package, the label required on the package is based on the radiation hazard **OUTSIDE** the package.

Radioactive material has three possible labels, depending on the relative radiation levels external to the package. Labels for radioactive material are the only ones that require the shipper to write information on the label. The information is a number called the Transport Index (TI), which is the highest radiation level at one meter from the surface of the package.

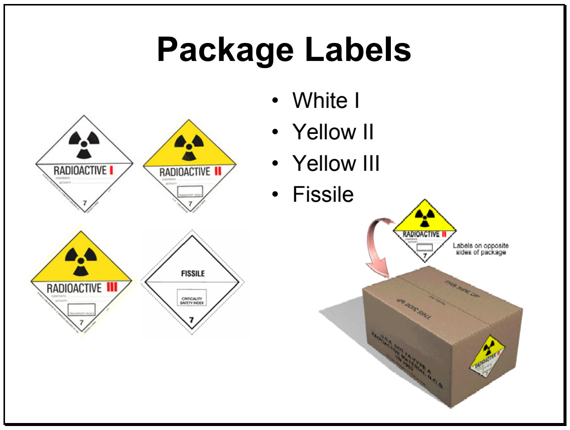
The three labels are commonly called White I, Yellow II, and Yellow III, referring to the color of the label and the Roman numeral prominently displayed. A specific label is required based upon the surface radiation measurement and the measurement at one meter from the surface.

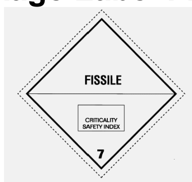
Label types:

- Empty;
- White I;
- Yellow II;
- Yellow III; and'
- Fissile.

Label Meanings

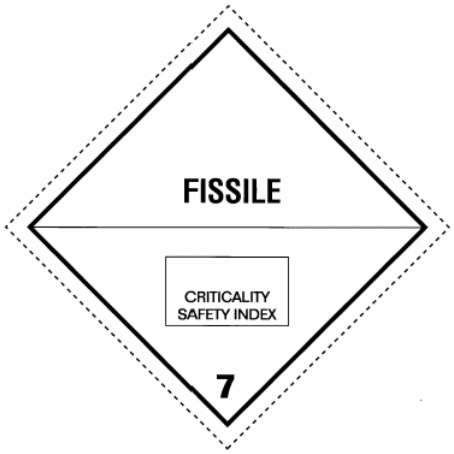
- The Yellow II, Yellow III label have Transport Index (mrem/hr at 1 meter away)
- The Fissile label has a Criticality Safety Index

	Packages labeled White I have very little radiation penetrating the undamaged package (0.5 mrem/hr at the package surface). Packages labeled Yellow II may have dose rates up to 50 mrem/hr at the package surface and up to 1 mrem/hr measurable 1 meter away. Packages labeled Yellow III may have intensities up to 200 mrem/hr at the package surface and up to 10 mrem/hr 1 meter away. Fissile labels indicate that the package contains Plutonium 239, Plutonium 241, Uranium 233, or Uranium 235, which, under certain circumstances, can fission (atom splits into smaller elements), and release large amounts of energy and radiation.
Package Label White I 	≤0.5 mrem/hr at undamaged package surface.
Package Label Yellow II 	>0.5 mrem/hr -≤50 mrem/hr at undamaged package surface, ≤1 mrem/hr at 1 meter away.
Package Label Yellow III 	>50 mrem/hr – ≤200 mrem/hr at undamaged package surface, ≤10 mrem/hr at 1 meter away. Note: If shipped exclusive-use, up to 1 rem/hr at undamaged package surface.

Package Label Fissile 	Package contains U-233, U-235, Pu-239, or Pu-241.
Package Label Empty 	May contain residual radioactive material.
Label Information: Contents	The name of the most radiotoxic material in the package. Chemical symbol with mass number is authorized. e.g. U-238
Label Information: Activity	Quantity expressed in Becquerels (Bq), or Bq followed by Curies (Ci) in parenthesis; e.g. 37 GBq (1 Ci)

Label Information: Transport Index 	The dimensionless number (rounded up to the next tenth) placed on the label to designate the degree of control to be exercised by the carrier, as determined by the: Highest radiation dose rate at one meter away from any surface of the package in mrem/hr. Total of the T.I. of all packages in a vehicle may not exceed 50. The maximum T.I. of a package in a passenger aircraft is 3. Exception: shipping “exclusive use”.

Label Information: Criticality Safety Index



The dimensionless number (rounded up to the next tenth) placed on the label to designate the degree of control to be exercised by the carrier, as determined by:

Dividing 50 by the allowable number of packages which may be transported together.

The total of the C.S.I. of all packages in a vehicle may not exceed 50.

Exception: shipping “exclusive Use”.

Package Markings

- Proper Shipping Name
- UN Number

Located on a package and may be printed onto the package or appears in the form of a label.

Package markings include, among other things, the proper shipping name and the 4-digit UN number.

Pipelines

Underground pipelines are also transportation containers. Special markers to indicate their presence and to assist in obtaining aid in an emergency are required by the U.S. Department of Transportation. Underground pipelines are required to have markers when they cross another mode of transportation (such as a highway or railway). These markers indicate the owner of the pipeline, the name of the product(s) transported in the pipe and an emergency telephone number.

A single pipeline can be used to carry different products by simply switching over to the new product. When this is done only a few feet of the mixed product will occur. A “pig” is a term for a large slug that is sometimes used to separate two different products. Pigs with cameras or other devices can also be inserted to check the condition of the pipeline.

Companies using pipelines are required to educate local responders on suggested emergency response tactics regarding their pipeline. This will include information on how and where a pipeline can be shut down.

Container Damage Assessment

Another important aspect of the container is the amount of damage it has received as a result of the incident. HazMat technicians may need to make entry to recon and evaluate the amount of damage to a container. This can help to determine if any additional hazards exists such as a sudden container failure. Container specialists must be consulted prior to off-loading products or up-righting damaged containers.

Container Stressors

Most HazMat incidents are actually container related problems where the product has somehow been released due to one of three container stressors:

- **Thermal stress**, such as flame impingement and/or pressure build-up from heating the product. Extreme cold from cryogenics may make metals brittle;
- **Mechanical stress**, such as a puncture or dent; and’
- **Chemical stress**, such as contact with a corrosive or rusting.

Damage assessment of all containers must be performed before the container is moved, up-righted or attempts are made to patch or plug. **Warning: If you do not know why a container is leaking maybe you should not try to stop it.**

Container Breaches

In many instances, the stressor will cause the container to breach, releasing its product into the surrounding environment. Breaches fall into one of five types:

- **Disintegration,** such as a glass bottle shattering;
- **Runaway cracking**, such as an over-pressured cylinder;
- **Failure of an attachment**, such as where pipes and/or gauges are placed;
- **Punctures**, such as a forklift thru a drum; and'
- **Splits and tears**, such as a seam ripping apart under pressure.

Container breaches may not happen for hours (or days) after the initial incident. An incident that occurs when outside temperatures are low may result in a container failure when the temperature begins to rise or the product increases in pressure.

Release Events

Once the container breaches, the product will be released into the environment in one of four manners:

- **Detonation**, such as an explosion;
- **Violent rupture**, such as a pressurized container failure;
- **Rapid relief**, such as a pressure relief valve or hole; and,
- **Spills or leaks**, such as a leaking pipe

The release event will greatly affect the amount and size of the contaminated area.

Dispersion Pattern

Once released, the product will typically downwind, downstream, and downhill in one of the following patterns:

- **Cloud**;
- **Cone**;
- **Plume**; or a,
- **Stream**.

Product(s)

In addition to recognizing the presence of hazardous materials, identifying containers and assessing their damage, first responders need to be able to identify the specific product that is involved in the incident.

By identifying the specific product, first responders can determine its:

- Hazards;
- Routes of exposure;
- The appropriate level of PPE;
- How to decontaminate; and,
- The appropriate medical treatment.

We will look in detail at chemical properties in Unit 9 “Basic Chemistry”.

Certain products when released from their container, or when their container is damaged, will begin to eat or destroy the container. An example of this would be an acid tanker that cracks its inner ceramic lining in a rollover accident. The acid could then contact the metal shell and may cause a breakthrough of the tank and/or a pressure increase inside the tank. Cryogenic materials through the heat transfer process of conduction can cause the tank shell to become brittle this may also create a catastrophic release.

Environment

Once we have considered the container and the product the final factor to consider is the surrounding environment. It is important to take into account where the product is being released, the topography and weather conditions. Topography will help determine where the product will go. Weather conditions also play a role in where gases and vapors will drift, temperature changes will make adjustments in vapor production and/or rain may affect the product.

There are basically four areas of a release:

- Onto the ground;
- Into water;
- Into the air; and/or,
- Into the ground.

Emergency response teams usually can do little once the product moves into or below the surface of the ground; this will become EPA’s and the clean-up contractor’s responsibility.

Based on whether the product is a solid, liquid or gas we can create a matrix that allows us to look at possible control or confinement solutions. This matrix will be visited again in Unit 6.

Gas/Air	Ventilate Dissolve Blanket	Disperse Divert
Liquid/Water	Boom Divert	Dam Retain
Liquid/ Surface	Dike Absorb Neutralize	Divert Retain Apply gels
Solid/Surface	Blanket	

Special Environments

There are many special areas that will affect the behavior of the chemical and/or adjusts the tactics of the responder.

Confined Spaces

Confined spaces are environments that commonly have hazardous atmospheres. The confined space must be properly monitored to determine the dangers involved before entry is attempted. Monitoring with direct reading instruments must be done high in the space, in the mid areas and low in the space to check for stratification of atmospheres. The space's hazards should be "locked and tagged out" to assure safety to the entrant.

OSHA 29 CFR 1910.146 identifies the hazards that should be expected in confined spaces and then regulates industries in the proper entry procedures required before work is performed inside these spaces. Rescue requirements are also dictated in this requirement.

"Permit required" confined spaces are confined spaces known to have hazards inside. Hazards include:

- Chemical;
- Electrical;
- Mechanical;
- Atmospheric;
- Temperature; and,
- Natural (animal, reptile, insect etc.).

Hazardous Materials Bulk Storage Areas

Storage areas for large quantities of hazardous materials exist throughout the state. Tank farms are regulated to provide safety to workers and responders, the public and the products themselves. Minimum tank spacing requirements, dikes around the tanks, fire protection systems, and product transfer abilities are all items a HazMat technician should be knowledgeable in. The before mentioned items can affect the products in both positive and negative ways. Relief devices (pressure and vacuum) will be present and their operation must be understood. If these storage facilities are in your response area a tour should be set-up to preplan for these hazards.

Risk / Benefit Analysis

In the Operations course you learned basic hazard and risk assessment in order to judge the risks of getting involved and the benefits of your actions. Operations level responders should remain focused upon life safety.

HazMat Technicians must perform hazard and risk assessment for the purpose of protecting property and the environment. More time must be spent on this process since the benefit for each risk is inherently less than that of saving a victim's life. The tech must look at the risks of making entry into the hot zone compared to the benefit of preventing the spread of the hazardous material.

Summary

HazMat technicians must continue to learn about containers and how they affect the incident. Technicians must be knowledgeable in the product and where to find additional information on its hazards, and they must understand how the environment can also affect the released product. This information must be used to decide if the risk of entry is worth the benefit to the property and environment.

Exercise Module 1 Unit 5
Container Exercise

Time Allotted: 105 minutes

Equipment needed: Various types of non-bulk containers
- 55 gallon drum
- cylinder

Various types of bulk containers
- 307/407
- 312/412

Railcar
Damaged containers
Pressure gauging devices
Thermal imaging camera

Supplies needed: As directed by instructor.

Methodology: The instructor will give you the scenario and you will have to work through solutions based on the information that you have learned in this unit.

NOTES:

Module 1 Unit 5
Unit Quiz

1. Which of the below is not one of the three items of information that must be assessed on a HazMat incident?
    a. Containers
    b. Products
    c. Environment
    d. Cost

2. A container that holds less than 119 gallons is considered…?
    a. A bulk container
    b. A pressure container
    c. A non-bulk container
    d. A tanker

3. Which of the following is not one of the container stressors?
    a. Construction
    b. Thermal
    c. Chemical
    d. Mechanical

4. A glass bottle dropping and shattering is an example of which type of container breaches?
    a. Disintegration
    b. Runaway cracking
    c. Failure of attachment
    d. Puncture
    e. Splits or tears

5. The four types of release events for a container breach are…?
    a. Spills, leaks, drips and runs
    b. Runs, drips, spills and violent rupture
    c. Detonation, violent rupture, rapid relief and spills and leaks
    d. Cracks, Runs, Detonation and Leaks

6. A Cloud, cone, plume and/or stream are examples of the four different…?
    a. Product types
    b. Dispersion patterns
    c. Gas releases
    d. Cameo plot models

7. Which one of the below is not one of the four basic areas of a release into the environment?
    a. Into a room
    b. Onto the ground
    c. Into the air
    d. Into the water

8. A DOT312 is…?
    a. A corrosive drum
    b. A corrosive tank car
    c. A flammable liquid tank car
    d. A bulk tote

9. Pipelines are considered by the US DOT to be transportation containers.
    a. True
    b. False

10. What are the three container stressors?
    a. Thermal, oxidation and detonation
    b. Chemical, wind sheer and time
    c. Time, distance and shielding
    d. Thermal, chemical and mechanical

Module 1
Unit 6

Module 1
Unit 6 - Control, Containment and Confinement

Scope of Unit

The purpose of this lesson is to discuss control, containment and confinement options for the HazMat technician. This lesson will be followed by hands-on practical exercises.

Learning Objectives

At the end of this unit of training each student will demonstrate control, containment and confinement for various leaking containers and/or the spills they have produced.

Student Performance Objectives

- Know the definitions of the 3 control zones.
- Use reference resources to set up a sufficient hot zone for a chemical incident.
- Know the importance of confinement and containment techniques at HazMat scenes
- Understand the difference between control, confinement, and containment
- Explain various techniques of confinement and containment
- Identify equipment used for confinement and containment techniques
- Must be able to successfully complete competency evaluations 021, 022, 023, 024, 025, 026, 027, 028, 029, 030, 031, 032, 033, 034, 035, 036, 037, 038 and 039.

