Rescue Technician—
Confined Space Rescue

Maryland Fire and Rescue Institute
University of Maryland
Steven T. Edwards

Spring 2015
The Maryland Fire and Rescue Institute of the University of Maryland is the State’s comprehensive training and education system for all emergency services.

The Institute plans, researches, develops, and delivers quality programs to enhance the ability of emergency service providers to protect life, the environment, and property.
Lesson 1-2: Introduction

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe the structure and requirements of this course.

Overview

- Course Structure and Introductions
- Course Requirements
Course Structure and Introductions

- Structure of class

Course Structure and Introductions

- Class Structure
  1-1 Registration
  1-2 Introduction
  1-3 Confined Spaces and Their Hazards
  2-1 Confined Space Entry Requirements
  3-1 Air Monitoring
  3-2 Ventilation and Inerting
  4-1 Lock Out/Tag Out
  4-2 Strategic Rescue Factors
  5-1 Using the Incident Command System
  5-2 SOPs
  5-3 Team Evaluation
  6-1 Safety
  7-1 Rescue
  7-2 Rescue Equipment
  8-1 Practical Exercises
  9-1 Practical Exercises
  10-1 Comprehensive Practical Exercise
  11-1 Final Written Exam
Course Structure and Introductions

- Attendance requirement
- Safety first
- Terms
- Introductions

Course Requirements

- PTIs – Must be completed prior to a student taking the final written exam.
- Final Written Exam – Student must receive a grade of 70% higher.

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe the structure and requirements of this course.
Review

- Course Structure and Introductions
- Course Requirements
Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to define what constitutes a confined space and describe the hazards associated with confined space rescue.

Overview

- Introduction
- Defining Confined Space
- Hazard Recognition
- Non-Permit Spaces versus Permit-Required Spaces
Introduction to Confined Space Rescue

- Lessons Learned
- OSHA History

Rule 1—Don’t become a victim

Introduction to Confined Space Rescue

- NFPA 1006 Level I versus Level II
  - Level I
    - Prepare to enter a confined space
    - Enter a confined space
    - Package a victim
    - Remove all entrants
  - Level II
    - Preplan a confined space
    - Assess a confined space incident
    - Control hazards at a confined space incident

Defining Confined Space

- A confined space
  - Is large enough to enter
  - Has limited openings
  - Is not meant for human occupancy
Defining Confined Space

Interior of a confined space. This space is large enough for a person to enter and work in.

View of a limited opening on a confined space—opening is on top of the vault.

Hazard Recognition

- Atmospheric hazards
  - Flammable gas, vapor or mist
  - Airborne combustible dust
  - High or low atmospheric oxygen
  - Atmospheric concentration in excess of permissible exposure limit
  - Other IDLH atmospheric conditions

Hazard Recognition

- Flammable/Explosive Range
  - Lower Flammable Limit (LFL)
  - Upper Flammable Limit (UFL)
  - Flash Point
- Dust Conditions
- Hazardous Materials
Hazard Recognition

Illustration showing flammable range. The fuel mixture to the left of the LFL is too lean (not enough fuel), and the fuel mixture to the right of the UFL is too rich (too much fuel, not enough oxygen).

Hazard Recognition

Flammable ranges of various materials. Some materials have a narrow flammable range, whereas others have a broad range.

Hazard Recognition

Different materials have different flash points. Knowing the identity of the material, the flash point, and the temperature of the material will give you an idea of the fire hazard.
Hazard Recognition

Effects of Reduced O2

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>21%</td>
<td>Normal atmosphere</td>
</tr>
<tr>
<td>10.5%</td>
<td>OSHA definition as oxygen-deficient</td>
</tr>
<tr>
<td>17%</td>
<td>Some muscular impairment, increased respiratory rate</td>
</tr>
<tr>
<td>12%</td>
<td>Dizziness, headache, rapid fatigue</td>
</tr>
<tr>
<td>9%</td>
<td>Unconsciousness</td>
</tr>
<tr>
<td>8%</td>
<td>Death within a few minutes</td>
</tr>
</tbody>
</table>

Effects of varying levels of oxygen on people.

---

Hazard Recognition

- Physical Hazards
  - Electrical
  - Mechanical
  - Fire
  - Physical Features
  - Engulfment

---

Hazard Recognition

A variety of physical hazards can be present in a confined space. Note the sludge thickener (screw) running up the center of the picture. A final clarifier tank in a sewage treatment plant. Hazards include the water, sloped sides near the top of the tank, and weirs.
Non-Permit Spaces versus Permit-Required Spaces

- Permit Spaces
  - Hazardous Atmosphere
  - Engulfment Potential
  - Internal Configuration
  - Other Health and Safety Hazards
- Non-Permit Spaces

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to define what constitutes a confined space and describe the hazards associated with confined space rescue.

Review

- Introduction to Confined Space Rescue
- Defining Confined Space
- Hazard Recognition
- Non-Permit Spaces versus Permit-Required Spaces
Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe the requirements to make entry into a permit-required confined space.

Overview

- Requirements for Confined Space Entry
- Confined Space Programs
- Confined Space Entry Permit
- Entry Permit Preparation
- Ropes and Rigging Review
Chapter 1 Review Questions

- Discuss the review questions found on page 11 of the text.

