



Department Of Fire Services

Massachusetts Firefighting Academy

Technical Rescue Programs



CONFINED SPACE RESCUE: TECHNICIAN LEVEL

STUDENT MANUAL

Reasons for the failure of Technical Rescue Operations

Acronym: FAILURE

F - Failure to understand or underestimating the environment

A- Additional medical implications not considered

I- Inadequate rescue skills

L- Lack of team work and experience

U- Understanding the logistical needs of the operation

R- Rescue versus recovery mode not considered

E- Equipment not mastered

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**DEFINITION OF A
CONFINED SPACE**

- 1. Is large enough and so configured that an employee can bodily enter and perform assigned work;

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**DEFINITION OF A
CONFINED SPACE**

- 2. Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry);

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**DEFINITION OF A
CONFINED SPACE**

- 3. Is not designed for continuous employee occupancy.

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**DEFINITION OF PERMIT
CONFINED SPACE**

- Permit Space means a confined space that has one or more of the following characteristics:

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**DEFINITION OF PERMIT
CONFINED SPACE**

- 1. Contains or has a potential to contain a hazardous atmosphere;

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**DEFINITION OF PERMIT
CONFINED SPACE**

- 2. Contains a material that has the potential for engulfing an entrant;

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**DEFINITION OF PERMIT
CONFINED SPACE**

- 3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section;

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**DEFINITION OF PERMIT
CONFINED SPACE**

- 4. Contains any other recognized serious safety or health hazard.

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CONFINED SPACES

● Storage tanks	● Machinery housings
● Sewers/manholes	● Reaction vessels
● Holds of ships	● Silos
● Underground utility vaults	● Truck and rail tank cars
● Boilers/pipelines	● Ducts
● Septic tank	● Pits and ditches
● Sewerage digester	

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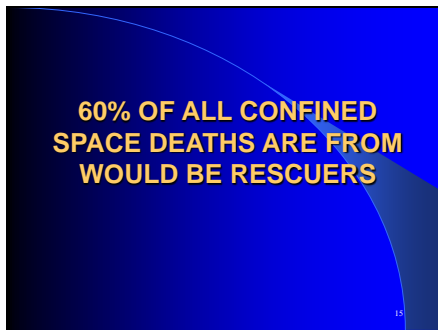
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HOW DO WE PREVENT THIS?

- Good Training
- Risk Benefit Analysis
- Rescue or Recovery mode

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WHAT CONFINED SPACE ENTAILS

ROPE SKILLS
And
HAZMAT SKILLS

- Atmospheric monitoring
- Protective breathing
- Rigging

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HAZARDS OF CONFINED SPACES

- Hazardous Atmospheres
- Deficient O₂ below 19.5%
– (most frequent)
- Enriched O₂
- Flammable Gas & Vapors
- Toxic (CO, H₂S)

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PHYSICAL AND MECHANICAL HAZARDS

- Engulfment – Liquids & Powders
- Entrapment – Walls, Floors, Narrow Passages
- Contact with moving machinery
- Contact with Electrical Equipment
- Asphyxiation atmospheres
- Flammable atmospheres

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PHYSICAL AND MECHANICAL HAZARDS

- Noise
- Heat/Cold
- Falls
- Isolating a Confined Space

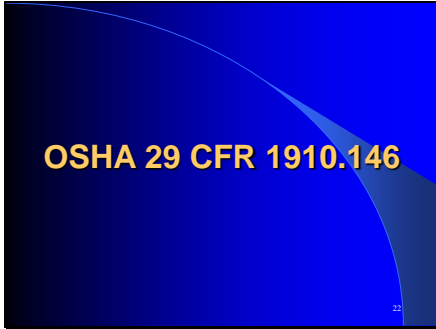
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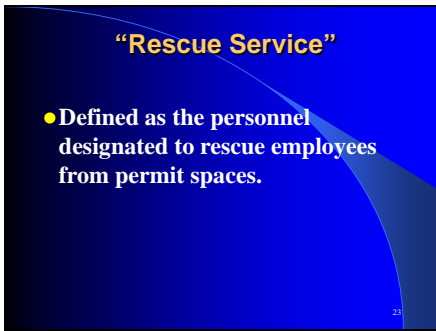
CASE STUDIES VIDEOS

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BASIC ROLES IN INDUSTRIAL CONFINED SPACE

- Entry Supervisor
- Attendant
- Entrant
- Permit – Check off list
- Standby – Rescue Team

