



PURPOSE

The purpose of this policy is to establish trench rescue methods and to address operations that involve the location, disentanglement, and removal of victims from collapses involving trenches and excavations. Rescue personnel must use judgment, experience, and training to adapt to the specific situation.

POLICY

The information presented in this procedure is general in nature and is not intended to be all encompassing.

Trench Rescue Definitions

The following definitions should be used when being referenced throughout this document.

Trench - As defined by OSHA, a trench is a narrow excavation in relation to its length made below the surface of the ground. In general, the depth is greater than the width, but the width is not greater than 15 feet.

Excavation - An excavation is defined as a man made cut, cavity trench, or depression in the earth surface, formed by earth removal. It is usually wider than it is deep.

"Sides", "Walls", or "Faces" - The vertical or inclined earth surfaces formed as a result of excavation work.

Lip - Grade level earth immediately surrounding the edge of the excavation.

Spoil pile - Mass of excavated dirt which is piled near and rises above the trench opening.

Shoring System - A temporary structure for the support of earth surfaces formed as a result of excavation work.

Braces - The horizontal member of the shoring system whose ends bear against the uprights or stringers.

Uprights - The vertical members of a shoring system.

Waler - The horizontal members of the shoring system whose sides bear against the uprights.

Shore - (Shoring panel) supporting member that resists a compressive force imposed by a load.

Screw Jack - Screw type jacks used as cross bracing in a trench shoring system.

Types of cave-ins:

- Slough-in - A portion of the side wall slides into the trench usually in a "V" shape, tapering in width and thickness as it nears the bottom of the trench.
- Shear Off - A portion of the side wall shears off and falls as a brick wall would fall, possibly covering the entire width of the trench.
- Spoil Pile Slide - The dirt piled above the trench slides back into the trench.

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Types of Soil

The following are the types and classes of soil that may be encountered. The average weight of soil is 100 pounds per cubic foot.

Type A: Cohesive type soils with an unconfined compressive strength of 1.5 tons per square foot or greater. Any soil with clay content is Type A. If the soil is fissured, subject to vibration, or previously disturbed it does not fall in this category.

Type B: Cohesive materials with an unconfined compressive strength of between 0.5 and 1.5 tons per square foot. Gravel, silt, and loam are examples of Type B soil.

Type C: Cohesive materials with unconfined compression strength of less than 0.5 tons per square foot. This category includes granular soils, sand, and submerged soils.

In a rescue situation, soil types are considered to be type C and shoring should be constructed accordingly.

Trench Rescue Assignment

Trench rescue incidents are generally classified by the dispatch center as "Technical Rescues". As such, those assignments receive a standard response of the following:

- 2 Closest Engine Companies
- Closest Medic
- Ladder 1
- Battalion 1

The standing orders for the companies assigned to the first alarm are as follows:

- 1st-In Engine Company: Establish Investigation Group. Perform scene assessment, immediate control actions (energy source control, identification of hazards), and locate witnesses and maintenance personnel. Prepare to transition to Rescue Group.
- 2nd-In Engine Company: Establish the Ground Support Unit. Be prepared to transport materials and provide personnel to assist with the development of a safe working environment.
- Ladder 1 Establish Supply Unit. Prepare to conduct shoring assessment (in conjunction with Rescue Group) and develop shoring solutions.
- Battalion 1: Incident Command
- Medic: Establish Medical Group

Incident Command It is the responsibility of the On Duty Battalion Chief to understand that trench rescues are rare and may not be dispatched properly by the 911 center. Therefore, the BC should upgrade any suspected incidents so that the resources listed above are sent. Besides the BC, any company officer may call for a technical rescue response in the event they find themselves in a situation requiring additional resources and expertise.

All technical rescue incidents shall have a structured intervention system that is compliant with the National Incident Management System. In large multi-strategy incidents, branches may be enacted.

A safety officer shall be assigned by the incident commander utilizing command staff or company officers as personnel allows. The addition of an assistant safety officer should be considered. Other fire department resources, including mutual aid, may be requested and dispatched, as needed.

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Technical Rescue Response (outside city limits of Russellville with or without assistance of another established technical rescue team.)

The requesting community shall as a minimum, have one engine company, one Incident Commander

General Guidelines

This policy is applicable to any incident in which a patient is trapped, buried, or experiencing a medical emergency in an unprotected or unsafe trench or excavation. Entry into trenches requires special training and knowledge and should only be done in the presence of trained responders.

No member shall enter an unprotected trench to render patient care or perform disentanglement operations. Emergency personnel should protect all trenches using approved methods prior to entry. Do not allow any civilians, bystanders, or responders into an unprotected trench.

All rescue responders shall wear appropriate PPE while working in a trench, including:

- Rescue Helmet
- Gloves
- Industrial work/safety harness with tag line (if entering the trench)
- Safety Glasses

Size-Up Considerations

Different collapse scenarios will require different types of shoring techniques. Each scenario shall be evaluated using the same evaluation mechanism and adaptations made for the current operation as required by the configuration of the trench or excavation.