Requirements for Confined Space Entry

- Lessons-learned review
- Rescue standard operating procedures
- Entry permit
  - Determine if an entry permit exists
  - Use the entry permit during size-up

Confined Space Programs

- Attendant
- Authorized Entrant
- Confined Space Supervisor
Confined Space Programs

Attendant communicating with the entrants working inside the confined space.

Any person who makes entry into a confined space is an entrant and must be trained as an entrant. This entrant training requirement includes rescuers.

The confined space supervisor is responsible for making sure that the entry permit is properly filled out.

Confined Space Entry Permit

- Permit Spaces
  - Hazardous atmosphere
  - Engulfment potential
  - Internal configuration
  - Other health and safety hazards

- Non-Permit Spaces

Not all spaces are permit-required confined spaces. This space does not require a confined space entry permit because it does not meet the definition of a permit-required confined space. But if an emergency occurred, how would you handle this space?
Confined Space Entry Permit

- Elements of an Entry Permit
  - Issue and expiration date
  - Identification of job site/space and supervisor
  - Equipment to be worked on and work to be done
  - Identification of attendant and entrants
  - Atmospheric checks before and during entry

Confined Space Entry Permit (continued)

- Lockout/tagout in place
- Ventilation requirements
- Atmospheric monitoring
- Communication procedures
- Rescue procedures

Confined Space Entry Permit (continued)

- Identification of all persons associated with the permit, including stand-by personnel
- Equipment required
- Review and approval signature
Entry Permit

Entry Permit Preparation
- In-class exercise
  - Groups fill out permit
  - Review with whole class

Rope and Rigging Review
- Review rope and rigging skills required to perform practical exercises in Sessions 7, 9 and 10.
Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe the requirements to make entry into a permit-required confined space.

Review

- Requirements for Confined Space Entry
- Confined Space Programs
- Confined Space Entry Permit
- Entry Permit Preparation
- Ropes and Rigging Review
Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe why and how to monitor the air in a confined space.

Overview

- Combustible Gases
- Oxygen Monitoring Equipment
- Specific Gas Monitoring
- pH Devices
- Understanding Monitoring Equipment
- Readings
Chapter 2 Review Questions

Discuss the 10 review questions found on page 28 of the text.

Combustible Gases

- Lessons-learned review
- Direct Reading Instruments
- Combustible Gas Indicator (CGI)
  - Wheatstone Bridge
  - LFL %
  - Gas used to calibrate
  - Action limit
  - Effects of vapor density

A combustible gas detector combined with a multiple gas detector and calibration equipment.
Combustible gas detectors indicate how close the gas concentration is to the lower flammable limit of the gas with which the meter is calibrated.

For a CGI calibrated on methane, a meter reading of 50 percent would indicate a gas concentration equal to 2.5 percent methane in air.

Depending on the vapor density of the gas you are attempting to monitor, the gas concentration may vary within the space. A gas that is heavier than air will tend to be more concentrated at the bottom of the space. The reverse would be true for a gas that is lighter than air.
Combustible Gases

- Demonstration
- Student practice

Oxygen Monitoring Equipment

- Upper and lower limits
- Impact of oxygen content on rescue efforts and safety
- Evaluation of the space and monitoring different levels of the space

Oxygen Monitoring Equipment

<table>
<thead>
<tr>
<th>Effects of O₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Above 20.6%—materials can ignite easily and will burn rapidly</td>
</tr>
<tr>
<td>- 23.5% — O₂ IA definition as oxygen enriched</td>
</tr>
<tr>
<td>- 21% — normal</td>
</tr>
<tr>
<td>- 19.5% — O₂ IA definition as oxygen deficient</td>
</tr>
<tr>
<td>- 17% — some muscular impairment, increased respiratory rate</td>
</tr>
<tr>
<td>- 12% — dizziness, headache, rapid fatigue</td>
</tr>
<tr>
<td>- 9% — unconsciousness</td>
</tr>
<tr>
<td>- 5% — death within a few minutes</td>
</tr>
</tbody>
</table>

Oxygen levels that are above or below the normal range of 19.5 percent to 23.5 percent lead to problems that must be addressed.
Oxygen Monitoring Equipment

- Demonstration
- Practice

Specific Gas Monitoring

- Identification of potential gases
- Use of gas specific monitors
- Interpreting readings
- Presence of an IDLH
- Use of colorimetric tubes
- Limitation of indirect monitoring devices

Specific Gas Monitoring

This is a meter that is designed to monitor carbon monoxide levels. It is not intended to detect or measure any other gas.
Specific Gas Monitoring

This meter is designed to measure combustible gases, oxygen, and hydrogen sulfide.

Specific Gas Monitoring

Colorimetric tubes are designed to be used to detect specific chemicals. These tubes are used by drawing a sample of air through the tube and then noting any color change.

Specific Gas Monitoring

- Demonstrate
- Practice
pH Devices

- Nature of corrosive materials
- pH of specific substances
- Methods of determining pH
- Use of pH tools

pH Devices

- pH meter
- pH paper

pH Devices

- Demonstrate
- Practice
Understanding Monitoring Equipment Readings

- Order of equipment use
- Monitoring outside environment
- Use of pre-plans
- Confined space size-up and the role of monitoring
- Continuous monitoring
- Use of manufacturer documentation
- Interference with monitoring equipment

1. Monitor the atmosphere outside of the confined space as you approach the opening. Then begin monitoring the space, beginning at the top of the space, moving to the middle, and finally moving near the bottom of the space.