Resource List

- Ohio HAZMAT / WMD Technician Manual
- Pen / Pencil
- Scratch paper for notes

References

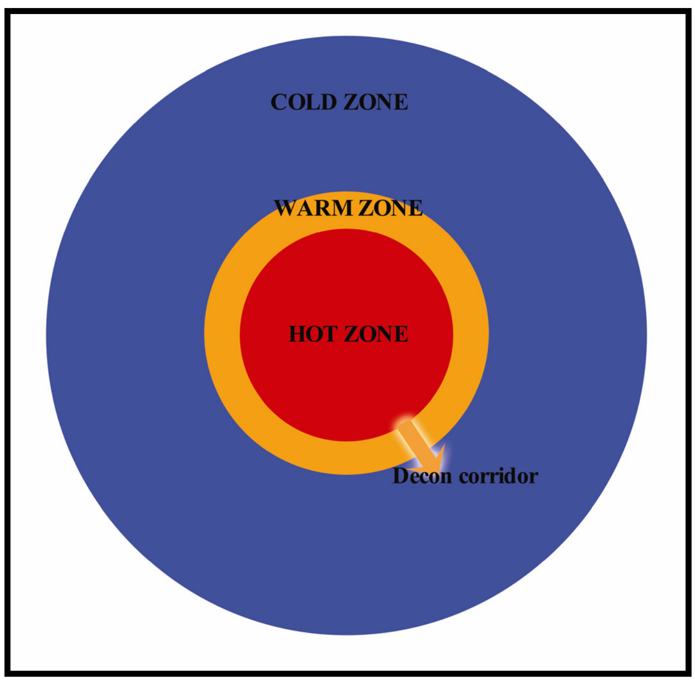
- The University of Findlay Technician Manual
- MSDSs
- NAERG
- CHRIS manual

Control, Containment and Confinement

The main objective of the HazMat technician is to prevent or minimize the extent of the release. Obviously, this will minimize the effect on public health, property, and the environment. In order to mitigate the impact of the incident, the release must be controlled. At the Operations level you were to use defensive measures to control or confine the product (controlling the product without coming into contact with it). The technician will approach the leak in order to stop it. In this chapter we will revisit the Operations level tasks to control and confine the HazMat to a given area. We will then focus on technician level tasks.

Control

Control zones - In order to prevent the spread of the chemical there are three zones that should have been established at an incident: the hot; warm; and, cold zone. If they have not been setup and identified by the time the HazMat team has arrived then this should be one of the first goals.



The **hot zone** is the area immediately around the contamination. This zone is established, identified and secured in order to prevent accidental exposure to the hazards. Initial size of the zone can be determined by consulting the Emergency Response Guidebook. The technician can adjust this zone once more information is obtained. This zone can be more accurately determined by using air monitoring equipment.

The **warm zone** or decontamination corridor is an area adjacent to the hot zone where movement to and from the contaminated area is controlled. This zone becomes the area where responders set up technical and/or equipment decontamination lines. Technicians will need to determine the type and extent of decontamination.

The **cold zone** is the safe area around an incident that responders control in order to establish command and stage equipment. This area also needs to be identified by boundaries and secured from the public. It usually contains the Incident Command Post, the Staging Area, the Medical/Rehab Area and other incident related functions. The cold zone should also be monitored to verify that it remains safe from contamination throughout the incident.

Measures used to control a release involve processes, methods, procedures, and techniques that prevent or reduce the spread of the material or its by-products into the environment. They may also lessen the severity of the material's impact on the environment. Control measures may include: Fire control; Spill control; and/or, Leak control:

Fire Control

The first concern for a spilt flammable material is to prevent ignition. Once a product is on fire controlling the burn is becomes the priority. There are multiple options for controlling flammables spills or fires they include: Removing ignition sources; extinguishing the fire; removing the fuel supply; removing the oxygen; protecting exposures; preventing container failure; and/or, simply withdrawing from the area.

Remove Ignition Sources - This will aid in preventing ignition of flammable vapors and gases. Removing all ignition sources is usually very difficult to accomplish. Responders should continually monitor the area to determine if a flammability hazard is present. In addition, to ensure all ignition sources are removed, responders will require the assistance of personnel from the electric and gas companies. Fuel spills can be blanketed with foam to suppress vapors.

Extinguish Fires - This is one of the primary objectives when responding to an incident. It is important to extinguish fires to minimize the danger to the public and the environment. Compatibility between the product and the suppression agent must be considered before applying the control agent.

To extinguish burning hazardous materials the proper extinguishing agent must be used. Although straight water streams may be effective for extinguishing high flash point liquids, such as kerosene and diesel fuel, water is generally ineffective for extinguishing low flash point liquids such as gasoline and a variety of solvents.

As covered at the Operations level, low flash point liquids may be extinguished with foam or dry chemicals. When selecting the proper extinguishing agent, response personnel must be sure not to mix incompatible agents, e.g., foam and water. In some situations, water should be shut off prior to using any foam. If foam and water are used at the same time, the fire may not be extinguished. Moreover, the water may wash the foam away. Another example of incompatible agents is foam and some dry chemical-extinguishing agents. These agents are effective only when used separately.

If response personnel are required to extinguish water-reactive materials, special extinguishing agents should be used. If water-reactive chemicals are present, extreme reactions can occur that can escalate the severity of the incident if water is used. In addition, water (particularly large volumes) will spread contamination farther away from the incident. The water that came into contact with the chemicals is now contaminated and must be treated.

Remove Fuel Supply - A second tactic that may be used to extinguish ignited materials is to remove the fuel supply. To decrease the hazard, responders should consider closing valves to reduce the amount of fuel entering the area.

Remove Oxygen Source - Removing the source of oxygen is another tactic that may be used to extinguish ignited materials (i.e., smothering the hazardous material). For certain hazardous materials, a fire may be effectively extinguished through the removal of the oxygen supply by smothering the material with foam, sand, or dirt.

Control Burn - Responders might consider extinguishing ignited material by letting the substance burn itself out. Some fires involving pesticides or poisonous gases should be allowed to continue to burn so as to prevent the spread of products. If you cannot stop the release of a flammable product, extinguishment will allow an explosive atmosphere to be created. Protection of the exposures around the fire and cooling containers in close proximity will need to be considered when allowing the product to burn itself out. Evacuation from the areas that may be affected by the “smoke” produced by the fire will should be addressed.

Exposure Protection - Preventing the spread of the fire to adjacent property will be the main concern in allowing the product to burn itself out. The use of water curtains and unmanned appliances should be considered.

Preventing Container Failure - This can be accomplished by cooling the container, using stress barriers, or removing uninvolved materials that may contribute to the container failure.

> ***Cool Containers*** - A tactic that can be used to reduce the probability of a container failure because it is on fire, or near a fire, is cooling the container. Applying large quantities of water to the container usually accomplishes this. A minimum of 500-gallons-per-minute should be applied at the point of flame impingement. If there are several points of flame impingement, very large quantities of water are needed to meet this requirement.

Maintaining an adequate water supply may be difficult in areas that do not have a domestic water supply. For example, in areas around interstate highways and railroad yards it may not be possible for responders to have access to an adequate supply of water.

Keep in mind that the area of the container above the liquid line contains vapors. This vapor space, a critical area in the tank, is generally the point at which failure of the container will occur. Heavy streams of water must be applied to the vapor space in order to cool the container and prevent the container from failing.

When a container holding a hazardous product is on fire, or near a fire, responders should also consider whether it presents an undue risk to response personnel manning the cooling streams. If it is determined the risk is high, unmanned water cannons or hoses should be used. The equipment should be set up and then all response personnel should leave the danger area.

Use Stress Barriers – A stress barrier is a large object, placed between the fire and the container you desire to protect, that can absorb the heat from the fire to prevent container failure. Stress barriers absorb the radiant heat or prevent the container from coming into contact with the flame.

Remove Uninvolved Materials - Another tactic is to remove containers (assuming they are mobile) that have not been affected or are not involved in the fire. This tactic should be used with extreme caution. Remember that materials subjected to the heat of a fire may have undergone some type of chemical or physical change due to the heat of the fire. In large tanks transferring the product out of leaking or burning containers may also be an option.

Tactical Withdrawal - Sometimes, responders may have to withdraw from an area to protect personnel, equipment, and vehicles. Withdrawal from a danger area must always be considered a possibility and withdrawal plans should be prepared.

Response personnel should not be placed in a situation where they can become trapped. Before entering an area, responders should plan withdrawal routes to ensure a quick and safe exit in the event the situation becomes dangerous and requires rapid withdrawal.

Explosion-Resistant Barriers - Explosion-resistant barriers can also be very helpful in protecting personnel and vehicles from chemicals, fire, or radiant heat. Natural barriers, such as ditches and depressions, can be helpful in protecting personnel. Crews and resources should be standing by to handle the possibility of additional fires.

Spill Control (Confinement)

Confinement techniques are methods that limit the physical size of the area of the release. Hazardous materials can be released (directly or indirectly) to air, surface water, groundwater, or land surface. Depending on the media affected, various methods are available that may help restrict the spread of materials.

Techniques for confining hazardous materials depend on whether the release is into the air, on land, into surface waters, or into the groundwater.

Air Releases - Releases of gases, vapors, mists, or particulates into the air may present a serious threat to the public and employee health and safety. The cloud of material may be flammable, toxic, corrosive, or have other hazardous properties.

Once in the air the material can move rapidly depending on wind and other weather conditions, and therefore has the capability of affecting a large physical area. Controlling airborne materials is very difficult especially if large quantities are involved.

The best option is to contain the material by closing valves or otherwise stopping the release. If this cannot be done, then vapor suppression or dispersion techniques may work depending on the quantity and type of chemical being released. Weather conditions, such as humidity, temperature, and wind speed and direction, can greatly affect vapor-cloud formation and dispersion. If the cloud is large, then initial consideration must be given to immediate evacuation of the area that may be impacted.

Some chemicals (acid mists, chlorine gas, and ammonia) readily combine with water to form solutions. The use of fog patterns to disperse and absorb the vapor cloud can work. When a fog stream is used, the material is condensed and falls to the ground. If possible, a collection point, such as a dike, should be used to capture the now contaminated water. This collected material should be pumped into a container for analysis and disposed of properly.

This use of fog patterns to disperse a vapor cloud should be carefully considered because extensive ground contamination, as well as excessive cleanup costs, can be associated with this method. As with any method, a cost-versus-benefit analysis should be made.

Air releases or suspected air releases should always be approached with caution from the upwind direction, whenever possible. Personnel must also be on the alert for changes in wind direction. Visual observations or direct-reading instruments may give some indication of the type and quantities of materials being released and whether vapor suppression will work.

Materials that are lighter than air will drift upwards into the atmosphere. These materials will generally disperse rather than be captured by water application. Heavier-than-air materials will tend to pocket in low areas, following the contours of the land from higher to lower elevations, and be pushed by the wind movement.

Releases Onto Land - Generally, solids that spill on the land are the easiest materials to confine. Solids ordinarily do not migrate far from the source. The release area should be segregated to avoid having the materials tracked away from the site on shoes, clothing, or vehicle tires. It is also important not to increase the mobility of the material by the indiscriminate application of water or other liquids. Covering the material with plastic, tarps, or other means can help prevent it from becoming windborne or being dispersed by rain.

Liquids spilled on the land may be somewhat more difficult to confine. In some cases confinement may already be in place. For example, most above ground storage tanks are required to have a containment structure around their periphery for confining leaks. The likely place for an uncontrolled release is during transportation or loading.

Generally, the best initial approach is to protect sewer openings with sewer pads and surfaces with absorbent material. If the spill is on the ground, berms can be constructed by simply mounding the soil itself. In many cases, though, it may be more advantageous to "herd" the liquids, by using existing ditches, swales, and berms, to an existing low point or to construct a catch basin. This allows the material to pool and may make cleanup easier.

Diversion, diking and retention are three techniques for controlling spills on the land.

Diversion is the controlled movement of the liquid from one course or area to another where the effects to human health and the environment are substantially reduced.

Diking is using a barrier to control the movement of liquids from the spill area so they do not enter an area where they may cause more harm.

Retention is the temporary confinement of the liquid in an area where it can be absorbed, neutralized, diluted, or pumped out. The most desirable retention area is one that is liquid-tight so the spilled liquid will not infiltrate the soil.

Determining which of these three techniques should be used to control a HazMat spill depends on several factors:

- Time;
- Personnel;
- Equipment;
- Supplies;
- Potential harmful effects of the leaking material; and,
- Availability of a suitable area.

For example, response personnel may determine that diversion, rather than diking and retaining, is more appropriate for controlling the movement of fuel oil that could enter a storm drain. In this situation, response personnel may determine that diversion should be used to control the movement of oil because the oil is flowing toward the storm drain at a rate that will not permit the timely construction of a dike. Or, response personnel may determine the available personnel and equipment is insufficient to construct a dike or a retention pond. In many cases, however, diking and retention techniques will follow the diversion technique. That is, diversion can begin immediately, while diking and retaining work may begin as resources arrive.

Diversion – Usually containment socks, rubber booms, or dirt can be used as a barrier to divert a spilled liquid. Because diversion requires that barriers be constructed in advance of the flow, it is important to preplan and have supplies on hand.

In constructing the diversion wall, the speed and the angle of the oncoming, flowing spill must be considered. For fast-moving spills, angles of 60° or more should be used for intercepting the spill. Generally, the greater the speed of the flow, the greater the distance and angle required to slow it down. Construction equipment may be needed to build a diversion barrier if large quantities of liquids are involved. This is practical when the equipment, materials, and trained personnel are available at the scene.

Diking

Although diversion can be accomplished with absorbent materials, it is best performed with a nonabsorbent material. The absorbent material, once at its capacity, needs to be changed out or replenished so the liquid will not flow through it. If nonabsorbent materials are not available then the absorbent materials can be wrapped or covered in plastic.

Diking - Dikes can be constructed from commercially available booms, absorbent socks, media, or dirt. Over time, both vertical and horizontal seepage through and around the dike will occur. This process can be slowed by the use of "visqueen" or "poly" sheeting (a form of polyethylene).

