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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CONFINED SPACE RESCUE: TECHNICIAN LEVEL

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OPERATIONAL LEVELS

- AWARENESS
- OPERATIONS
- TECHNICIAN

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REGULATIONS AND STANDARDS

- OSHA 1910.146 - Permit Required Confined Spaces
DEFINITION OF A CONFINED SPACE

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

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).

3. Is not designed for continuous employee occupancy.
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;
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;

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

CONFINED SPACES

- Storage tanks
- Sewers/manholes
- Holds of ships
- Underground utility vaults
- Boilers/pipelines
- Septic tank
- Sewage digester
- Machinery housings
- Reaction vessels
- Silos
- Truck and rail tank cars
- Ducts
- Pits and ditches
PERMIT REQUIRED
CONFINED SPACE VIDEO

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CONFINED SPACE
STATISTICS
- 2.5% of all occupational fatalities are a direct result of work performed in confined space
- 50,000 emergency responses
- 300 fatalities
- 60% of all confined space fatalities involve would-be rescuers

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60% OF ALL CONFINED SPACE DEATHS ARE FROM WOULD BE RESCUERS

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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
- Asphyxiating 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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OSHA 29 CFR 1910.146

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“Rescue Service”
- Defined as the personnel designated to rescue employees from permit spaces.

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WHO IS USUALLY LISTED AS THE RESCUE SERVICE?
- USUALLY THE FIRE DEPARTMENT!
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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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**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
ENTRY SUPERVISOR

Person responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required.

DUTIES OF ENTRY SUPERVISOR

- Know hazards that will be encountered
- Verifies by checking:
  - appropriate entries made on permit
  - all specified tests conducted
  - all specified equipment in place

DUTIES OF ENTRY SUPERVISOR

Determines, whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with the terms of the entry permit and that acceptable entry conditions are maintained.
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.

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

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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FIRE DEPARTMENT OPERATIONS

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FIRE DEPARTMENT PRE-PLAN

- Should include:
  - Locations
  - Hazards
  - Specific isolation methods
  - Accesses to the location of the entry opening
  - All types of entry openings
  - Internal configuration and special resource needs

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ATMOSPHERIC HAZARDS

- Oxygen deficient
- Oxygen enriched
- Flammable
- Toxic/Inert

- Consider the internal configuration of the space.
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.

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.

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.
ATMOSPHERIC HAZARDS
Flammable atmospheric hazards

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

- A fuel (such as a combustible gas)
- Oxygen
- Ignition source

Flammable range

THE flammable range is the range between the LEL (Lower Explosive Limit) andUEL (Upper Explosive Limit)

PROPAINE
FLAMMABLE RANGE
2.2 - 9.5

Flammable atmospheric hazard

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

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.

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.
CONTROL MEASURES
- Mechanical ventilation
- PPE
- Communication equipment
- Hot work policies
- Isolation of permit spaces

- Atmospheric testing
- Cleaning, purging, or inerting
- Lockout/tagout
- Blanking or blinding of pipes

ATMOSPHERIC MONITORING AND TESTING
Important to identify hazards and monitor for change
Order of testing
- O2
- Flammable Gas/Vapor
- Toxicity

ATMOSPHERIC TESTING AND MONITORING
Help to determining Tactics & Strategies
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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**

- Radios
- Hard Wired Systems
- O.A.T.H.
  - 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
PERSONAL PROTECTIVE EQUIPMENT
- Rescue Helmet
- Fire Rated Coveralls/Hood/Gloves
- Footwear
- Eye Protection
- Hearing Protection
- Class III Harness
- Communications and Lighting

LIGHTS
- Intrinsically safe
- 3 Sources

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 (ABCD)
- Determine mode of injury
- Begin psychological first aid
- Determine feasibility of safe retrieval and retrieve if possible
SIZE UP

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

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

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 carabiners
- Check edge protection
ACCESS PATIENT

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

STABILIZE AND PACKAGE THE PATIENT

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

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.
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.

**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.

- 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.
The training shall establish employee proficiency in the duties required by this section and shall introduce new or revised procedures, as necessary, for compliance with this section.

The employer shall certify that the training required has been accomplished through documentation containing: employees name, trainers signature or initials, dates of training. The certification should be available for inspection.