2. Depending on the length of any hose or tubing attached to the monitoring equipment, the response time of the equipment will vary. The longer the hose, the longer it takes for the sample to reach the sensors.

3. If the space is deep, you might want to consider taking readings at intermediate levels between the top, middle, and bottom levels.

4. Do not allow the sampling tube to touch or rest on the bottom of the confined space. Debris can enter sampling hose and plug or damage the meter.
Monitoring

- PTI 3-1: Environmental Monitoring

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe why and how to monitor the air in a confined space.

Review

- Combustible Gases
- Oxygen Monitoring Equipment
- Specific Gas Monitoring
- pH Devices
- Understanding Monitoring Equipment Readings
Lesson 3-2: Ventilation and Inerting

Student Performance Objective
- Given information from discussion, handouts, and reading materials, the student will be able to describe and demonstrate how to ventilate a confined space and identify the impact of inerting a confined space.

Overview
- Ventilation
- Inerting
- Practical Exercises
Ventilation

- Ventilation eliminates or reduces hazards.
- Atmospheric hazards can originate from outside the space.
  - Accidental (such as vehicle exhaust)
  - Intentional (such as inerting)
- Ventilation reduces contaminants by dilution or removal.
- Ventilation can provide victims with increased oxygen.

Ventilation

- Mechanical ventilation can protect victims.
  - Entry is not required.
  - Set-up is quick.
- Prior to ventilation:
  - Know what hazards are in the space.
  - Initiate constant monitoring.
  - Estimate space size and ventilation requirements.

Ventilation

You know that this space contains a hazardous atmosphere. Now you must determine what the hazard is.

This confined space has a single, small (2′1-inch) opening for ventilation and access.
Ventilation

A mechanical blower that moves 2,500 cubic feet per minute (cfm) will change the air 2.5 times per minute in a 1,000 cubic foot space.

By blowing air into a space and placing the air hose near the victim, you can provide fresh air to the victim.

This large, bulk storage tank will be difficult to ventilate due to the large volume of the space.

Ventilation

Inlet and exhaust openings must be planned.
- Consider the hazard to people outside the space.
- Locate ventilation openings to take advantage of vapor density.

You must know where your exhaust gases are going as you vent a confined space. If these exhaust gases are heavier than air, or the intake opening was downwind of the exhaust opening, what effect would that have on your operation?
Ventilation

Churning occurs when air is blown through the fan or blower, enters and immediately exits the space, and is drawn right back through the fan. When you are venting a space, you must be aware of how effective the air movement is. Air that is churning does not contribute to ventilating the space.

Prevent churning by using a hose attached to the fan—this creates a remote discharge point for air being moved by fan. When you have a space with a single opening, it must be used for intake and exhaust. By using a hose to push air into the lower areas, air will circulate more effectively.

Other factors to consider:
- Where exhaust gases will go
- Victim location
- Gas location
- Fans’ placement
  - Volume
  - Stacking and tandem use
  - Hose length and diameter
Ventilation

- Saddle Vent™
  - Air is received from an 8-inch blower hose, passed through Saddle Vent™ and passed into an 8-inch hose for delivery.

- Heaters
  - Heaters are used in cold confined spaces.

- Filters
  - Filters are placed in the line to remove dust.

Power sources for ventilation equipment include:
- Gasoline
- Internal combustion engine
- Electric motor
- Air compressor

Some equipment can be an ignition source for flammable vapors.

Potential equipment failures can be simple problems (an accidental unplugging) or complex problems (loss of electrical power).
- Determine if you can safely work around the problem or if rescuers need to be pulled out.
- If impact is minor, make sure it remains minor.
- Minimize impact of failures by maintaining equipment.
Ventilation

- Positive-pressure ventilation
  - Takes air from outside and forces it inside
  - Use a hose to direct air to victim
  - Avoids flammable vapors coming into contact with the fan blades or motor
  - Static electricity still may occur

Ventilation

It is possible to use a single opening for positive-pressure ventilation. You must allow for a space at the top of the intake opening for exhaust gases to pass to the outside.

Ventilation

It is possible to use fans in combination for both positive-pressure and negative-pressure ventilation.
Ventilation

- Negative-pressure ventilation is
  - Drawing air out
  - Directing air to a location remote from inlet opening
- A combination of negative and positive pressure may also be used

Ventilation

A gasoline powered blower and two electrically powered fans. Note the size and length of the ventilation hoses as well as the different sizes of the fans.

Inerting

- Inerting
  - Removes oxygen from a confined space
  - Uses gases such as:
    - Nitrogen
    - Carbon dioxide
    - Combinations
Inerting

- Inerting removes oxygen to:
  - Eliminate one leg of the fire triangle (oxygen) to reduce fire potential
  - Stop oxidation of products

Inerting

- A significant amount of inerting gas replaces the volume of air in the space.
- If a space has been inerted, find out why.
- Adding air to inerted confined space containing flammable liquid and vapors may bring vapors into flammable range.

Inerting

- Gaseous fire extinguishing agents used in a confined space may create a low oxygen atmosphere (inert) or a toxic atmosphere.
Inerting

The white tank, next to the two silos shown in this picture, is a liquid nitrogen tank for inerting the atmosphere within the silos. Without preplanning, you may not realize that this hazard is present.