The process of constructing a dike is very similar to the process of constructing a diversion barrier. Response personnel must consider the time required to confine the land spill, the resources available (i.e., response personnel and equipment), and the quantity of the hazardous material spilled. As indicated above, any absorbent material used for a dike should be wrapped in plastic sheeting to prevent flowthrough and to keep the diking material from becoming contaminated.

Retention - Retention of liquids involves determining where the flow will migrate and providing the ability to hold it in that area. Diversion is often used with retention. Retention may involve the following processes:

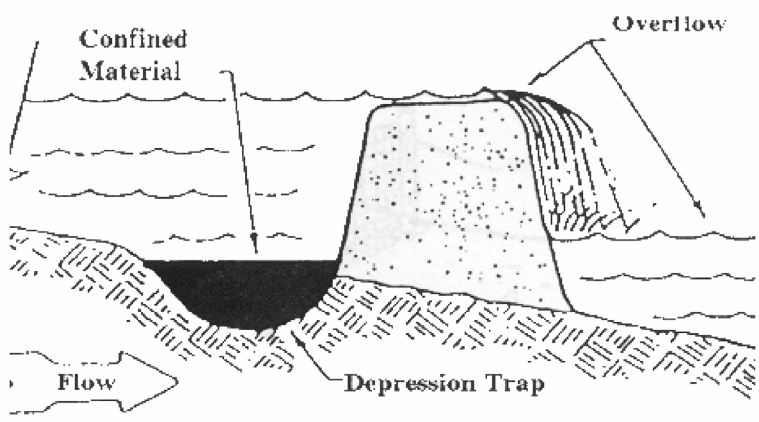
- Salvage covers or tarps placed over the drain and weighted down with any heavy objects; and/or'
- Absorbent socks or impermeable dikes around the drain

Retention

Releases Into Water - Releases of materials into water may be controlled using several different measures:

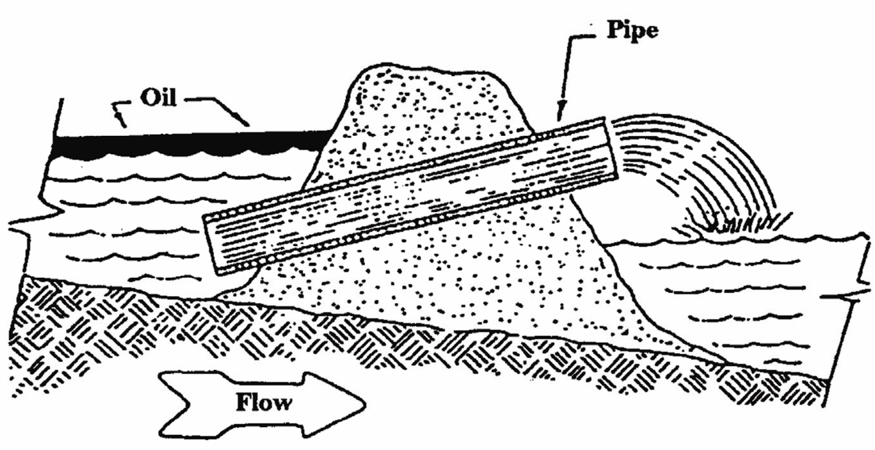
Overflow Dam - Material with a specific gravity greater than 1 that is insoluble in water will sink. These materials are hard to remove from the water. A method for confinement might be an overflow dam.

An overflow dam is used to trap heavier-than-water material by causing the material to sink to the bottom of the stream upstream of the dam. When the material is trapped, relatively uncontaminated water flows over the barrier. Care, therefore, must be taken in building the barrier because if it breaks, it will release the contaminants. A depression in the waterway may be dug to trap the spilled material. An overflow or confinement dam works best on slow-moving and relatively narrow waterways. The faster the waterway, the less likely this method will work.



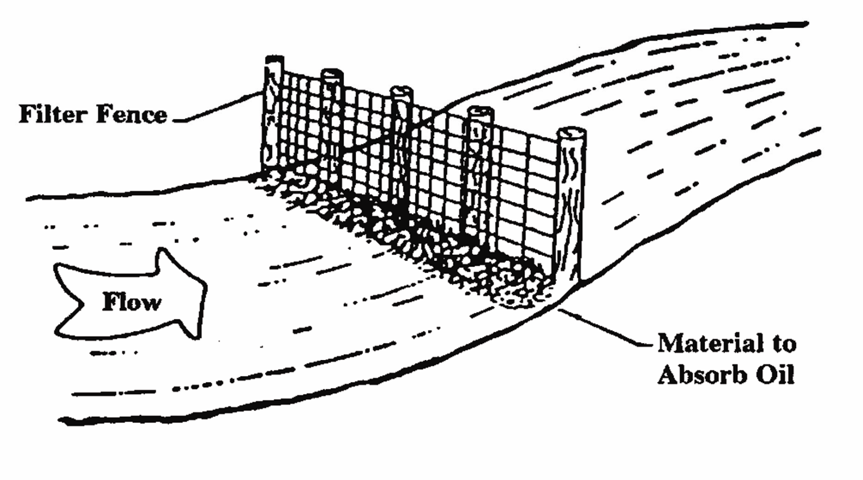
OVERFLOW DAM

Siphon Dam - A siphon or underflow dam is used to trap lighter-than-water material behind the dam by causing it to float on the water surface, while relatively uncontaminated water flows through pipes installed in the dam. When constructing the siphon dam, care must be taken to ensure large enough diameter pipes or a number of pipes are used to allow for an adequate volume of water to flow through the dam. The contained material is then absorbed or vacuumed off the water surface.



SIPHON DAM

Filter Fence - A filter fence is used to absorb small volumes of lighter-than-water material from a flowing watercourse. A fence, typically of galvanized wire mesh, is staked out across the watercourse. The fence acts as a support structure for the filter media that is placed on the upstream side of the fence.



FILTER FENCE

Floating Boom - A confinement measure for a spilled material that floats and is insoluble or slightly soluble in water is a floating boom. Once the spilled material has been contained, it can be removed at a collection point. There it can be skimmed from the surface using several different types of skimmers. Alternatively, the spilled material can be collected for disposal by absorbents, which can be loose or in sheets or pads. In the case of a viscous liquid, straw may be used. There are several different types of commercially available booms, including some that absorb the spill instead of confining it. Booms are available in

a variety of sizes ranging from 2-inch diameter to 48-inch floating skirted booms used in rough water and open bodies such as the Great Lakes or the oceans. Care must be taken to select the correct boom, as small booms are not usually effective in rough water. However, booms are usually the fastest method of containment in small, slow-moving streams.

Material that is highly soluble in water is very difficult to confine and contain. This is especially true in a stream that is fairly wide, deep, and has a moderate-to-fast flow rate. In fast water, even floating material is difficult to control.

***Chemical Control Methods* -** There are methods of controlling hazardous materials that involve the use of chemical additives.

Adsorption – The use of activated charcoal or other adsorbents can be used to minimize the effects of chemicals. Adsorption is a process where the product is chemically adhered to the adsorbent material. This is not to be confused with absorption in which the product is simply “soaked up”.

Neutralization – Acids and bases can be chemically reduced to a more acceptable pH by neutralization. Mild acids can be added to strong bases to slowly bring down their pH. Mild bases can be added to strong acids to slowly bring up their pH. Neutralization will produce heat and other by-products and must be done with extreme caution. (Never overpack warm neutralized products or place neutralized product into the same container with un-neutralized product!)

Solidification – Certain chemicals can be solidified by the addition of certain other chemicals. This process might slow down or even stop the flow of a HazMat and allow an easier clean-up.

Dilution – Sometimes simply diluting the product with water is the best answer. EPA may allow diluted products to be disposed of in storm or sanitary sewers.

Dispersion – Oil spills on waterways are often sprayed with a detergent-like chemical, called a dispersant, that allows it to break-up disperse. In the case of gasses spilling into the air using fog nozzles or ventilation fans may cause the gasses to break-up and disperse.

Groundwater Contamination - Responders do not usually handle groundwater contamination. Occasionally, they may be required to take samples to ensure a release does not contaminate groundwater. Because groundwater cleanups are expensive, any incorrect actions taken by responders may contribute to groundwater contamination. It is very important, therefore, that response personnel take special precautions when conducting response operations to ensure groundwater is not affected by their actions. The Ohio Environmental Protection Agency can be called to assist with below the surface ground contamination.

Leak Control (Containment)

Containment techniques are methods used to restrict the material to its original container. Until the released materials are contained, the area of involvement will grow larger. Whenever possible, it is important to contain the materials in order to limit the size of the area involved and minimize cleanup difficulties and cost.
A variety of techniques for emergency leak containment have been developed. Most of these techniques involve the use of tools and materials that are readily available or can be made easily and inexpensively. The type of materials and tools needed to temporarily patch a leak is dependent on the type and size of and construction materials used for the container.

A practical way of determining what equipment may be required is to plan ahead. Leak-control equipment is available through many manufacturers. Facility response groups and coordinators should ensure appropriate containment and patching/plugging equipment is available.

Often a leak may be controlled by simply tightening fittings such as bungs, caps, pipes, or flange bolts. Other times, it will require patching or plugging materials to stop the leak.

Primary Tool Kit - A variety of tools and materials may be necessary to accomplish patching and plugging. A basic tool kit should be available to the response group and should contain, at a minimum, the following items:

- Rubber or nylon mallet;
- 18- and 36-inch pipe wrenches;
- Open- and box-end wrench set;
- Slip-joint pliers (two pair);
- Common pliers;
- Assorted screwdrivers with plastic handles;
- Medium-weight, ball-peen hammer;
- Linoleum knife;
- Utility knife;
- 8-inch, vise-grip and needle-nose pliers;
- Portable explosion-proof handlight;
- 18- to 36-inch bolt cutters;
- Bung wrenches (two–brass or nonsparking);
- Diagonal side-cutting pliers;
- Tin snips;
- Wire brush with long handle;
- Hacksaw with blades; and,
- Variety of non-sparking tools.

Additional materials that might prove beneficial are:

- Teflon™ tape–available in a variety of widths and used for wrapping threads on fittings and connections;
- Duct tape–used to slow leakage from pipes, fittings, etc., by wrapping tightly around the affected area; also can be used as a gasket with wedges or plugs;
- Commercially available preformed pipe clamps;
- Rubber sheeting (old inner tubes work well)–useful as gasket material for any type of patch or plug;
- Plug and dike compound;
- Assorted wooden taper plug assortment;
- Wooden wedge assortment;
- Assorted sheet metal screws–when backed by fiat washers and rubber gaskets, useful for small holes, pinholes, and some cracks;
- Assorted pipe caps–can be used on threaded pipe ends;
- Bungs–used to secure drums;
- Assorted automotive clamps–used to secure rubber sheeting over pipe ends, etc.;
- Assorted threaded pipe plugs–used on internally threaded pipe ends;
- Flat washers for sheet metal screws; and,
- Epoxy compounds–used as a patch or binder and filler.

Once tools are obtained, response personnel should "practice" with them to determine whether there are any special problems. Hand tools are awkward to use while wearing protective gloves. Response personnel may have to enlarge the handles on the small tools and practice patching-and-plugging techniques while wearing gloves. Personnel must be able to hand carry tools and be mobile within the response area. A canvas mason's bag or 5-gallon bucket may be used to hand carry the tools.

A complete list of equipment and supplies that are suggested for each type or level of HazMat team can be found in the Ohio HazMat TAC appendix.

Leaks from Drums - Leaking drums are fairly common. A typical low-pressure metal drum is a flat piece of metal rolled into a tube with two capped ends. It may be welded at both ends or clamped at the top for access to the contents. A rim or lip runs around the outer edge of each end. Sometimes, various access holes are found on different drums, although typically, the main opening is found at the top. These openings or access holes are closed with a right-handed screw cap referred to as a bung.

One approach to controlling leaks in a drum is to raise the hole above the level of the liquid or solid. This can be done quickly by rolling the drum so the hole is on top or by standing the drum on end so the leak is on top above the liquid level.

Typically, holes or gashes in drums are the results of punctures–often caused by forklifts. A number of drum patches of varying sizes should be available in advance. Patching or plugging can be done using:

- Plug and dike compound;
- Sheet metal screws with washers and rubber gasket;
- Boiler plugs (round or flat wooden plugs); and/or,
- Golf tees.
- Rubber plugs

Response personnel may also perform a "drum-to-drum transfer." This method involves pumping the contents of a damaged drum into a new and empty drum, or into a drum containing the same material. We will cover this below in the product transferring section however always verify that the receiving drum is compatible to the product you are transferring. When transferring flammable liquids remember to properly bond and ground the containers and pump.

Successfully patched drums should be removed from normal service and placed inside a recovery drum (also referred to as an overpack drum) designed to fit over the damaged container. Additional protection can be obtained by first placing the damaged drum inside a large polyethylene bag. The final package must be clearly marked so receivers at its destination are made aware of the hazardous materials stored inside. Failure to mark the recovery drum could be in violation of state and federal regulations. Properly packaged recovery drums will be suitable for transportation to a recycling facility or waste dump. Attachment A at the end of this section provides direction from the DOT on over-packed containers.

Leaks From Piping - Because of pressure buildup, plugging is generally not conducted on piping. Instead clamps or threaded control devices are used. Plugs, if used, should be specially designed for the application. The plugs can be vented or un-vented, although if system pressure exceeds 2 psi, vented plugs will probably be necessary to facilitate plug installation. One type of plug includes a threaded nipple on the vent tube to which a valved hose can be attached. This allows responders to pipe off the material to a suitable container after plug installation.

Leaks from Tank Trucks and Assorted Containers - Tank truck leaks usually occur in the tank shell or its installed pipe and valve system. Breaches in the cargo tank itself normally occur from stress caused on impact, such as the vehicle overturning. Typical holes in the tank shell take the form of punctures and tears. Because tanks may be breached in several locations, they should always be inspected on as many sides as possible during the incident.

The lower the leak on the tank, the greater the spill potential. Naturally, leaks located below the liquid level should be controlled first; however, holes above the liquid should not be overlooked. Vapors may be released through the hole to the surrounding area or fresh air can be drawn inside the tank, possibly placing the vapor space in the explosive range if flammable or combustible liquids are involved.