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AUTHORIZED ENTRANT

An employee who is authorized by the employer to enter a space

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DUTIES OF AUTHORIZED ENTRANT

- Familiar with hazards that could be encountered
- Proper use of all equipment
- Communicate with attendant
- Alert attendant of dangerous or prohibited condition

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DUTIES OF AUTHORIZED ENTRANT

- Exit permit space as quickly as possible when:
 - ordered to evacuate,
 - recognize warning sign or symptom
 - exposed to dangerous situation or prohibited condition
 - evacuation alarm activated

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ATTENDANT

Individual stationed outside one or more permit spaces who monitors the authorized entrants and performs all attendant's duties assigned in the employer's permit space program

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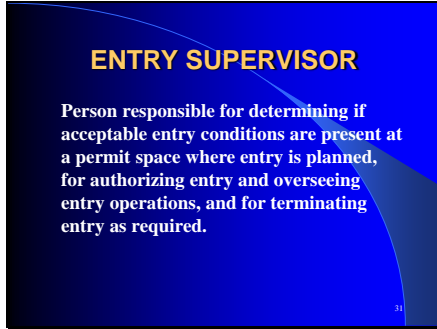
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DUTIES OF ATTENDANT

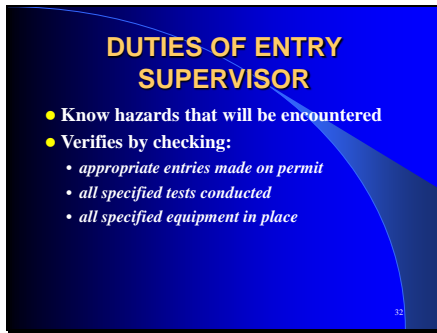
- Know hazards that might be encountered during entry
- Aware of behavioral effects of hazard exposure to authorized entrants
- Continuously maintains accountability
- Remains at space until relieved or entry terminated
- Performs non-entry rescues

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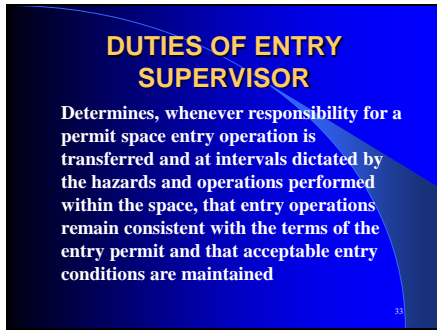
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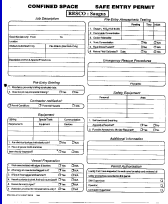
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PERMIT SYSTEM

A permit signed by the entry supervisor and verifying that pre-entry preparations have been completed and that the space is safe to enter, must be posted at entrances or otherwise made available to entrants before they enter a permit space



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ENTRY PERMITS
MUST INCLUDE THE FOLLOWING INFORMATION

- Name and signature of supervisor who authorizes entry;
- Name of permit space to be entered, authorized entrants, eligible attendants, and individuals authorized to be entry supervisors;
- Purpose of entry and know space hazards;
- Test results;
- Testers signature or initials

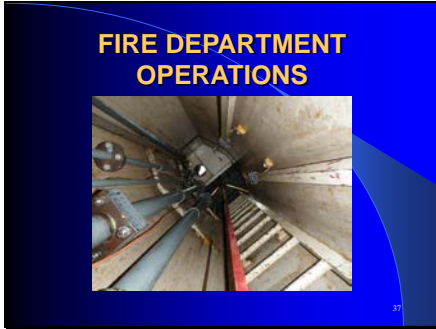
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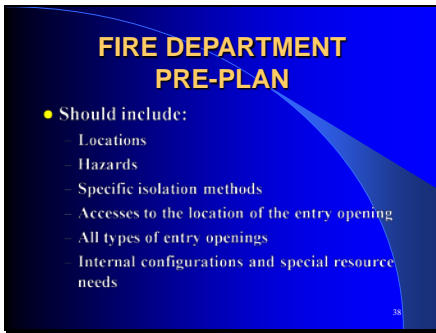
ENTRY PERMITS

- Measures to be taken to isolate permit spaces and to eliminate or control space hazards(lockout/tagout, purging, inerting, flushing, and ventilation)
- Names and numbers of Rescue and EMS
- Date and duration of entry
- Communication equipment and procedures
- Additional permits
- Special equipment and PPE
- Any other info needed to ensure safety