Practical Exercises

- Demonstration
- Student practice
- PTI 3-2: Ventilation

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe and demonstrate how to ventilate a confined space and identify the impact of inerting a confined space.
Review

- Ventilation
- Inerting
- Practical Exercises
Lesson 4-1: Lockout/Tagout

Student Performance Objective

Given information from discussion, handouts, and reading materials, the student will be able to describe lockout/tagout procedures and how they apply to confined space rescue.

Overview

- Lockout/Tagout Requirements
- Preplanning
- Hazard and Risk Assessment
- Lockout/Tagout Devices
- Lockout/Tagout Equipment
- Lockout/Tagout Strategic Factors
- Demonstration and Student Practice
Chapters 3 and 7
Review Questions

- Discuss the review questions found on pages 44 and 105 of the text.

Lockout/Tagout Requirements

- Purpose
  - To identify and control energy sources
- Inclusion in entry permit
- Identification in pre-plan

A lockout control center showing some of the equipment required for controlling energy sources.
Preplanning

- Identify hazards
- Identify how to control hazards
- Understand that preplans help with size-up but do not replace size-up
- Expect changes when using a preplan
- Carry a basic lockout/tagout kit as part of rescue equipment

Preplanning

Product stored in this hopper is intended to be released through the chute at the bottom. The source of the energy moving this product is gravity, and it must be thought of as stored energy.

Hazard and Risk Assessment

- Conduct Assessment
  - What energy sources exist?
  - How are sources controlled?
  - Is this a recovery or a rescue effort?
  - What is likely to happen as rescue proceeds?
  - What must be done to protect the victim and the rescuers?
- Document the assessment and incorporate into the IAP
Lockout/Tagout Devices

- Electrical Circuit Breakers
- Disconnect Switches
- Line Valves
- Latches, Chains and Chocks

Lockout/Tagout Equipment

- Rescuers' basic equipment
- On-site and/or specialized equipment
- Improvised devices (with caution)
Lockout/Tagout Strategic Factors

- Energy sources can kill or maim and must be understood and controlled
- First answer basic size-up questions, then ask:
  - Can energy be controlled?
  - Is additional assistance needed?
  - Where will assistance come from?

Lockout/Tagout Strategic Factors

- For energy sources found, consider:
  - Is the energy source part of the cause of the incident?
  - Is the energy source controlled and if so, how?
  - Is there equipment that starts automatically?
  - Is there a preplan that discusses energy sources?
  - What is the current situation and what has to happen next?

Warning sign indicating the presence of automatic starting equipment. Automatic starting equipment can start without warning.
Practical Exercise

- Demonstrate
- Practice
- PTI 4-1: Lockout/Tagout

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe lockout/tagout procedures and how they apply to confined space rescue.

Review

- Lockout/Tagout Requirements
- Preplanning
- Hazard and Risk Assessment
- Lockout/Tagout Devices
- Lockout/Tagout Equipment
- Lockout/Tagout Strategic Factors
- Demonstration and Student Practice
Lesson 4-2: Strategic Rescue Factors

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe the strategic factors that have to be considered when sizing up a confined space rescue.

Overview

- Basic Rescue Size-Up
- Basic Strategic Factors
Basic Rescue Size-Up

- Conduct Size Up
  - Analyze extent of problem
  - Identify readily available information and determine its impact
  - Identify critical factors and analyze their impact
  - Determine what additional information is required

- Prepare preplans
  - Identify spaces and their hazards.
  - Define limits of the organization.
  - Plan for common types of facilities.
  - Identify training needs.
  - Examine SOPs/SOGs for adequacy.

- Gain access for preplanning and training
  - OSHA requires all involved to have access to training.
  - The preplan should be in writing.

- Standardize confined space SOPs
  - Look for similarities
  - Incorporate into the SOP

- Identify variations in SOP requirements
  - Categorize as high or low impact
  - Prepare expanded procedures for high impact variations
  - Minimize efforts on low impact variations
Basic Strategic Factors

- Impact varies according to incident
  - A confined space permit should indicate:
    - Type of work being performed
    - Expected hazards
    - Number of people in the confined space
    - Who to contact for additional information
  - If no permit is present:
    - Gather information
    - Analyze
    - Use what you know to develop an action plan

Basic Strategic Factors

- Atmospheric hazards
  - What work was being done?
  - Were toxic substances being used?
  - Was sludge disturbed?
  - Where will exhaust venting gases go?
  - Will an atmospheric hazard be spread?
  - Will rescue equipment generate hazardous gases?

Basic Strategic Factors

Depending upon the type of work being performed within the confined space, hazards may be introduced that you might not expect.
Basic Strategic Factors

This trench has a variety of physical hazard items surrounding it that can easily be knocked or dropped into the space and injure people.

---

Basic Strategic Factors

- Physical Hazards
  - After performing lockout/tagout, identify any other potential hazards
- Exposures
  - Will hazards be spread?
- Construction
  - Is the space structurally stable?
  - Has the structure been damaged?

---

Basic Strategic Factors

- Contents
  - What is normally in the space?
  - What other products have been brought in?
- Resources
  - Is the response adequate?
  - Are more resources needed?
- Time
  - How long will the rescue take and what will be the effect on the victims and the rescuers?
Basic Strategic Factors

- Communications
  - How will rescuers communicate both inside and outside the space?