The types of tools and equipment used are similar to those discussed in the drum section. Special equipment is also available commercially to control tanker spills. These include low-profile inflatable pools, pressure patches that are strapped completely around the container, and various other types of equipment.

Product Transferring - Many times the product must be removed from a damaged container and transferred to a similar undamaged container. Product transfers should be done by trained individuals only. The containers must be bonded and properly grounded before transferring any flammable or combustible material. HazMat teams are many times called upon to verify that this operation is done safely at the scene of an overturned tanker or railcar. There are methods that can be used to transfer gasses, liquids and even liquefied gasses.

A simple technique for transferring a liquid from a 55 gallon drum would be to use a diaphragm pump. Compatibility between the product and the hoses and pump must be considered.

Specialty Tools - Some specialty devices, such as air bags for righting overturned tankers, are available commercially. There are also inflatable patch systems for large vessels. These patch systems are secured against the container breach with chains or webbing and then inflated. Devices similar to air bags are available for use on pipes and small-diameter container systems. Air bag devices designed for controlling leaks operate on relatively low inflation pressures.

Specialty kits such as Chlorine A, B, and C kits are available from manufacturers. These kits require special training to use and are limited to chlorine leaks from standardized chlorine containers. The Chlorine A kit is for 100 or 150-pound cylinders and can be used to temporarily repair valve and wall leaks. The B kit is designed for use on ton containers of chlorine, and the C kit is for emergency leak stoppage from chlorine tank car domes.

Chlorine Kit

Sulfur dioxide is shipped in containers similar to chlorine. A special gasket kit can be obtained to allow the chlorine kit equipment to be used on sulfur dioxide leaks.

Entering a site to patch HazMat leaks requires special training. Responders should be familiar with hazard recognition and the use of protective clothing and equipment before attempting to use equipment. It is recommended that training on leak abatement and spill control be conducted with personnel wearing the protective gear they would wear at an incident. Because protective clothing used at chemical incidents restricts vision, mobility, and adversely affects normal dexterity, the need for all personnel to receive prior training is very important.

Product displacement – Under certain circumstances the addition of water into a tank or holding area will result in the oil or other petroleum products floating on top of the water. If response personnel can maintain the flow of water into the area at the same rate as the leak, and the hole is in a low position then you might be able to contain the product without actually stopping the flow from the container. In this case that water will be leaking and not the hazardous material. This technique is an effective measure only for materials lighter than water or for materials that are insoluble in water. In most cases, it may be more appropriate to retain hazardous materials in an excavated pit, pond, or basin.

Introduction to Strategy and Tactics

During size-up, a general picture of the HazMat incident is developed. Responders gather information about the materials that are involved, the hazardous conditions that exist, and then attempt to determine the severity of the incident and what effects the incident will have on the surrounding area. Based on initial size-up and a continuous evaluation of what is happening, many decisions need to be made:

- Priorities should determined:
- An action plan (strategy) should be developed; and'
- Tactics (actions) should be implemented.

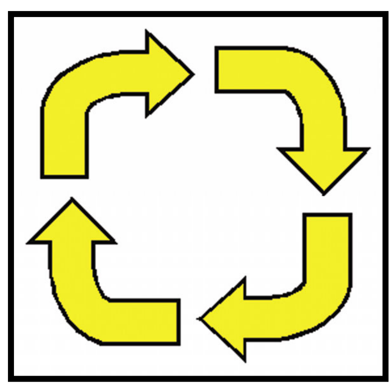
Because each incident is different, the strategy used to prevent or reduce the potential effects on people, property, or the environment must be tailored to the specific conditions present. The strategy chosen must be continuously reevaluated and modified, if necessary, to effectively mitigate any conditions that change during the course of the response.

Strategy and tactics are two different, but inseparable, components of response operations that result in an action plan used to control the emergency.

Strategy is the general plan or course of action for preventing or reducing the effects of an incident.

Tactics are the methods and tasks used to accomplish the selected strategy.

To develop and successfully execute a specific strategy, responders must be properly trained and have available adequate personnel, equipment, and other resources.



Response Objectives - Initial size-up and successive follow-up assessments provide information about the incident from which problems are identified and priorities for response operations are established. Problems, solutions, and priorities are the basis for an evolving strategy and for determining the best control tactics to use.

The objectives of responding to a hazardous materials emergency are to:

- Prevent or reduce the loss of lives or injury to those involved in the incident, including responders, or to those in the surrounding area who could be affected by the hazards produced;

- Prevent or reduce loss of property or damage to property; and
- Prevent or reduce the impact of the incident on the environment.

Strategy - Based on the information obtained, problems are identified and priorities for operations are established by the above mentioned response objectives. Strategic goals are broad based solutions to the identified problems. This is the strategy that will be used to complete the response. A strategy is implemented to prevent or reduce the effects of the incident.

There are nine generally accepted Strategic goals for HazMat incidents:

- **Isolation** of the product form the public and/or responders;
- **Notification** of other's that might be needed;
- **Identification** of hazards on the scene;
- **Protection** of responders;
- **Control the spill;**
- **Controlling the leak;**
- **Controlling the fire;**
- **Recovery** from the incident; and'
- **Termination** of the incident.

Tactics - Tactics are the methods, procedures, and techniques used to complete a strategic goal. There can be several tactics for each of the above strategic goals. Tactics are the answer to the question of who will do what, to accomplish the strategy selected. Once the strategic goals have been identified by the IC or unified command as the correct approach to solve a problem then the proper tactic will be identified and implemented.

The use of any tactic must be thoroughly evaluated. Since various tactical options may exist for controlling a certain situation. The effectiveness of each must be determined and a decision made whether a particular option is more beneficial than some other action or even no action at all.
When evaluating any tactic, an important aspect is that the use of the tactic does not contribute to the problem. In addition the decision should protect the health and safety of responders. In this regard, a risk-versus-benefit approach is again used.

The "Hazardous Materials Goals and Objectives worksheet" is included to remind responders of the nine goals and suggested tactics.

Module 1 Unit 6
Unit Quiz

1. The zone in which the command post should be set-up is..?
    a. The warm zone
    b. The twilight zone
    c. The cold zone
    d. The hot zone

2. The area of greatest contamination should be within the…?
    a. Vapor reduction zone
    b. The warm zone
    c. The cold zone
    d. The hot zone

3. Keeping the product inside its original container is called?
    a. Confinement
    b. Containment
    c. Control
    d. Congestion

4. Diking and damming are examples of…?
    a. Confinement
    b. Containment
    c. Control
    d. Congestion

5. Wooden plugs can be used to stop leaks in drums no matter what the product is?
    a. True
    b. False

6. An overflow dam can be used to stop…?
    a. Miscible liquids
    b. In-miscible liquids with a density of less then 1
    c. In-miscible liquids with a density of more then 1
    d. Solids

7. Plugging a leaking pressure relief device is always a good idea?
    a. True
    b. False
    c. True, if it can be done quickly

8. The two little holes on top of a drum are called?
    a. Bongs
    b. Bings
    c. Bungs
    d. Drains

9. After you plug a leak in a drum it is OK to allow it to be transported to the consignee?
    a. True
    b. False

10. Fires involving hazardous materials must always be extinguished as quickly as possible?
    a. True
    b. False

HazMat Team

Hazardous Materials Goals and Objectives

Strategic Goal	Tactical Objective		
Isolation	Establish a perimeter Determine hot, cold, and warm zones Deny entry and secure area Provide initial public protection Withdraw		
Notification	Request assistance: EMA, EPA, PUCO, Health Departments Communicate Review response plans and/or preplans		
Identification	Recognize and identify the product Check for shipping papers or MSDSs Review preplans in files Conduct reconnaissance Perform air monitoring Take samples Interview victims or witnesses		
Protection	Use appropriate PPE Decontaminate Assess safety Rescue and EMS Reassess zones Provide secondary public protection		
Spill Control	Gas/Air	Ventilate Dissolve Blanket	Disperse Divert
	Liquid/Surface Dilution	Dike Absorb Neutralize	Divert Retain Solidify
	Liquid/Water	Boom Divert	Dam Retain
	Solid/Surface	Blanket	
Leak Control	Direct methods	Plug Overpack Crimp	Patch Tighten
	Indirect methods	Transfer Product Shut off sources Displace product	

HazMat Team	
Hazardous Materials Goals and Objectives Page 2	
Strategic Goal	**Tactical Objective**
Fire Control	Control burn Protect exposures Extinguish Confine Withdraw Cool Containers Remove fuel supply Remove oxygen
Recovery	Oversee product transfer, container handling, and cleanup Place companies back-in-service Turn incident over to proper authority
Termination	Restock and resupply Debrief with on scene companies Critique Paperwork

TITLE 49--TRANSPORTATION
CHAPTER I–RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION, DEPARTMENT OF TRANSPORTATION
PART 173–SHIPPERS--GENERAL REQUIREMENTS FOR SHIPMENTS AND PACKAGINGS–TABLE OF CONTENTS
SUBPART A–GENERAL

Sec. 173.3 - Packaging and Exceptions

(a) The packaging of hazardous materials for transportation by air, highway, rail, or water must be as specified in this part. Methods of manufacture, packing, and storage of hazardous materials, that affect safety in transportation, must be open to inspection by a duly authorized representative of the initial carrier or of the Department.

Methods of manufacture and related functions necessary for completion of a DOT specification or UN standard packaging must be open to inspection by a representative of the Department.

(b) The regulations setting forth packaging requirements for a specific material apply to all modes of transportation unless otherwise stated, or unless exceptions from packaging requirements are authorized.

(c) Salvage drums. Packages of hazardous materials that are damaged, defective, or found leaking and hazardous materials that have spilled or leaked may be placed in a metal or plastic removable head salvage drum that is compatible with the lading and shipped for repackaging or disposal under the following conditions:

(1) Except as provided in paragraph (c)(7) of this section, the drum must be a UN 1A2, 1B2, 1N2, or 1H2 tested and marked for Packing Group III or higher performance standards for liquids or solids and a leakproof test of 20 psi. Alternatively, a drum manufactured and marked prior to October 1, 1993 as a salvage drum, in accordance with the provisions of this section in effect on September 30, 1991, is authorized. Capacity of the drum may not exceed 450 L (119 gallons).

(2) Each drum shall be provided when necessary with sufficient cushioning and absorption material to prevent excessive movement of the damaged package and to eliminate the presence of any free liquid at the time the salvage drum is closed. All cushioning and absorbent material used in the drum must be compatible with the hazardous material.

(3) Each salvage packaging must be marked with the proper shipping name of the hazardous material inside the packaging and the name and address of the consignee. In addition, the packaging must be marked ``SALVAGE'' or ``SALVAGE DRUM.''

(4) Each drum shall be labeled as prescribed for the respective material.

(5) The shipper shall prepare shipping papers in accordance with subpart C of part 172 of this subchapter.

(6) The overpack requirements of Sec. 173.25 do not apply to drums used in accordance with this paragraph.

(7) A salvage packaging marked ``T'' in accordance with applicable provisions in the UN Recommendations may be used.

[Amdt. 173-224, 55 FR 52607, Dec. 21, 1990, as amended at 56 FR 66265, Dec. 20, 1991; Amdt. 173-234, 58 FR 51531, Oct. 1, 1993; Amdt. 173-261, 62 FR 24719, May 6, 1997]

SUBPART B–PREPARATION OF HAZARDOUS MATERIALS FOR TRANSPORTATION

Sec. 173.25 - Authorized Packages and Overpacks

(a) Authorized packages containing hazardous materials may be offered for transportation in an overpack as defined in Sec. 171.8 of this subchapter, if all of the following conditions are met:

(1) The package meets the requirements of Secs. 173.21 and 173.24 of this subchapter.

(2) The overpack is marked with the proper shipping name and identification number, and labeled as required by this subchapter for each hazardous material contained therein unless markings and labels representative of each hazardous material in the overpack are visible.

(3) Each package subject to the orientation marking requirements of Sec. 172.312 of this subchapter is packed in the overpack with its filling holes up and the overpack is marked with package orientation marking arrows on two opposite vertical sides of the overpack with the arrows pointing in the correct direction of orientation.

(4) The overpack is marked with a statement indicating the inside (inner) packages comply with prescribed specifications when specification packagings are required, unless specification markings on the inside packages are visible.

(5) Packages containing Class 8 (corrosive) materials in Packing Group I or Division 5.1 (oxidizing) materials in Packing Group I may not be overpacked with any other materials.

(b) Shrink-wrapped or stretch-wrapped trays may be used as outer packagings for inner packagings prepared in accordance with the limited quantity provisions or consumer commodity provisions of this subchapter, provided the complete package is capable of meeting performance standards at the Packing Group III performance level. Each package may not exceed 20 kg (44 lbs) gross weight.

(c) Hazardous materials which are required to be labeled POISON may be transported in the same motor vehicle with material that is marked or known to be foodstuffs, feed or any edible material intended for consumption by humans or animals provided the hazardous material is marked, labeled, and packaged in accordance with this subchapter, conforms to the requirements of paragraph (a) of this section and is overpacked as specified in Sec. 177.841(e) of this subchapter or in an overpack which is a UN 1A2, 1B2, or 1N2 drum tested and marked for a Packing Group II or higher performance level.

[Amdt. 173-165, 48 FR 28099, June 20, 1983, as amended by Amdt. 173-224, 55 FR 52612 Dec. 21, 1990; 56 FR 66266, Dec. 20, 1991; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-214, 59 FR 67491, Dec. 29, 1994]

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Module 1
Unit 7

Module 1
Unit 7 - Decontamination

Scope of Unit
The purpose of this lesson is to train the technician in proper decontamination techniques and warm zone setup.

Learning Objectives
At the end of this unit of training each student will demonstrate the set-up of the warm zone and knowledge of proper decontamination techniques.