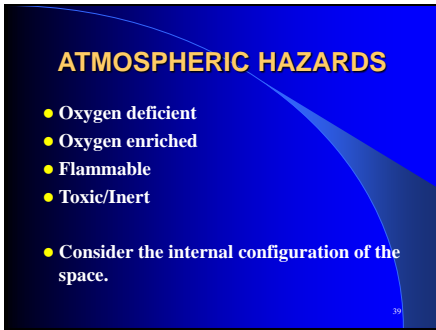
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ATMOSPHERIC HAZARDS

- **Oxygen deficient**- of 173 fatalities in confined spaces, 67 were attributed oxygen deficient atmospheres
- Oxygen levels below 19.5 % by volume are considered unsafe and can result from either consumption or displacement
- Oxygen consumption can be caused by :
Combustion, Decomposition of organic matter, Oxidation of metals

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ATMOSPHERIC HAZARDS

- **Oxygen Enriched**, oxygen level greater than 23.5% a very serious fire hazard.
-flammable materials like clothing and hair will burn very rapidly in oxygen enriched atmosphere
-Never ventilate with O2

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ATMOSPHERIC HAZARDS
Effects of various oxygen levels

- 23.5% and above, oxygen enriched and extreme fire hazard
- 21% Normal concentration of atmosphere we live in
- 19.5% Minimum "safe level" set by NIOSH
- 15% Disorientation and impaired judgment and breathing
- 14% Faulty judgment and rapid fatigue
- 8% Mental failure, loss of consciousness
- 6% Difficulty breathing , rapid death

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ATMOSPHERIC HAZARDS
Flammable atmospheric hazards

For fire or explosion to occur three components must be present:


- A fuel (*such as a combustible gas*)
 - The specific mixture of fuel that will ignite or explode (*flammable range*) varies with each combustible gas
- Oxygen
- Ignition source

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FLAMMABLE RANGE

THE *flammable range* is the range between the **LEL** (*Lower Explosive Limit*) and **UEL** (*Upper Explosive Limit*)



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FLAMMABLE ATMOSPHERIC HAZARD

- Flammable gas, vapor, or mist in excess of:
10% of its *Lower Explosive Limit*

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ATMOSPHERIC HAZARDS
TOXIC

- Measured in parts per million (ppm)
- 10,000 ppm = 1%
- Carbon Monoxide (CO) and Hydrogen Sulfide(H₂S) are the most common toxins found in confined spaces.
- Toxic levels, atmospheric concentration of any substance above the permissible exposure limit(PEL).

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ATMOSPHERIC HAZARDS
TOXIC

- Any atmospheric condition that is immediately dangerous to life or health (IDLH).
- Product stored in space, Product absorbed in walls
- Sludge removal
- Work being performed
 - Welding, cutting, degreasing, cleaning solvents& migration of products into space from outside

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ATMOSPHERIC HAZARDS

- Due to physical properties all areas of space must be tested
 - Important to determine internal configuration of space
- Check permits /MSDS for information on product including vapor density, vapor pressure, toxicity

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ATMOSPHERIC HAZARDS
INERTED ATMOSPHERIC HAZARDS

- Inerting means the displacement of the atmosphere in a permit space by a non-combustible gas (such as nitrogen) to such extent that resulting atmosphere is non-combustible. *This procedure produces an IDLH oxygen deficient atmosphere*

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ENGULFMENT HAZARD

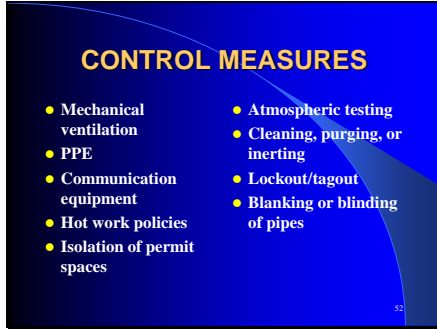
- Engulfment- means the surrounding and effective capture of a person by a liquid or finely divided (flowable solid) substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or by crushing.

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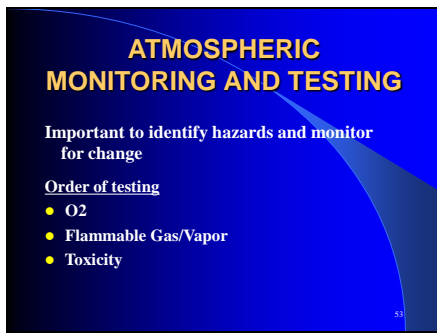
HAZARD CONTROL

- For each hazard identified, the employer must develop and implement appropriate control measure to protect authorized entrants.
- The specific control measures implemented will be dictated by the characteristics of each individual space.