- Risk to Life
  - What are the hazards?

- Weather Conditions
  - How will weather affect the rescue (temperature, wind, rain)?

Basic Strategic Factors

- Special Problems
  - Site specific issues (can you think of examples?)

- Life Safety
  - Safety of victims, rescuers and onlookers

- Incident Stabilization
  - Hazard control, site safety

- Property Conservation
  - Necessary versus unnecessary damage

Basic Strategic Factors

- Basic actions at a confined space rescue:
  - Manage the risk to operating personnel
  - Locate the victim(s)
  - Identify how you will communicate with the entry team while they are in the space
  - Determine how you will rescue the entry team, if needed
  - Identify how you will remove the victim
  - Enter only with proper PPE for rescue entry team
Basic Strategic Factors

- Incident priorities:
  - Life safety
    - Eliminate or decrease hazards to victims
    - Rescue once rescuers are protected
  - Incident stabilization
  - Property conservation

Practical Exercise

- PTI 4-2: Confined Space Rescue Preplan

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe the strategic factors that have to be considered when sizing up a confined space rescue.
Review

- Basic Rescue Size-Up
- Basic Strategic Factors
Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe the necessity of using the incident command system in management of a confined space rescue.

Overview

(1 of 2)

- Safety
- Unity of Command
- Span of Control
- Common Terminology
- Single Command and Unified Command
- The Incident Action Plan
Overview
(2 of 2)
- The Command Post
- Resource Management
- Incident Priorities
- Command
- Other Command Support Staff
- Applying the Incident Command System to Confined Space Rescue

Chapters 4 and 6 Review Questions
- Discuss the review questions found on pages 55 and 93 of the text.

The Incident Command System
- Safety
  - Safety first
  - Nature of hazards and risks
- Unity of Command
  - Confined space incident command is much the same as that of other incidents
  - There is one IC and each person has one supervisor
- Span of control
  - Span of control cannot exceed 7 people
  - Staff needs to increase as resources increase
The Incident Command System

- Common Terminology
  - Unit numbering, radio terms, etc.
- Single command and unified command
  - Single command—single incident commander is in charge
  - Unified command—multiple agencies involved
- The Incident Action Plan
  - Goals and objectives
  - Strategy and tactics incorporating SOPs

The Incident Command System

- The Command Post
  - Location must be known to all personnel
  - Size will increase with complexity of the incident
- Resource Management
  - Task assignments
  - Accountability
  - Additional resources
- Incident Priorities
  - Life safety
  - Incident stabilization
  - Property conservation

Command

- Command must exist on every incident
- Staff other positions only as needed
  - The Incident Safety Officer (ISO)
    - Must have knowledge of confined space rescue
    - Must recognize hazards present/possible
    - Must have authority to act
  - The Public Information Officer (PIO)
    - Allows IC to focus on incident
    - Must be given factual information by the IC
Other Command Positions
- Planning
- Operations
- Logistics
- Finance/Administration

Applying Incident Command to Confined Space Rescue
- Incident command structure needs to meet the size and complexity of the incident
- Structure must consider span of control
- Command requires good, timely information to be effective

Student Performance Objective
- Given information from discussion, handouts, and reading materials, the student will be able to describe the necessity of using the incident command system in management of a confined space rescue.
Review (1 of 2)

- Safety
- Unity of Command
- Span of Control
- Common Terminology
- Single Command and Unified Command
- The Incident Action Plan

Review (2 of 2)

- The Command Post
- Resource Management
- Incident Priorities
- Command
- Other Command Support Staff
- Applying the Incident Command System to Confined Space Rescue
Lesson 5-2: Standard Operating Procedures

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe the role of standard operating procedures in conducting effective and efficient confined space rescues.

Overview

- Development of Standard Operating Procedures
- Written SOPs
- Use of Checklists
Development of Standard Operating Procedures

- Why do we need SOPs in confined space rescue?
- SOPs must be
  - Accurate
  - Current
  - Taught

Written SOPs

- Why do SOPs need to be written?
- SOPs should be
  - In standard format
  - Detailed
  - Simple
  - Exercised

Use of Checklists

- How do checklists support SOPs?
- How can a checklist serve as an evaluation tool?
Use of Checklists

**Step 1 - Establish command**

<table>
<thead>
<tr>
<th>Command established and identified</th>
<th>☐ YES</th>
<th>☐ NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command is:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Command has been transferred to:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Step 2 - Identify the type of rescue problem (choose only one)**

<table>
<thead>
<tr>
<th>Confined-space rescue</th>
<th>☐ YES</th>
<th>☐ NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid rescue</td>
<td>☐ YES</td>
<td>☐ NO</td>
</tr>
<tr>
<td>Hazardous materials incident with rescue</td>
<td>☐ YES</td>
<td>☐ NO</td>
</tr>
<tr>
<td>Other confined rescue</td>
<td>☐ YES</td>
<td>☐ NO</td>
</tr>
</tbody>
</table>

**Step 3 - Parameterized and risk assessment**

<table>
<thead>
<tr>
<th>Parameterized and risk assessed</th>
<th>☐ YES</th>
<th>☐ NO</th>
<th>☐ NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date and Time Assess.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site description</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use rescue techniques to rescue</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
<tr>
<td>Use personnel and equipment to rescue</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
<tr>
<td>Location of victim</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of rescue</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location of incident</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Step 4 - Identify rescue objectives**