Student Performance Objectives
- List the 5 separate types of decontamination
- Perform emergency decontamination of a victim
- Set-up a mass decon corridor
- Set-up a technical decontamination area
- Must be able to successfully complete competency evaluations 040, 041 and 042

Resource List
- Ohio HAZMAT / WMD Technician Manual
- Decontamination equipment
- Reference resources
- Pen / Pencil
- Scratch paper for notes

References
- The University of Findlay Technician Manual
- NAERG
- NIOSH Guide
- MSDS

Decontamination Procedures

The Hazardous Materials technician should be able to understand and implement decontamination procedures. We will discuss five separate areas of decontamination that the technician should be knowledgeable about and able to setup and manage.

Emergency Decon

True emergency decon

The most important thing for all levels of responders to remember is that water is the universal decontamination solution for human skin. The rapid flushing of skin with water is the best hope to physically remove the chemical and to minimize the pain, skin destruction and symptoms of a chemical exposure.

When people are dying it is not the time to worry about the protection of property or the environment. Assembling sophisticated decon setups or even laying out plastic is a waste of precious time; time that the victim may not have.

If first responders have not initially deconned the victim this must be your first priority. The contaminated person should be instructed to remove their clothing, use their clothing to wipe off anything that remains stuck to their skin and then to leave their clothing on the ground and exit the area.

Instructions can be given verbally or even by using a P.A. system. Anyone experiencing the severe discomfort of a corrosive industrial chemical will probably follow these instructions without concern for their personal effects. Fast decontamination of victims may also prevent them from leaving the scene to seek help elsewhere, which would probably contaminate other areas, such as hospitals or other emergency care facilities.

First-in responders should wear some type of PPE if readily available. For example, firefighters should wear full structural firefighter protective clothing (SFPC) and law enforcement officers could wear their rain gear.

Emergency decon should be performed in the best level of protective clothing available on the scene, however, risk vs. benefit should be applied in how much time to take dressing vs. how quickly the victim needs decontaminated.

Hydrant Cap Decontamination – special hydrant caps that allow a sprinkler type effect can be pre deployed for events or in high hazard areas for rapid deployment by first responders.

Yard sprinklers; Fire sprinkler systems; industrial emergency showers and/or eyewash stations; garden hoses are all sources for emergency decon.

Mass Decontamination

When a large number of victims are contaminated (or potentially contaminated) a larger decon operation must be established after or while emergency decon is being performed. This second decon area, is essentially the same as emergency decon, but will focus on controlling the crowd. They can be setup away from the immediate threatened area. Mass casualty decon corridors would be an excellent way to "herd" the crowd into an area where they could be triaged, treated and transported to a medical facility. HazMat Teams can assist the I.C. in decisions on where and how to do mass casualty decon. Operational level responders were taught the following mass casualty decon techniques.

Hoseline Decontamination - One technique is to use multiple hoselines. These could be setup at each exit from a building and people could be decontaminated as they exit. Alternatively triage areas can be setup inside large buildings and the decon area setup outside entrances so as to only allow properly deconned victims to enter the building.

Engine Corridor Decontamination - In this technique, engine companies are positioned to establish more efficient decon "corridors" by placing engines side by side (facing opposite directions so the pump panels are on the outside) about 25' apart. Each engine has a fog nozzle attached to a discharge on the inside of the corridor. The fog nozzles are opened to wide fog patterns to completely cover the corridor with fog streams. Ambulatory victims are directed to walk through the corridor to be washed.

Emergency Dcon
Source: http://www.35fire.org/newsdecon.htm

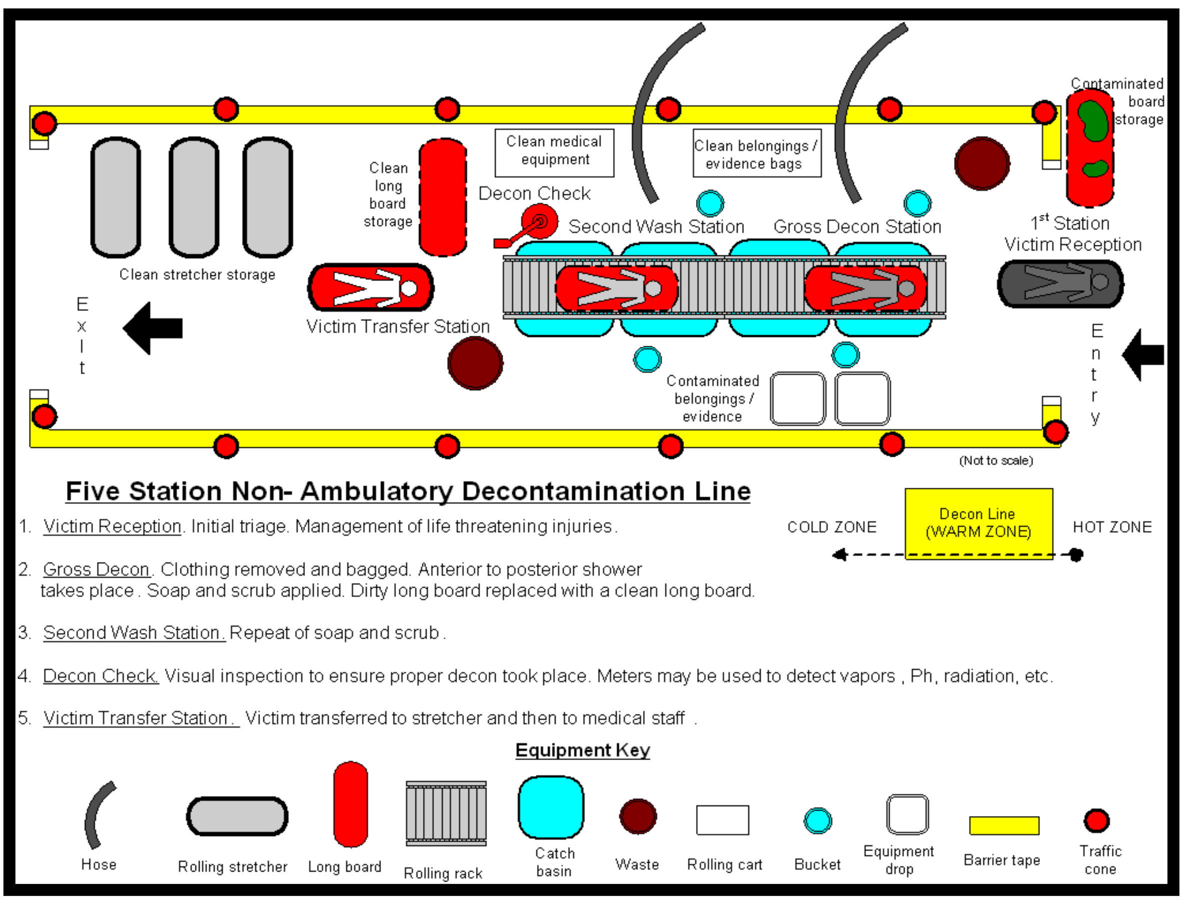
Ladder Corridor Decontamination - Aerial ladders or platforms can be extended horizontally and covered with tarps or plastic that drapes down over the sides to create a tunnel for victims to go through. Hose lines and/or ladder pipes can then be placed on the ladder spraying downward in to the tunnel. This set-up will require practice to lesson the amount of time required for setup.

Decontamination Tents and Trailers - Many jurisdictions have purchased decon tents and/or trailers to provide mobile facilities for mass casualty decon. These units may include water heating devices, equipment for non-ambulatory victims and enclosed changing areas. These may not be as rapidly deployable as the first three listed but do provide a more comfortable decon experience. These units may also be pre-deployable for events.

Technicians who arrive on the scene can also begin to address how to protect the environment. Blocking sewers and drains and controlling runoff can be a priority now that the victims are being treated.

Hospital Decon

Another level of decontamination will be decon at hospitals and/or urgent care centers. Each hospital must have procedures to handle the initial arrival of a contaminated victim without outside assistance. Medical care facilities should



Non-Ambulatory Decon
Source: http://www.publicsafetyphoto.com/decon non.htm

have decontamination procedures so as to protect their own facility from becoming cross contaminated by a victim or victims arriving at their door with product still on them. SOPs should be developed and practiced to deploy decon equipment at a moment's notice. However, always remember that if the chemical is threatening the life of the victim washing the victim with water is the quickest way for survival. The environment can be cleaned up after the victim is properly treated. Many hospitals already have deployable decon tents which are ideal for their needs. Technicians may be needed by hospitals to assist with overwhelming amounts of victims and/or to assess the effectiveness of the process.

Technical Decon

Technical decon will be set up by the HazMat team to safely remove contamination from the PPE worn by the entry teams. They will also decon their tools and equipment in this area.

Responder Decontamination
Source: http://hps.org

Purpose of Decontamination - Most activities that involve handling hazardous materials or wastes will result in some form of contact with the hazardous materials. Contamination is described as the presence of an unwanted material or substance. Personnel may become contaminated in a number of ways including:

- Contacting vapors, mists, or particulates in the air;
- Being splashed by materials while sampling or opening containers; spray from releases;
- Walking, sitting, or kneeling on contaminated surfaces; and'
- Handling contaminated instruments or equipment.

Fortunately, protective clothing and respirators prevent the wearer from being exposed to contaminants. Good work practices will reduce contamination on protective clothing, instruments, and equipment. Even with PPE and good work practices, hazardous substances have the ability to stick to personnel and equipment. Personnel will always have the potential to contaminate the equipment and clothing during site operations. If hazardous substances are not removed from workers and equipment exiting the hot zone they could be spread to clean areas including office areas, vehicles, homes, or restaurants.

To prevent the spread of contamination, methods to reduce and remove contamination must be developed. These methods and procedures must be established before anyone enters the hot zone.

Contamination Prevention - The best way to eliminate problems with decontamination is to prevent or minimize contamination from occurring in the first place. This can be accomplished by:

- **Minimizing contact**: Do not walk through obviously contaminated areas, if possible. Do not physically handle contaminated objects, if it can be avoided. Whenever possible, work from the outside (clean) to the inside (hot) and clean walking surfaces toward the inside to reduce contamination.

- **Remote procedures**: Use remote-handling procedures wherever possible for sampling, handling drums, opening containers, etc. It is generally safer to remove contamination from equipment than to remove it from PPE.

- **Protective covers**: Whenever possible, place instruments, clipboards, and radios into bags. Plastic sheeting can be used to wrap airlines. Covering will prevent permeation of chemicals into equipment and can be removed and disposed later.

- **Disposable clothing**: Wear disposable outer garments and use disposable equipment whenever possible to reduce the need for wet decontamination. Disposable clothing can also be used to protect more expensive, non-disposable protective garments. (i.e. a splash suit worn over the top of structural fire gear).

- **Limit contact**: If contact is required, minimize the amount of time contact is required.

- **Cover contaminants**: Cover heavily traveled areas with plastic or absorbent pads.

Decontamination Planning - The appropriate methods of removal depends on many factors. The most important factors are the type and nature of the contamination.

Types of Contamination - Contaminants may adhere to the surface of an item or article or be permeated into the subsurface area.

- **Surface contamination** - Surface contamination is an unwanted substance that has not been absorbed into the internal spaces of a material. It is normally easier to detect and remove than permeated contamination. Adsorbed is the term used for surface adherence.

- **Permeated contamination** - Contamination that has absorbed into and past the surface of the material it is on. Absorbed is the term for movement of a substance into the structure of another material.

Factors Affecting Contamination - The extent of contamination and the amount of decontamination required may be affected by several factors:

- **Contact time** - The longer a contaminant is in contact with an object, the greater the probability and extent of permeation.

- **Concentration** - The higher the concentration level, the more difficult it may be to remove. This may also increase the potential for permeation to occur.

- **Temperature** - The higher the temperature, the greater the chance of permeation. Liquids and solids may begin to vaporize and more readily permeate protective clothing and equipment.

- **Physical state** - As a rule, gases, vapors, and low-viscosity liquids tend to permeate more readily than high-viscosity liquids or solids, which remain on the surface.

Methods of Decontamination - There are many methods that can be used for technical decontamination. The methods selected must be effective for the situation. The removal technique is based on:

- Type, nature, and concentration of the contaminant involved;
- The amount of contamination;
- The levels of protection required;
- The type of protective clothing worn;
- The type of contamination (surface or permeated); and'
- The characteristics of the surface or equipment that will be decontaminated.

Physical Removal Techniques - Physical removal is effective for surface (adsorbed) contamination. Several methods may be employed. It is important to remember that some physical removal techniques may lead to airborne contamination.

- Brushing: Loose particulate material can simply be brushed off of protective clothing and equipment. Brushing should be performed starting at the top and sweeping downward. Using damp wipes may be appropriate to lower the potential of airborne dusts.

- Scraping: Scrapers are effective in removing highly viscous liquids and solids from surfaces of boots, gloves, and equipment.

- Vacuuming: Vacuums equipped with HEPA filters may be used to remove and contain particulate matter from surfaces. Vacuums may also be employed for liquid spills. Special precautions for flammable liquids must be observed.

- Washing and rinsing: Washing and rinsing will remove surface and some permeated contamination. Pressure washers can be used to remove many contaminants from structures (not people). All water removal techniques require a plan for the collection and disposal of the wastewater that is generated.

- Heat and steam cleaning: In some limited circumstances, heat can be used to drive off volatile contaminants. Heat is most effectively used with equipment decontamination. Steam jets can be used to liquefy viscous petroleum products and allow removal from equipment.

Chemical Removal Techniques - Chemical removal techniques either change the contaminant's form or properties. This either makes the contaminant less hazardous or easier to remove. Various forms of chemical removal include:

- Dissolving contaminants: Chemical removal of surface contaminants can be accomplished by dissolving them in a solvent. The solvent must be chemically compatible with the equipment being cleaned. In addition, care must be taken in selecting, using, and disposing of any organic solvents that may be flammable or potentially toxic. Usually surfactants are used rather than solvents.

- Surfactants: A surfactant enhances physical cleaning methods by reducing adhesion forces between contaminants and the surface being cleaned. Household detergents are among the most common surfactants. Some detergents can be used in conjunction with solvents to improve the dissolving and dispersal of contaminants into the solvent.

- Neutralization: Although rarely done on PPE, neutralization can be used to render acids and bases non-corrosive. Acids can be neutralized with lime, limestone, or sodium bicarbonate. Bases can be neutralized with weak acids. These chemical reactions may result in a non-hazardous by-product that can be disposed of easily. Neutralization reactions give off heat and must be done slowly in a controlled manner by trained and experienced personnel.