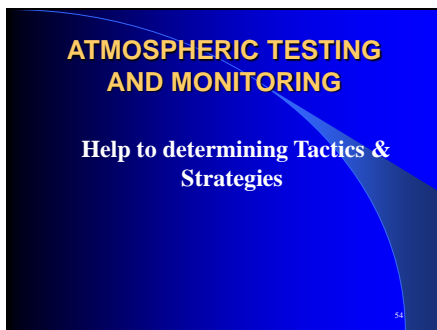
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BASIC EQUIPMENT

Atmospheric Monitoring

Respiratory Protection

- S.C.B.A.
- S.A.R.



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BASIC EQUIPMENT

- Retrieval Equipment
- Mechanical Advantage
- Class III Harness

● Consider

- Vertical Lift
- Horizontal Movement




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VENTILATION EQUIPMENT

- Is it needed?
- Positive or Negative?
- What will it do to the atmosphere?



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COMMUNICATION EQUIPMENT

- Reliable, Safe for the atmosphere
- Must have back up means of communicating
- Doesn't affect atmospheric monitoring equipment



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COMMUNICATION EQUIPMENT

O.A.T.H.

- Radios
- Hard Wired Systems
- O - O.K.
- A - ADVANCE
- T - TAKE UP
- H - HELP

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EXTRICATION DEVICES

- LSP Halfback
- Yates Spec Pak
- SKED
- Miller Full Body Splint
- KED
- Victim Harness



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PERSONAL PROTECTIVE EQUIPMENT

- Rescue Helmet
- Fire Rated Coveralls/Hood/Gloves
- Footwear
- Eye Protection
- Hearing Protection
- Class III Harness
- Communications and Lighting

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LIGHTS

- Intrinsically safe
- 3 Sources



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TRAINED AND ORGANIZED TEAM UNDER ICS

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PHASES OF CONFINED SPACE RESCUE

- Make the scene safe
- Victim contact
- Size Up
- Preparation
- Access the patient
- Stabilize and package the patient
- Evacuate

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MAKE THE SCENE SAFE

- Hazard assessment
 - (1) Atmospheric hazards
 - (2) Chemical hazards
 - (3) Temperature extremes
 - (4) Engulfment and entrapment
 - (5) Any other recognized safety or health hazard
- Hazard mitigation: Control or remove the hazard
- De-energize and protect the sources of electricity, fluids, hydraulics, and so forth

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VICTIM CONTACT BY PRIMARY RESPONDER


- Establish victim location
- Primary medical survey (ABCs)
- Determine mode of injury
- Begin psychological first aid
- Determine feasibility of safe retrieval and retrieve if possible

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SIZE UP

- Information gathering
- Resource identification
- Primary responder report
- Brainstorm strategy: risk/reward
- Incident management system (IMS)
- Team member assignments



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SIZE UP

- Distinction between rescue and recovery
- Scope and Magnitude
- Additional Resources
- Location and Number of Victims
- Risk Benefit Analysis
- Separation, isolation, interviewing, security of witnesses

- Hazards- utilities, mechanical, hazmat
- Access to Scene
- Environmental Factors

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RISK ASSESSMENT

- Determines:
 - “What” can occur,
 - “When” (how often) it is likely to occur,
 - “How” bad the effects could be.
- Methods:
 - Checklist
 - “What if ?” Scenarios

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RESCUE VS. RECOVERY

- Based on Risk/Benefit Analysis
- Duration of the operations
- Mechanism of Injury
- Environmental conditions
- Victim access

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PRINCIPLES OF RESCUE


- (Best) Self Rescue
 - Establish Communication With Victim
- (Next Best) Non entry rescue
- (Most Risky) Entry Rescue

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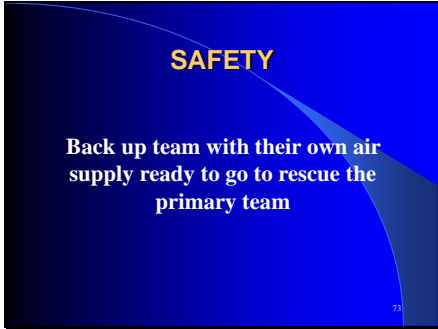
PREPARATION

- Rescuer personal protective equipment
- Anchoring and rigging rescue equipment
- Authorized entrant review