<table>
<thead>
<tr>
<th>Rescue objectives</th>
<th>☐ YES</th>
<th>☐ NO</th>
<th>☐ NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can you identify rescue objectives?</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
<tr>
<td>Can you identify rescue objectives?</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
<tr>
<td>Water recovery</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
<tr>
<td>Medical personnel</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
</tbody>
</table>

**Step 5 - Identify resources needed to support rescue objectives**

<table>
<thead>
<tr>
<th>Resource needed</th>
<th>☐ YES</th>
<th>☐ NO</th>
<th>☐ NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct means gas monitors</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
<tr>
<td>Safety equipment and fire protection</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
<tr>
<td>Rescue equipment</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
<tr>
<td>Financial resources</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
<tr>
<td>IQR/RR (Initial and rapid response)</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
<tr>
<td>Protocol documents</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
<tr>
<td>All other equipment</td>
<td>☐ YES</td>
<td>☐ NO</td>
<td>☐ NA</td>
</tr>
</tbody>
</table>
Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe the role of standard operating procedures in conducting effective and efficient confined space rescues.

Review

- Development of Standard Operating Procedures
- Written SOPs
- Use of Checklists
Lesson 5-3: Team Evaluation

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe components of selecting and evaluating confined space rescue teams.

Overview

- OSHA’s Response Time Evaluation
- OSHA’s Potential Rescue Team Evaluation: Qualifications
- NFPA Standards
- Other Considerations for Evaluating Confined Spaces
- Managing Confined Spaces and the Need for Rescue
OSHA’s Response Time Evaluation

- Characterizing the hazards of a confined space
  - Does a higher threat need faster action?
  - How are hazards controlled?
- Time consideration
  - How long will it take for rescuers to arrive on scene after notification?
  - How much time will be needed to set up?

OSHA’s Potential Rescue Team Evaluation: Qualifications

- Initial Evaluation
  - Confined space training
  - EMS training
  - PPE and rescue equipment
- Performance Evaluation
  - Measurable objectives
  - Identified shortcomings
  - Periodic training

NFPA Standards

- NFPA 1006, Chapter 7
- NFPA 1670
Other Considerations for Evaluating Confined Spaces

- NFPA Standard 1006, Chapter 7
- Other considerations for evaluation
  - Configuration of the space
  - Elevation of the openings
  - Portal size
  - Access and retrieval lines

Managing Confined Spaces and the Need for Rescue

- Non-entry rescue
- Rescue classifications
  - Class A
  - Class B
  - Class C
  - Class D

Managing Confined Spaces and the Need for Rescue

- Class A Confined Space:
  - A class A confined space is permit-required
  - Hazards require immediate rescue of victims and a rescue team to effect the rescue
  - An approved rescue team must be on location at entry point
Managing Confined Spaces and the Need for Rescue

Class B Confined Space:
- A class B confined space is permit-required
- Hazards require immediate rescue of victims
- An attendant can perform rescue from outside the space

Class C Confined Space:
- A Class C confined space can be permit-required or non-permit required
- There are no hazards or hazards are fully controlled
- Rescue requires use of a rescue team
  - An approved rescue team must be available and able to respond in a timely manner

Class D Confined Space:
- A class D confined space can be permit-required or non-permit required
- There are no hazards or hazards are fully controlled
- An attendant can perform rescue from outside the space
Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe components of selecting and evaluating confined space rescue teams.

Review

- OSHA’s Response Time Evaluation
- OSHA’s Potential Rescue Team Evaluation: Qualifications
- NFPA Standards
- Other Considerations for Evaluating Confined Spaces
- Managing Confined Spaces and the Need for Rescue
Lesson 6-1: Safety

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will describe how to manage risk and protect personnel during confined space rescues.

Overview

- Safety Considerations for Personnel
- Personal Protective Equipment
- Noise
- Practical Exercises
Chapters 5, 10 and 12
Review Questions

Discuss the review questions found on pages 76, 162 and 202 of the text.

Safety Considerations for Personnel

Inherent risk associated with confined space rescue
– By definition of a confined space
– Hazardous atmosphere
– Engulfment potential
– Physical configuration that can cause entrapment
– Other hazards

Actions therefore required
– Identify hazards
– Analyze hazards
– Control or eliminate hazards
– Determine appropriate PPE and other safety equipment and use it
Safety Considerations for Personnel

Temperature stress
- Hydration of rescuer
- Dress of rescuer
- Pace of work

Prevention of heat stress
- Change conditions
- Limit exposure
- Ventilate
- Hydrate
- Manage time of PPE use
- Plan pace of work

Prevention of cold-related injuries
- Avoid getting wet
- Consider wind chill
- Heat the confined space
- Minimize exposure to cold
- Pace the work
Safety Considerations for Personnel

Minimize the number of people who are needed to perform the rescue safely.

Protective clothing can increase the potential for heat stress injuries to rescuers.