- Chemical oxidation: Some chemicals, like cyanide, are easy to break down with oxidizing materials. Technically-qualified personnel, who understand the reaction path, should supervise these activities.

- Solidification: Solidifying liquid or gel contaminants can enhance their removal by physical methods. Generally, solidification is used to remove moisture and bind the chemical so it will not be released from the solid.

- Disinfection/sterilization: Chemical disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization techniques are generally impractical for large equipment and for personal protective clothing and equipment.

Decontamination Implementation - The initial decontamination plan for an emergency response is based on a worst-case scenario. Decontamination procedures must be developed, communicated to employees, and implemented before any employee or equipment enters areas onsite where the potential for exposure to hazardous substances exists, i.e., the hot zone.

Decontamination procedures must provide an organized process by which levels of contamination are systematically reduced. The process must include:

- Standard operating procedures to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances;

- Decontamination of all employees exiting contaminated areas; and,

- Monitoring of all decontamination procedures by the site-safety officer to determine their effectiveness. When such procedures are found to be ineffective, appropriate steps shall be taken to correct any deficiencies.

Location - Decontamination must be performed in geographical areas that will minimize the potential for exposure of personnel and the environment. The decontamination line is established as a control point on the hot line to prevent the spread of contamination.

The size of the decontamination area will depend on the number of stations in the decon procedure, overall dimensions of work-control zones, and the amount of space available at the site. Whenever possible, it should be a straight path.

It is located in the warm zone; however, the first stages of decontamination occur on the "hot side" of the hot line. All decontamination must be completed prior to any personnel or equipment entering the cold zone. The decontamination area should be conspicuously marked with signs for entry and exit.

PPE – The decon corridor can be setup without wearing any PPE due to the fact that the warm zone is not contaminated until the decontamination process begins. The level of PPE for decon team members is related to what the entry team is wearing. Decon team members coming into contact with the contaminated entry team members should be in a level of PPE no more than one level below the entry team.

Personnel Decontamination Procedures - The decontamination process should consist of a series of procedures performed in a specific sequence. Outer, more heavily contaminated items (e.g., boots and gloves) should be decontaminated and/or removed first, followed by the decontamination and removal of inner, less contaminated items of clothing.

- Tarps should be used to protect the ground from contamination tracking and water application.

- Each procedure should be performed at a separate station in order to prevent cross contamination.

- Stations should be separated physically to prevent cross contamination and should be arranged in order of decreasing contamination, preferably in a straight line.

- Separate flow patterns and stations should be provided to isolate workers from different contamination zones containing incompatible wastes.

- Where possible, assign a “clean side” and a “dirty side” to the decon area. Workers who assist contaminated persons should stay on the clean side to avoid traveling through and tracking the contamination.

Decontamination of Decon Equipment Procedures – Decontamination of equipment, materials, and supplies are generally selected based on availability. Other considerations include the ease of decontaminating the piece of equipment or disposability. Most equipment and supplies can be easily procured. For instance, soft-bristle scrub brushes or long-handle brushes are used to remove contaminants. Water in buckets or garden sprayers is used for rinsing. Large galvanized washtubs or stock tanks can hold wash and rinse solutions. A child’s wading pool can also be used for employees to stand in when being decontaminated.

Large plastic garbage cans or other similar containers lined with plastic bags are convenient for storing contaminated clothing and equipment. Contaminated liquids can be temporarily stored in metal or plastic cans or drums. Other gear includes paper or cloth towels for drying protective clothing and equipment.

Decontamination Solution - PPE, sampling tools, and other equipment are usually decontaminated by scrubbing with detergent water using a soft-bristle brush followed by rinsing with copious amounts of water. This process may not be fully effective in removing some contaminants (or in a few cases where contaminants may react with water); however, it is a relatively safe option. When using a chemical-based decontamination solution, the contaminant must be identified. A decontamination chemical is then needed that will change the contaminant into a less harmful substance.

Especially troublesome are unknown substances or mixtures from a variety of known or unknown substances. The appropriate decontamination solution must then be selected in consultation with an experienced chemist.

Processes - Once decontamination procedures have been established, all personnel that may require decontamination must be given precise instructions and training. The site-safety officer should regularly inspect the process to determine its effectiveness. The time it takes for decontamination must also be ascertained, since personnel wearing SCBAs must exit their work area with sufficient air to walk through the decontamination process.

Wet process: Wet processes may be used when the PPE worn has sealed seams. Wet decon on sewn seam suits will transport contamination into the suit and potentially contact the skin. In general, wet decon should be reserved for situations where:

- Level A PPE is worn;
- The chemical presents severe skin corrosion;
- The casual contact by the decon crew may be hazardous to them; and,
- Runoff can be contained.

Dry process: A dry decon process involves the careful and controlled removal of garments. It can be a very effective technique. This method is preferred for disposable garments when chemicals are not pervasive and have low skin contact hazard.

Decontamination Effectiveness - There are several methods used to determine the effectiveness of decontamination. The method used must be consistent with the hazards of the product and the level of decontamination.

- Visual observation: Check for visible material discoloration, stains, corrosive effects, or visible dirt. For products that are of a low toxicity and remain on an item's surface, visual observation is an acceptable means of verifying decontamination.

- Monitoring devices: Photoionization detectors, Geiger counters, Draeger tubes, etc., may show that contamination levels are low. With the exception of radiation, instrument detection is generally not used to verify removal of contaminants.

- Ultraviolet light: Certain contaminants, such as polycyclic aromatic hydrocarbons, fluoresce and can be visually detected when exposed to ultraviolet light. The use of ultraviolet light can increase the risk of skin cancer and eye damage; therefore, a qualified health professional should assess the benefits and risks associate with ultraviolet light prior to its use on site.

- Wipe sampling: Wipe testing provides after-the-fact information on the effectiveness of decontamination. In this procedure, a dry or wet cloth, glass fiber filter paper, or swab is wiped over the surface of the potentially contaminated object and then analyzed at a laboratory. Problems with this method include determining what are an acceptable surface concentration and the time lag between collecting the sample and receiving analysis results.

- Chemical analysis: Sometimes you will need to acquire a sample of the decontaminated item for actual chemical analysis. An alternative is to analyze the decontamination solution to determine whether any contaminants are present and/or in what concentration. Spot-test analyses are easy to do and can give fast information. For example, pH paper can be used on a surface to see if the chemical has been neutralized.

Note: In most situations, there is no reliable method to determine the effectiveness of personal decontamination. Procedures should be verified with dye studies to demonstrate they are effective. Personnel must be trained to follow the prescribed procedure to ensure decontamination was effective.

Equipment Decon

After a large terrorism incident shifts from life safety concerns to evidence retrieval and/or operational recovery elaborate, "equipment" decon will be needed. This decon expertise will come from the next higher level of response. Advanced HazMat teams, Civil Support Teams (CST) and/or Clean-up contractors will arrive, set-up and assist in equipment decon. These groups will take the time to research the best solution to use for the product(s) involved. Specialized decon solutions such as Super-tropical bleach can now be introduced. Plans will also need to be made for decontamination of contaminated areas.

Expired victims that are still in the hot zone can now be deconned and removed for the purpose of autopsies.

EXERCISE MODULE 1 UNIT 6 & 7
DECON, PATCHING AND PLUGGING EXERCISES

Time Allotted: 240 minutes

Equipment needed:

- Various types of non-bulk containers
  - 55 gallon drums
  - Chlorine cylinder
- Various types of bulk containers
  - 1 ton cylinder
  - 307/407
  - 312/412
  - Railcar
- Overpack drums
- Chlorine kits A, B, and C
- Transfer pumps
- Plugging kit

Supplies needed:

- Bonding and grounded equipment
- Patches and plugs
- Full decon set-up
- Decon checklist
- Level B suit ensembles
- Level B dressout checklist

Methodology: The instructor will give you the scenario and you will have to work through solutions based on the information that you have learned.

NOTES:

Module 1 Unit 7
Unit Quiz

1. Decon is performed in the…?
    a. Cold zone
    b. Hot zone
    c. Warm zone
    d. At the hot line

2. The best solution for emergency decon is…?
    a. Alcohol
    b. Consult the MSDS of the chemical
    c. Water
    d. Bleach

3. The best solution for technical decon is…?
    a. Alcohol
    b. Consult the MSDS of the chemical
    c. Soap and water
    d. Bleach

4. Which of the following is not one of the five phases of decon?
    a. Hospital decon
    b. Mass casualty decon
    c. Dry decon
    d. Technical decon

5. What level of PPE is required for setup of the decontamination area?
    a. None
    b. Level B
    c. The same level as the entry team
    d. Level C

6. What is the minimum level of PPE for the decon team to wear?
    a. Level C
    b. Level B
    c. One level below the entry team
    d. Level D

7. Which of the below is not a factor in determining the method of decon required?
    a. Level of PPE worn
    b. Amount of air in the SCBA
    c. Amount of contamination on the PPE
    d. Permeated or surface contamination

8. Brushing, scrapping and vacuuming are all examples of physical removal techniques.
    a. True
    b. False

9. Neutralization may be dangerous to use on suits because…?
    a. It creates heat
    b. It creates pressure
    c. It may not work
    d. It creates water

10. Which of the following is a surfactant?
    a. Soap
    b. Chlorine
    c. Alcohol
    d. Ammonia

Decon Checklist

Name of decon tech____

Names of personnel assigned for decon per the I.C.:

______________________ ____________________ _____________________

______________________ ____________________ _____________________

1-5 gal bucket w/soap	3 trashcans w/liners	2 scrub brushes
2 hoses w/wands	manifold	lights(optional)
tarp (optional)	duct tape (optional)	plastic visqueen
2 decon decks w/bladders (pools)		

___ Confirm type and extent of decon with HazMat branch officer

___ Confirm selected decon area (upwind, uphill, flat surface)

___ Light area if at night

___ Place canvas tarps down if on rough ground (gravel)

___ Lay out plastic minimum size 20' x 50'

___ Roll up sides and tape (optional)

___ Lay 1 1/2 hose from an engine; attach decon manifold and 2 garden hoses

___ Place zoning tape around perimeter and mark entrance and exit

___ Place decon decks (pools) in position and attach bladders

___ Place 5 gal bucket with soapy water and brushes for washing

___ Review decon procedures with I.C.

___ Confirm dress out level for decon personnel

___ Assign tenders and dress decon personnel as per dress-out procedures

Standard Decon procedures

___ Exit hot zone and enter decon area

___ Leave all tools, equipment, and monitors at tool drop

___ One entry team member at a time

 ___Step onto decon deck, wash, scrub and rinse outer suit

 ___Step off decon deck

 ___Remove outer suit, boots and gloves while remaining on air

 ___Place outer suit and gloves in trashcan

 ___Step onto second decon deck

 ___Rinse inner suit

 ___Step off second decon deck

 ___Remove SCBA and inner suit and gloves

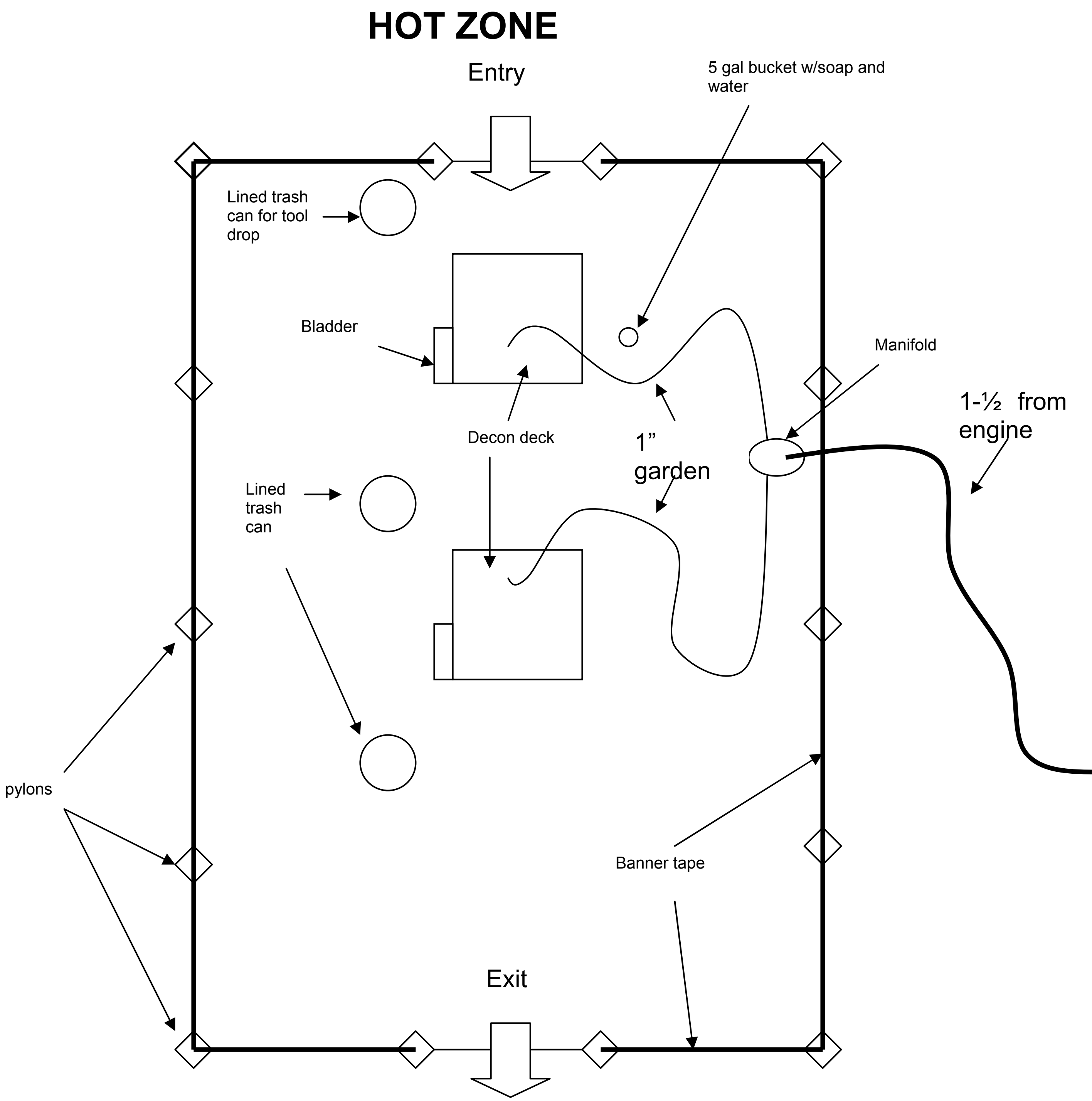
 ___Place inner suit and gloves in trashcan

___ Repeat above steps for each entry team member

___ Have decon team clean and/or wipe off all equipment

___ Rinse off decon team members prior to exit

Standard Decon Diagram



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Module 1
Unit 8

Module 1
Unit 8 - Termination Procedures

Scope of Unit

The purpose of this lesson is to train the technician on proper incident termination.