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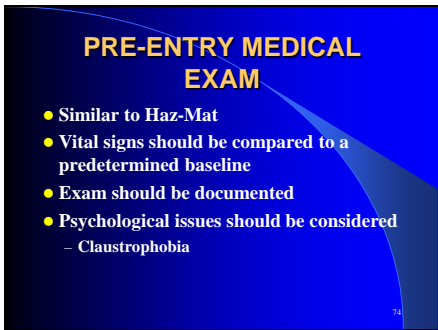


SAFETY

Back up team with their own air supply ready to go to rescue the primary team

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PRE-ENTRY MEDICAL EXAM

- Similar to Haz-Mat
- Vital signs should be compared to a predetermined baseline
- Exam should be documented
- Psychological issues should be considered
 - Claustrophobia

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CONDUCTING A SYSTEM SAFETY CHECK

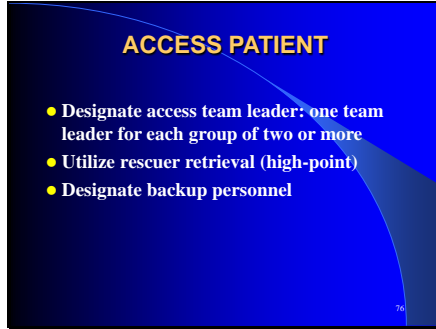
- Tech rescue safety officers
- Acronym - ABCDE
- Never check something you built
- Start at the anchor end
- Check all knots
- Check all carabineers
- Check edge protection

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ACCESS PATIENT

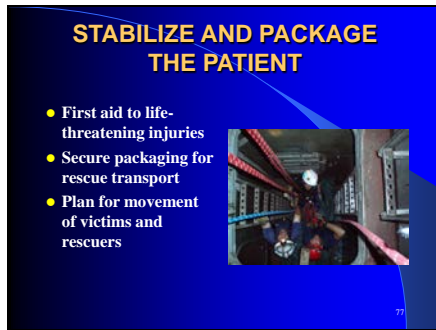
- Designate access team leader: one team leader for each group of two or more
- Utilize rescuer retrieval (high-point)
- Designate backup personnel



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STABILIZE AND PACKAGE THE PATIENT

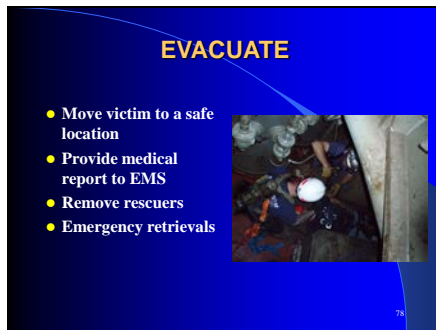
- First aid to life-threatening injuries
- Secure packaging for rescue transport
- Plan for movement of victims and rescuers



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EVACUATE

- Move victim to a safe location
- Provide medical report to EMS
- Remove rescuers
- Emergency retrievals



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RESPONSE TERMINATION

- Pick up and inventory gear
- Decontaminate (if necessary)
- Rebuild gear packages for the next call
- Field-evaluate rescuer mental state

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DECONTAMINATION

- Consider decontamination if operations are in potentially contaminated spaces.
 - Hazardous Materials
 - Sewage
 - Flood Water
- Ensure appropriate equipment / personnel are available.

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OSHA requirements are out there to minimize the risk to us as rescuers and the people who work around confined spaces.

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Any incident that you go to and involves a confined space is defined as a rescue. Utility companies refer to manholes as enclosed spaces to get around the law.

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**TRAINING
1910.146**

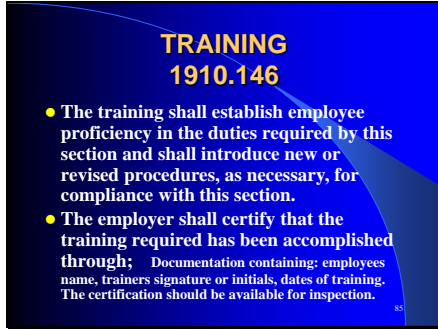
The employer shall provide training so that all employees whose work is regulated by this section acquire the understanding, knowledge, and skills necessary for safe performance of duties.

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**TRAINING
1910.146**

- Training shall be provided for each affected employee
 - before the employee is assigned duties;
 - before there is a change in assigned duties;
 - whenever there is a change in a permit space
 - operations that present a hazard which an employee has not been previously trained;
 - whenever the employer has reason to believe either that there are deviations from permit entry procedure or that there are inadequacies in employee knowledge or use of these procedures.

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