Medical monitoring
- Heat-related injuries
  - Consider temperature—ambient space temperatures above 78 degrees can cause heat injuries
  - Consider age, physical condition, type of PPE worn
  - Monitor vitals before and after entry

Medical monitoring
- Cold-related injuries
  - Consider temperature—temperatures as high as 50 degrees can cause cold injuries
  - Consider age, physical condition, type of PPE
  - Monitor vitals before and after entry
Personal Protective Equipment

- Respiratory protection
  - SCBA
  - SAR
- Retrieval equipment
  - Harness
  - Gloves
  - Foot protection
  - Skin protection

PPT:202-6-1-12

Personal Protective Equipment

A supplied air respirator showing the air supply and air hose

Escape bottle and facepiece.

PPT:202-6-1-13

Personal Protective Equipment

This is a Class III harness with "D" rings at the shoulders and center of the back.

PPT:202-6-1-14
Chemical-resistant gloves, firefighter's gloves, leather utility gloves, and rescue gloves. Each type of glove has a purpose and limitations.

Sharp edges such as those shown here require responders to protect themselves from cuts and puncture wounds.

Damage to chemical protective clothing
- Permeation
- Penetration
- Degradation
Personal Protective Equipment

Noise
- Effect of noise in a confined space
- Need for hearing protection
- Importance of hand signals

Practical Exercises
- Demonstrate
- Practice
- PTI 6-1: Personal Protective Equipment
Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will describe how to manage risk and protect personnel during confined space rescues.

Review

- Safety Considerations for Personnel
- Personal Protective Equipment
- Noise
- Practical Exercises
Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe the nine-step process for confined space rescues.

Overview

- Rescue Considerations
- Equipment
- Initial Scene Operations
- Assessing the Victim
- Victim Stabilization
- Victim Removal
Chapter 8 Review Questions

Discuss the review questions found on pages 125 and 126 of the text.

Rescue Considerations

The Nine-Step Process
1. Establish command and take control of scene
2. Identify the type of rescue problem
3. Perform a hazard and risk assessment
4. Identify rescue objectives
5. Identify resources needed

Rescue Considerations

The Nine-Step Process (continued)
6. Develop an action plan
7. Implement the action plan
8. Evaluate the effectiveness of the plan
9. Terminate the incident
Equipment

- Tripods
- Improvised lifting devices
- Rope and hardware
- Electrical equipment
- Communications equipment
- Training of personnel (use of equipment)
- Termination (evaluation of operation)

Tripods are among the various pieces of equipment that can be used for confined space rescue.

1. You have one tripod that accepts three attachments for retrieval/safety lines.
2. One rescuer enters wearing retrieval line 1 and one safety line.

Skills/Procedures 9-2. Managing three retrieval/safety lines for two rescuers and a victim.
3. The first rescuer detaches the safety line, which is brought out of the space and attached to the second rescuer along with retrieval line 2. Rescuer 2 then enters the space.

4. When the victim has been packaged by the rescuers, rescuer 2 is brought out of the space, and retrieval line 2 and the safety line are detached from rescuer 2 and sent back into the space to be attached to the victim. Rescuer 1 attaches retrieval line 2 and the safety line to the victim, and the victim is removed from the space. Retrieval line 1 remains attached to rescuer 1 at all times.

Using this rope and harness, could you retrieve this rescuer if he became injured or entangled?
Equipment

A carabiner used to connect a figure 8 descender to a sling.

A Sked™ stretcher

Equipment

Stokes Basket
Arizona Vortex Tripod
Air Cart

Equipment

A harness, SAR, PPE, ropes, and other rope equipment being used during confined space rescue training.

A pulley being used to change the direction of pull on the rope by 90 degrees.
Equipment

Equipment for confined space rescue laid out in a staging area to organize and account for the equipment.

A rescuer wearing a supplied air respirator with a radio adapted for use during confined space entry.

Initial Scene Operations

- Use of Nine Steps
- Defensive operations
- Offensive operations

<table>
<thead>
<tr>
<th>Defensive Operations</th>
<th>Offensive Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performed without entering space or prior to entering space.</td>
<td>Performed by entering the confined space for rescue purposes.</td>
</tr>
<tr>
<td>Establishing ventilation.</td>
<td>Use of monitoring instruments while inside the confined space.</td>
</tr>
<tr>
<td>Use of monitoring instruments while inside the space.</td>
<td>Accessing and removing victim from within space.</td>
</tr>
<tr>
<td>Non-entry rescue or removal of victim</td>
<td>Accessing and removing victim within the confined space.</td>
</tr>
<tr>
<td>Advantages:</td>
<td>Advantages:</td>
</tr>
<tr>
<td>Limits risk to rescuers.</td>
<td>May be the only way to rescue the victim from the space.</td>
</tr>
<tr>
<td>May aid in stabilizing the incident prior to entry.</td>
<td>Disadvantages:</td>
</tr>
<tr>
<td>May be the least labor intensive method of rescuing victim.</td>
<td>Requires higher level of training and skill for rescuers.</td>
</tr>
<tr>
<td>Level of knowledge and skill possessed by rescuers at lower levels.</td>
<td>Requires additional equipment for entry, removal, and personal protection.</td>
</tr>
<tr>
<td>Disadvantages:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Victim Considerations

- Assessing the victim
- Victim stabilization
- Victim removal

Victim Considerations

How rapidly your victim must be removed should be one of the primary considerations in packaging.