Learning Objectives

At the end of this unit of training each student will demonstrate an understanding of termination procedures.

Student Performance Objectives

- List the 3 procedural components of incident termination.
- Define debriefing and perform an incident debrief.
- Define Critique and perform an incident critique.
- Understand your jurisdictions after action procedures including, documentation of an incident.

Resource List

- Ohio HAZMAT / WMD Technician Manual
- Pen / Pencil
- Scratch paper for notes

References

- The University of Findlay Technician Manual

Termination Procedures

Any organization's response procedures must include plans on how and when to terminate the incident and return the area to pre-incident conditions.

Incident Transition

As the emergency response phase reaches completion, the incident will transition to the clean-up phase. At this point, the incident can be turned over to the responsible spiller, Ohio EPA and/or local or state health departments. The long-term goal is to assure that the environment is returned back to its original condition. The Ohio EPA can also contact clean-up contractors if no responsible spiller has been identified or the responsible spiller can not pay for clean-up services.

Public sector incident commanders should be aware of the need to continue overseeing the incident during the clean-up phases. Safe recovery and clean-up activities still must be assured to protect public interest. Fire department command can be handed over to Ohio EPA or local health department officials for this phase.

Termination Procedures

After the emergency is contained, responders must properly terminate the incident. OSHA defines termination as "an administrative process that reviews the HazMat event with the goal of improvement." Federal regulations require termination as part of the emergency response.

Termination is documenting incident activities, determining deficiencies, and resolving those deficiencies. The process has three procedural components: **debriefing, critiquing, and after-action procedures**.

Debriefing

Debriefing consists of gathering information from all of the response groups involved in the incident. Debriefing takes place through group discussion. The objectives include discussing the sequential events of the response. A critical component to debriefing is providing the following information to all responders prior to leaving the scene:

- The chemical names of the substances involved in the incident;
- The signs and symptoms of an exposure to each substance; and,
- What you should do if you have or start to have symptoms of exposure.

Records and documentation collected at the scene should be compiled and summarized to produce an accurate timeline of the event.

Critiquing

Critiquing involves identifying and documenting specific accomplishments, problems encountered, and shortcomings. The term “critique” has a negative connotation and is often associated with negative circumstances, where blame and criticism are leveled at an individual or a group. This is not an appropriate use of the term. Critiques are simply asking yourself and others, what, if you had a chance to do the exact incident over again, you would do differently. Constructive criticism is acceptable whereas blaming others is not. Critiques are also referred to as post-incident analysis, operational evaluations or hot washes.

To be effective, the critique must be conducted in a positive manner to get the honest input needed to identify deficiencies within the response system. The critique process should examine operations, command, resource allocation, SOPs, use of response plans, and training.

After-Action Procedures

After action procedures involve analysis, corrective-action planning, reporting, and follow-up.

- **Analysis:** Involves the review and evaluation of both the debriefing and critiquing processes. Its purpose is to identify specific trends and causes of the strengths or weaknesses of the response.

- **Corrective-action planning:** Is determining the changes in procedures, equipment, resources, communication channels, or other elements that were identified as being ineffective. The need for additional training should be determined as well.

- **Reporting:** Is the written summary of findings, conclusions, and recommendations from the debriefing, critiquing, and corrective-action process. Also included in reporting is specific entry of data into personnel and medical records, equipment exposure records, internal report submission, and external reporting to regulators and the community.

  Personnel and medical files should be updated and individual exposure data or injuries should be recorded. These records must be maintained and kept confidential.

  Equipment-exposure records are vital for all reusable equipment and should accurately document when and to what substance(s) equipment may have been exposed. If necessary, someone should record the time and manner of its disposal.

- **Follow-up:** Should be assigned to individuals with the authority to implement corrective actions. Reasonable corrective-action timelines should be assigned.

Module 1 Unit 8
Unit Quiz

1. The termination procedure that includes discussion of the chemicals involved and their hazards is…?
   a. Debrief
   b. Critique
   c. After- action procedures

2. The termination procedure that includes reporting requirements, documentation and equipment replacement is…?
   a. Debrief
   b. Critique
   c. After-action procedures

3. The termination procedure that includes an honest look at how things might go better the next time is?
   a. Debrief
   b. Critique
   c. After-action procedures

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Module 1
Unit 9

Module 1
Unit 9 - Basic Chemistry

Scope of Unit
The purpose of this lesson is to discuss basic chemistry terms.

Learning Objectives
At the end of this unit of training each student will demonstrate knowledge of basic chemistry and will understand how a product's chemical properties can affect the outcome of the HazMat incident.

Student Performance Objectives
- Know and understand chemical terms.
- Understand the terminology (including any glossary of WMD terms, chemical reference manuals, equipment manuals), classes of materials and agents, and toxicology of hazardous materials and WMD agents.

Resource List
- Ohio HAZMAT / WMD Technician Manual
- Basic chemicals for demonstration.
- Pen / Pencil
- Scratch paper for notes

Reference
- Radiological Emergency Management (FEMA)
- The University of Findlay Technician Manual

Basic Chemistry

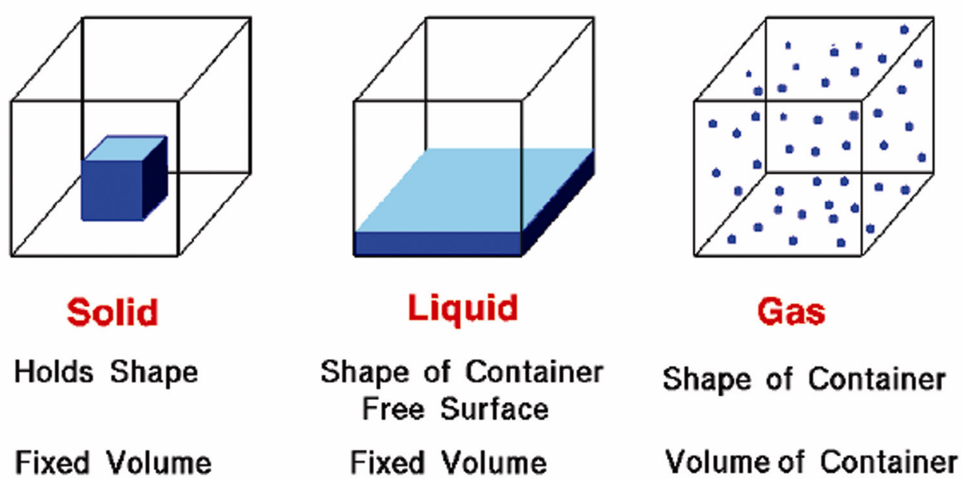
Technician level responders need to understand basic chemical and toxicological terminology and behavior. Knowledge of these terms is important to understand the hazards of each product and to help predict the behavior of the material and its impact on the container and the environment in an emergency. Material Safety Data Sheets (MSDS) as well as reference books and the internet are all resources that can provide information about a specific chemical. Technicians should be familiar with references books that their team uses as well as computer programs and internet sites available.

Terminology

Physical Properties Terms

Physical properties help us understand the ways that chemicals will act in the environment. They help tell us where they will go, what they may do and where they can be found.

Physical State - Hazardous materials are found in three physical states: solids, liquids and gases. Knowing the physical state of the product will help you predict the behavior of the product when it is released.



Source: www.grc.nasa.gov

Appearance - The color and physical state, size of particles, consistency, and/or other describable characteristics of a material. This can be used to verify that the product is what you think it is.

Boiling Point - The temperature at which a liquid changes to a vapor state, usually expressed in degrees Fahrenheit at sea level pressure. Products above their boiling point are normally found as gasses. Products below their boiling point are solids and liquids.

Melting Point/Freezing Point - The temperature at which a solid substance changes to a liquid state or a liquid changes into a solid. Products below their MP/FP are solids.

Sublimation - Some solids turn directly into gases or vapors without going through the liquid phase. This process is called sublimation. When a solid sublimes to a vapor, a tremendous expansion of gas occurs. Dry ice and wood are good examples of a solid that will sublime.

Temperature of Product – The actual temperature of the product. This is important to realize that the temperature of a product inside a 55 gallon drum may be higher or lower then the temperature of its environment. The temperature of the product will eventually become the temperature of its environment.

Viscosity – This is the internal resistance to flow exhibited by a fluid. Viscous materials flow more slowly. Temperature of product will affect its viscosity.

Expansion ratio – This is the rate of expansion between a product in its liquid or solid state and a product’s vapor state. 1 cubic foot of water will make 1270 cubic feet of steam.

Chemical Reactivity (Incompatible) – Two or more materials that, if in contact with each other, could cause a dangerous reaction.

Solubility - The ability of a solid or gas to dissolve in a liquid is termed as solubility. This definition can also apply to two liquids that mix; though technically the mixing of two liquids is referred to as miscibility.

Materials that separate after mixing are referred to as insoluble or immiscible with one another. The solubility of a material is important when determining its dispersion, recovery, and treatment when spilled. Solubility is usually measured as a percentage or in parts per million (ppm)

Specific Gravity – Specific gravity is the weight of a volume of material compared to water (water is given the value of 1). Products with a specific gravity of less than one will float on water, while products with a specific gravity greater then one sink. This term is important and can be used to determine where the product will go once in contact with water.

Vapor Density – Vapor density is the weight of a gas compared to air (air is given the value of 1). Materials lighter than air, such as methane, have vapor densities less than 1.0 and will rise in air. Materials heavier than air, such as propane, will have densities greater than 1.0 and remain low. This helps determine how gases will travel when released.

Vapor Pressure - The pressure exerted by a vapor against the sides of a closed container is called vapor pressure. It is temperature dependent. As temperature increases, so does a products vapor pressure as more liquid evaporates or vaporizes. For example, the vapor pressure of water, measured in millimeters of mercury (mmHg), ranges from 25 mmHg at 70°F to 760 mmHg at 212°F. Common units used to describe vapor pressure are:

- ***Millimeters of mercury (mm/Hg)***: This is an old (but common) term used to measure pressure. This term refers to the amount of mercury that can be lifted in a column in a device like a barometer by the material in vapor form.

- ***psi***: Vapor pressure may be expressed in pounds per square inch (psi) by conversion: 1 millimeter of mercury (mmHg) x .0193 = 1 psi.

- ***Atmosphere (atm)***: An atmosphere is a unit for measuring air pressure. One atmosphere is the relative pressure of the earth's atmosphere. (1 atm = 760 mmHg or 14.7 psi or 1 Barr)

The route of entry into the body is always a consideration when dealing with a hazardous material. Liquids with high vapor pressures are more likely to enter the body through inhalation. Liquids with low vapor pressures are more likely to enter by skin contact.

Critical Temperature and Pressure – The combined temperature and pressure needed to liquefy a gas.

Flammability Terms

Terms related to flammability help us understand the fire hazards associated with a particular chemical. Understanding these hazards will help us select tactics, extinguishing agents and the need for controlling ignition sources.

Auto-ignition Temperature - The lowest temperature at which a product will spontaneously ignite without the presence of a spark or flame. If a product contacts a heat source above its auto-ignition temperature it will ignite. Some products have auto-ignition temperatures close to room temperatures and must be stored in cold areas.

Flash Point - The lowest temperature at which a product produces enough vapor to ignite momentarily (flash) when in the presence of a spark. A product warmer than its flash point can be ignited by a spark.

Fire Point – The lowest temperature at which a product produces enough vapor to ignite and continue to burn. This temperature is slightly higher then a product's flash point.

Lower Explosive Limit (LEL) or Lower Flammable Limit (LFL) - The lowest concentration of a compound in air, below which, a flame will not propagate in the presence of an ignition source. An amount less than the LEL is known as "too lean to burn".

Upper Explosive Limit (UEL) or Upper Flammable Limit (UFL) - The highest concentration of a flammable vapor or gas in air (usually expressed in percent by volume) above which propagation of a flame will not occur in the presence of an ignition source. An amount greater than the UEL is known as "too rich to burn".

Flammable Range – The percentages between a compounds' upper and lower flammable limits. The wider this range, the larger the physical area that a chemical can be ignited in, thus making it easier to ignite. The flammable or explosive range is the fuel concentrations between the LEL and the UEL.

Maximum Safe Storage Temperature (MSST) – The highest temperature that it is safe to store organic peroxides.

Self-Accelerating Decomposition Temperature (SADT) – The temperature that an organic peroxide will become self-heating and continue until exploding or self-igniting.

Corrosivity Terms

Corrosive materials, which include acids and alkalis, can cause damage to skin and eyes and can be very reactive with other chemicals. Corrosive materials may also release vapors which can be harmful. It is important to understand terms related to corrosives.

Corrosive/Corrosive Material - As defined by the U.S. Department of Transportation, a corrosive material is a liquid or solid that causes visible destruction or irreversible alterations in human skin (tissue) at the site of contact; or, in case of a leak from its package, a liquid that has a severe corrosion rate on steel.

The strength of an acid or a base can be measured using the pH scale. Strong acids have low pH values while strong bases have high pH values. The pH scale ranges from 0 to 14 as follows:

< Increasing Acidity   Neutral   Increasing Basicity >

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

pH – The pH scale is a measure of the hydrogen ion concentration of a material. The scale goes from 0 to 14. Chemicals with pH values below 7 are considered to be acids, while chemicals with pH values greater than 7 are considered to be alkaline. A pH value of 7 is considered to be neutral.

Dissociation/Corrosivity – The breaking up of a compound into simpler components.

Acid - A corrosive material with low pH. A strong acid turns litmus (pH) paper red. Examples are sulfuric acid and hydrochloric acid.

Alkali (Base) (Caustic) - A corrosive material with high pH. This type of substance turns litmus (pH) paper to greens and blue. Common strong alkalis are sodium hydroxide and potassium hydroxide.

Chemistry Terms

The study of how atoms can form into compounds can help the technician better understand chemical names and their properties. Knowledge of the table of periodicity is helpful in understanding many chemical terms.

Ionic Bond – The electrostatic attraction that holds ions together in an organic compound.

Covalent Bond – A shared pair of electrons between two atoms in a molecule.

Organic – Carbon containing non-salt compounds: Materials which contain carbon atoms.

Inorganic – Compounds derived from matter other than vegetable or animal sources which lack carbon chains but may contain a single carbon atom.

Saturated Hydrocarbon – A hydrocarbon containing only single covalent bonds. All of the carbon atoms are saturated with hydrogen.

Unsaturated (straight and branched) hydrocarbon – A hydrocarbon with at least one double covalent bond between two carbon atoms somewhere in the molecule. This double bond means that the carbon is not saturated with hydrogen atoms

Aromatic Hydrocarbons – A hydrocarbon that contains the benzene “ring” which is formed by six carbon atoms resonantly bonded.

Halogenated Hydrocarbon – A hydrocarbon derivative in which the hydrocarbon is bonded with any of the halogen family of chemicals (Fluorine, Chlorine, Bromine, Iodine and Astatine).

Auto Refrigeration – The ability to release a liquefied compressed gas quickly enough so that it lowers the temperature of the liquid below the point where it can produce vapors. By so doing the container may temporarily stop releasing vapors. This is also known as freeze down.

Chemical Interactions – Reaction caused by mixing two or more chemicals together. This may result in the production of heat or pressure.

Chemical Change – The changes in a chemical’s physical properties as it reacts with another chemical.

Compound Mixture – The chemical combination of two or more elements.

Concentration – The percentage of an acid or base dissolved into water. This is not the same as the strength of the acid.

Catalyst – A material that speeds up the rate of a chemical reaction without actually entering the reaction.

Inhibitor - A substance that is added to another to prevent an unwanted chemical reaction from occurring.

Instability – The ability of a material to undergo a chemical reaction with the release of energy. An instable chemical may react without warning.

Oxidation Potential – The ability of a material to (1) give up its’ oxygen molecule to stimulate the oxidation of organic materials or (2) receive electrons being transferred from the substance undergoing oxidation. The result of either activity is the release of energy.

Solution – Mixture in which all of the ingredients are dissolved.

Slurry – A pourable mixture of a solid and a liquid.

Strength – The degree in which a corrosive ionizes in water. Measured by pH.

Reactivity – The ability of a material to undergo a chemical reaction with the release of energy.

Physical Change – The changing of one or more of the chemical properties of a chemical.

Radiological terms

Radiological Materials - Radioactive materials are substances that decay at the nuclear level. When decay occurs, radiation is emitted. Radioactive materials may emit different types of harmful radiation.

The three most commonly encountered forms of radiation are *alpha particles*, *beta particles*, and *gamma waves*. All three forms harm living organisms by imparting energy that ionizes molecules in the cells. Hence, the three are referred to as ionizing radiation.

Alpha Particles have a positive charge and a mass. They travel a short distance (inches) from the source. Alpha radiation does not have enough energy to penetrate the dead layer of cells on the skin surface, but can be very toxic if inhaled, ingested, or injected into the body.

Beta Particles can have a positive or negative charge and they are a lot smaller than alpha particles. Beta particles may travel a couple of feet from the source and can penetrate the skin and cause burns. They are also toxic if inhaled or ingested. Protective clothing can prevent skin penetration.

Gamma Radiation is pure electromagnetic energy and is wave-like rather than particulate. Gamma waves will pass through most materials. Clothing, including protective gear, will not prevent gamma radiation from interacting with body tissue.

Half Life – The amount of time it takes for an isotope to lose one half of its radioactivity.

Radioactivity – The ability of a material to emit radioactive energy. The amount or rate of radiation that the isotope is releasing.

RAD (Radiation Absorbed Dose) – The basic unit of dose of ionizing radiation. A dose of one RAD means the absorption of 100 ergs of radiation per gram of absorbing material.

REM (Roentgen Equivalent Man) – The unit of dose of any type of ionizing radiation that produces the same biological effect as a unit of absorbed dose of ordinary x-ray.

CPM (Counts Per Minute) – This term is used in conjunction with radiation detection monitors. Some radiation detectors use CPM to indicate the level of activity. Kilo means 1000.

Toxicity Terms

Toxicity refers to the harmful effect of chemicals on living organisms. These terms are used in reference books and on Material Safety Data Sheets (MSDS) to describe the health effects associated with a chemical. Understanding the health hazard helps us to select the appropriate level of PPE.

Toxicology –The study of the harmful effects of chemicals on biological systems.

Acute Effect - An adverse effect on a human or animal with symptoms that develop rapidly.

Chronic Effect - An adverse effect on a human or animal with symptoms that develop slowly over a long period of time, or recur frequently.

Allergic Reaction - An abnormal physiologic response to a chemical or physical stimuli by a sensitive person. Some dermatitis and asthma-like symptoms result from allergic reactions.

Asphyxiant - A vapor or gas that can cause unconsciousness or death by suffocation (lack of oxygen). “Simple asphyxiants” are those asphyxiants that are harmful to the body only when they become so concentrated that they reduce oxygen in the air (normally about 21%) to dangerous levels (16% or less).

Carcinogen - A substance or agent capable of causing or producing cancer.

Irritant - A substance that will cause an inflammatory response or reaction of the eye, skin, or respiratory system, following exposure.

Sensitizer - A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

Convulsant – A chemical which causes a substantial number of exposed people to develop seizures after exposure.

PPM, PPB (parts per million, parts per billion) – The amount of parts of a substance in a million (billion) parts of air or water. This term is used to describe the toxicity levels of gas molecules in air or products mixed in water.

Lethal Concentration 50% (LC50) – The concentration of a material in air that will kill 50% of the test subjects (animals, typically mice or rats) when administered as a single exposure (typically 1 or 4 hours). Usually expressed in parts per million (ppm), for example LC50 = 200ppm (rat). It is a means of comparing relative toxicity. This value gives you an idea of the relative acute toxicity of an inhalation hazard. The lower the number the more toxic the substance.

Lethal Dose 50% (LD50) - The amount of a solid or liquid material that it takes to kill 50% of test animals (for example, mice or rats) in one dose. The concentration of a material, usually expressed in milligrams per kilograms (mg/kg) that a test animal is exposed by ingestion, injection or skin absorption which causes death to 50% of the test animals within a specified time. For example LD50 = 10 mg/kg (mice). It is a means of comparing relative toxicity.

Permissible Exposure Limit (PEL) - The concentration of a chemical in the workplace air to which most people can be exposed without experiencing harmful effects. PEL's are established and enforced by OSHA. Exposure limits should not be taken as sharp dividing lines between safe and unsafe exposures. It is possible for a chemical to cause health effects, in some people, at concentrations lower than the exposure limit.

Threshold Limit Value – Time Weighted Average (TLV-TWA) – An exposure guideline developed by the American Conference of Governmental Industrial Hygienists (ACGIH). The TLV-TWA is the time-weighted average concentration of a chemical in air for a normal 8-hour work day and 40-hour work week to which nearly all workers may be exposed day after day without harmful effects. Time-weighted average means that the average concentration has been calculated using the duration of exposure to different concentrations of the chemical during a specific time period. In this way, higher and lower exposures are averaged over the day or week.

TLV - Short Term Exposure Limit (STEL) - An exposure guideline developed by the American Conference of Governmental Industrial Hygienists (ACGIH). The average concentration to which workers can be exposed for a short period (usually 15 minutes) without experiencing irritation, long-term or irreversible tissue damage, or reduced alertness. The number of times the concentration reaches the STEL and the amount of time between these occurrences can also be restricted.

TLV - Ceiling Limit (C) – The ceiling exposure limit is the concentration which should not be exceeded at any time, even if averaged into a TLV-TWA.

Immediately Dangerous to Life and Health (IDLH) - IDLH means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from that atmosphere.

Toxic Products of Combustion – Many materials undergo chemical changes when they burn and will produce toxic gases and/or particulate matter during this process. Often these toxic gases will differ substantially from the material which is burning. Some may be much more toxic than the material which produced them.

Dose – The amount of a chemical absorbed, inhaled, ingested or injected into the body.

Dose-Response Relationship – The reaction that occurs from the amount or dose of the chemical taken into the body.

Infectious Dose – The required amount of exposure to a biological agent that will produce signs and/or symptoms.

Incubation Period – The time between an exposure to an infectious dose of a biological agent and the appearance of the first recognizable sign and/or symptom.

Reactivity Terms

Explosive - A substance that undergoes a very rapid chemical breakdown that produces large amounts of gas and heat. The gases produced rapidly expand at velocities exceeding the speed of sound. This creates a shock wave (high-pressure wave front) and noise. Explosives are divided into categories based on the speed of the detonation.

High Explosives - Chemical transformation occurs very rapidly with detonation rates as high as 4 miles per second

- **Primary high explosive:** Materials detonated by shock, heat, or friction. Examples are lead azide, mercury fulminate, and picric acid.

- **Secondary high explosive:** Materials that need an outside force to detonate. They are relatively insensitive to shock, heat, or friction. Examples are dynamite and TNT.

Low Explosives - Materials that deflagrate (burn fast) up to 1,000 feet per second. Generally, these materials will explode when ignited under confinement.

Examples are smokeless powder, black powder, and solid rocket fuel.

Pyrophoric (Air Reactive) - Chemicals which will ignite spontaneously in air at a temperature of 130 degrees F (54.4 degrees C) or below. Pyrophoric materials are usually stored in cylinders or under water or an inert gas

Polymerization - The process of forming a polymer by combining large numbers of chemical units or monomers into long chains. Polymerization can be used to make some useful materials. However, uncontrolled polymerization can be extremely hazardous. Some polymerization processes can release considerable heat and can generate enough pressure to burst a container or can be explosive. Some chemicals can polymerize on their own without warning. Others can polymerize upon contact with water, air or other common chemicals. Inhibitors are normally added to products to reduce or eliminate the possibility of uncontrolled polymerization. Most MSDSs have a section called "Hazardous Polymerization" that indicates whether hazardous polymerization reactions can occur. Shaving cream is an example of a mild polymerization.

Water Reactive - Material that reacts with water to release a gas that is either flammable or presents a health hazard. Reactions are usually exothermic (heat producing).

Hypergolic - Self-igniting upon contact of its components without a spark or external aid.

Oxidizers - Oxidizers are aggressive chemicals that react and break down other materials. In fire situations, oxidizers enhance the burning of the fuel by giving off oxygen. The chemical reaction between an oxidizing material and a fuel may start the fuel on fire without an external ignition source.

Chemical Warfare Terms

Biological Agents and Toxins (Etiological Agents) - Etiological agents are living organisms (or their products) that can cause sickness, disease, and even death to an exposed individual. There are four general categories of biological agents that are capable of causing infection or disease in exposed individuals. They are *viruses, bacteria, fungi*, and *mold*. Like chemical hazards, they may be dispersed throughout the environment via wind, water, soil, or dust.

Many biological agents have complex life cycles that require host and intermediate (carrier) host organisms to develop. Rodents, for example, are commonly found at landfills and act as carriers for the rabies virus. Likewise the tick can carry the organism that produces Lyme disease in man. Most biological organisms can be destroyed with sterilization techniques.

Blood Agents – Chemicals that affect the blood's ability to utilize oxygen.

Blister Agents (Vesicants) – Chemicals that produce blisters after contact with skin.

Irritants (riot control agents) – Agents designed to reduce the ability of the victim to fight back including mace and pepper spray.

Nerve Agents – Chemical agents that disrupt the body's central nervous system.

Persistence – A product's ability to resist evaporation. Agents with very low vapor pressure are considered persistent.

EXERCISE MODULE 1 UNIT 9
CHEMISTRY

Time Allotted:	30 minutes
Equipment needed:	(2) 4 gas air monitors P.I.D. pH paper
Supplies needed:	Acetone or other organic solvent Acetic Acid (vinegar) Battery Acid (Sulfuric acid) Ammonia (window cleaner) 4 to 6 small containers with lids or covers NIOSH pocket guide and other references
Methodology:	The instructor will give you the scenario and you will have to work through solutions based on the information that you have learned.

NOTES:

Module 1 Unit 9
Unit Quiz

1. Flp, LEL, UEL and SADT are terms of…?
    a. Corrosiveness
    b. Flammability
    c. Chemical properties
    d. Physical properties

2. The weight of a product compared to water is its…?
    a. Vapor density
    b. pH
    c. Specific gravity
    d. Vapor pressure

3. A vesicant is…?
    a. A nerve agent
    b. An incapacitating agent
    c. An explosive
    d. A blister agent

4. Water's vapor pressure at room temperature is…?
    a. 14.6 psi
    b. 25 mmHg
    c. 760 mmHg
    d. 1 Bar

5. Pyrophoric means…?
    a. Air reactive
    b. Explosive
    c. Water reactive
    d. Hypergolic

6. Persistence means…?
    a. Burns readily
    b. Self-igniting
    c. Dangerous when wet
    d. Resists evaporation

7. Which of the following is a halogenated hydrocarbon?
    a. Methyl alcohol
    b. Acetone
    c. Chloro-difluoromethane
    d. Di hydrogen monoxide

8. Which of the following is an aromatic hydrocarbon?
    a. Hydrogen chloride
    b. Chlorine
    c. Benzene
    d. Acetic acid

9. Miscibility is another word for?
    a. Solubility
    b. Insolubility
    c. Reactive
    d. Concentration

10. A product will boil when its vapor pressure reaches…?
    a. 14.6 psi
    b. 1 bar
    c. 760 mmHg
    d. All of the above

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