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe the nine-step process for confined space rescues.
Review

- Rescue Considerations
- Equipment
- Initial Scene Operations
- Assessing the Victim
- Victim Stabilization
- Victim Removal
Lesson 7-2: Rescue Equipment

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe and operate equipment designed to support confined space rescues.

Overview

- Types of Loads
- Equipment Standards
- Harnesses
- Tripods and Other Legged Rescue Equipment
- Hoisting Devices and Fall Protection
- People and Equipment
- Practical Exercises
Types of Loads

- Static load
- Impact load
- Working load
- Axial load
- Eccentric load

Static loads are applied and remain in the same position and location.
- Example: forces applied to a harness or life safety rope during testing

A static load is applied in only one direction and the whole system is at rest.

An impact load is created when a load that is in motion is applied to the support.
Types of Loads

During impact loading, the load is in motion, and the acceleration increases the effect of the load. The result of an impact load can be great enough to cause the support to fail.

Working load is the expected load applied to equipment during use.
- Maximum working load is maximum weight expected to be supported by equipment
- Axial load refers to the direction the load is carried.
- Eccentric loads are off center.

An axial load is applied in the same plane as the axis of the support. Even though a tripod has three legs to carry the load to the ground, there is still an axis for the entire tripod. Each leg also has an axis.

An eccentric load is one that is applied off center. The eccentric load can cause a failure of the support.
Equipment Standards

- Different standards carry different legal weight
  - OSHA and CAL/OSHA are legally adopted standards.
  - NFPA and ANSI are consensus standards.

There are a variety of standards that affect how different types of equipment are designed, manufactured, and used.

Equipment Standards

- OSHA, ANSI, and NFPA
  - Do not certify equipment
  - Typically do not test for compliance

This label, on a harness, shows the standards that the harness is designed to meet, the manufacturer, lot number, and model number.

Harnesses

- Harnesses
  - Classes of harnesses
  - Wristlets
  - Inspection
A Class I harness is designed to support a single person. All harnesses should be clearly marked as to their class.

The ladder belt should not be used to support a person while raising or lowering on a rope, cable, or other support.

Class II harnesses are designed to support a two-person load, and they look similar to Class I harnesses.

A Class III harness. This harness not only supports a two-person load, but also protects a wearer from falling out if inverted.

The stitching pattern and number of stitches per inch in a harness are important considerations because they can affect the strength of the harness.

Wristlets may be used when a harness cannot
- Safety factor is 3:1

To lift a 300-pound load, wristlets must have a 900-pound minimum breaking strength

Wristlets that can be used to raise or lower a person.
Harnesses

- An inspection program:
  - Must document harness and equipment history
  - Should be based on a manufacturer’s recommendations for inspection, testing, and maintenance

Tripods and Other Legged Rescue Equipment

- Tripods and other legged rescue equipment
  - Lifting capacity
  - Surfaces

Specialized tripods
- Have features such as four leg configurations, davit arms, bolts, attachment devices, anchors

Tripod selection
- Should be based on the situation
Tripods and Other Legged Rescue Equipment

- Lifting capacity
  - Varies, so rescuers must know the capacity of the tripod being used

- Surfaces
  - A sloped surface presents hazards
  - Anchors and locks for the legs should be used

The locking device at the head of this tripod keeps the legs rigidly in place.

Chains between the tripod feet keep the legs from spreading as a load is applied.

This transformer retrieval support is specifically designed and built to be bolted to the manway opening.

(Taken courtesy of DBI/SALA.)

Tripods with adjustable legs may have reduced load carrying capacities because the legs are extended.

The number of retrieval devices that can be attached to a tripod will have an impact on your rescue operations.

Just as a tripod must be loaded axially, so must other devices.
Hoisting Devices and Fall Protection

- Hoisting devices and fall protection
  - Retrieval winches
  - Equipment integrity
  - Ropes and rope equipment

Hoisting Devices and Fall Protection

- Retrieval winches:
  - Are designed for hoisting
  - May have stainless steel or galvanized steel cables attached to allow use as lifting devices

This retrieval device has a variety of features that make it valuable for confined space rescue.

Hoisting Devices and Fall Protection

- A snap hook for connecting O-rings, D-rings, and other equipment to retrieval equipment.

Match the snap hook to the size of the device to which it is to be connected.
Hoisting Devices and Fall Protection

- Rope and rope equipment use is common
  - Rescuers must have the capability to perform rope rescue tasks
  - Rescuers must follow NFPA Standard 1983 for inspection, maintenance and testing
- Fire Service Life Safety Rope and System Components

Maintaining your equipment in a safe manner is essential to the reliability of the equipment. The duct tape shown here is not an acceptable repair.

People and Equipment

- People and equipment
  - Training for equipment use
  - Proper use of equipment
  - Maintenance of equipment
  - Damage to equipment
  - Skill refreshment
People and Equipment

- Equipment is useful only if people who use it know how to correctly use it.
  - Understand equipment purpose
  - Understand design features
  - Understand how to maintain it

Practical Exercises

- Demonstrate
- Practice
- PTI 7-2: Rescue Equipment

Student Performance Objective

- Given information from discussion, handouts, and reading materials, the student will be able to describe and operate equipment designed to support confined space rescues.
Review

- Types of Loads
- Equipment Standards
- Harnesses
- Tripods and Other Legged Rescue Equipment
- Hoisting Devices and Fall Protection
- People and Equipment
- Practical Exercises