Tactical Considerations

Phase I: Scene Size-Up

1. *First Arrival.* The first arriving company officer should assume command and immediately begin sizing-up the scene.
2. *Spotting Apparatus.* All emergency vehicles should be positioned at least 100 feet away from the collapse site with engines turned off. All traffic should be stopped or detoured within 300 feet of the collapse site.
3. *Initial Size-up of the Scene.* The initial size-up should survey a 100 foot radius around the collapse scene. This should include:
 - Conducting a primary assessment of the scene to determine what has happened and immediate needs.
 - Assessing all potential hazards to all rescuers. All sources of vibration (construction equipment, traffic, bystanders, etc.) within 300 feet should be eliminated.
 - Identifying the number of victims, their location, and the nature of their injuries. A critical decision to be made early on involves whether the incident is rescue or recovery.
 - Locating a foreman, co-workers, or bystanders in order to obtain information. Information should include length of time since the collapse and the equipment available to first responders on the scene.

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- Establishing scene safety, including all bystanders in and around the emergency incident.
 - Finding the dimensions of the trench: length, width, and depth. Any trench over 5 feet deep must be shored before personnel are allowed to enter.
 - Ensuring all utilities are controlled, including water, gas, sewer, and electrical in the trench and the surrounding scene. All trench rescues must also follow the guidelines for a confined space rescue in regards to monitoring and ventilation.
4. *Secondary Size-up of the Scene.* Once the initial size up is completed, the secondary assessment should begin. This secondary size-up should be conducted at least 50 feet away from the collapse scene. This area should be taped or fenced off, leaving only one way to enter and exit the collapse scene. The following considerations for the secondary size-up shall be met:
- When approaching the trench to make the secondary size-up, always approach it from the ends.
 - Establish mode of operation based on time and degree buried, (Totally buried, buried to the neck, buried to the waist, or trapped by utilities), risk-benefit analysis, and rescue-probable or recovery. The mode should be announced to all personnel.
 - Assess the need for additional resources. Any trench over 5 feet deep mandates the use of the shoring or other protective systems.
 - Establish visible command and control access to the collapse area.
 - Locate any shoring material, such as lumber, cross ties, shoring, etc that can be used on scene.
 - Assist victims out of trench who are not trapped by the collapse, but DO NOT ENTER the trench at any time until shoring has been put in place.
5. *Patient Care.* Make contact with the victim(s) and remain in contact with them throughout the operation. The following aid should immediately be rendered to the victim(s) if safe to do so:
- Determine their level of consciousness
 - Provide the patient with oxygen via a non-rebreather mask lowered down to the patient.
 - If the patient is buried above their chest, which inhibits their breathing, use a long pike pole or 2x4 to remove dirt from the chest area of the patient.
6. *Update Dispatch and Responding Units.*
- Confirm number of entrapped victims.
 - Inform responding units of victim(s) medical status.
 - Establish an area for supplies and equipment.
 - Request any additional resources.

Phase II: Pre-entry Operations

Incident Command Resource Assignments

The Rescue Group Supervisor shall be responsible for ensuring the following tasks are completed with their assigned resources.

1. Identify shoring needs and equipment necessary to protect the trench. Communicate needs to the Supply Unit.
2. Develop a victim survivability profile and determine access options.
3. Conduct air monitoring operations.
4. Stabilize the surrounding area using ground pads and other necessary equipment.
5. Insert shoring and apply pneumatics according to industry standards and rescue best practices.

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The Rescue Group is responsible for air monitoring in the area of the trench. However, on large or complex incidents this may require the establishment of a separate Air Monitoring Group. Air monitoring should be performed for the following conditions:

- Oxygen-deficiency: less than 19.5% oxygen
- Oxygen-enrichment: greater than 23.5% oxygen
- Combustible Gases and Vapors (LEL) any atmosphere containing over 10% of lower explosive limit presents an explosion or fire hazard
- Toxicity: Carbon Monoxide over 35 ppm or Hydrogen Sulfide over 10 ppm.

All Rescue Group members will be fully briefed on their assignments after the Rescue Group Supervisor has consulted with the IC, a rescue plan has been formulated, and prior to the commencement of rescue operations. A backup plan should also be in place.

Site Safety

In order to ensure scene safety, the following precautions should be taken:

1. Create hot and cold zones.
 - Hot zone extends 0-50 feet (Essential emergency personnel only.)
 - Warm zone extends 50-300 feet (support and command functions)
 - Cold zone extends >300 feet (The perimeter of the cold zone is the crowd/traffic control line.)
 - Shut down roadway if necessary
 - Re-route all non-essential traffic at least 300 feet around the scene.
2. Rescue technicians shall accompany all EMS personnel during patient access and removal.

Rescue Area Safety

Initial site safety is needed in order to control the safety in and around the trench collapse zone.

1. Ground pads should be placed around the trench or collapse site lip. Approach the ends of trench when possible. Provide level area for ground pads and place within 6 inches of the trench lip.
2. Assess spoil pile and clearance to trench. Minimum of 2"x12" lumber placed between spoil pile and trench on level ground. 2 feet between trench and spoil pile is optimal.
3. Assess angle of repose and need for adjustment.
4. Place minimum of 2 ground ladders for emergency exit. Ladders must remain within 25 feet of personnel for emergency access.
5. Ventilate the trench until air quality returns to acceptable range in all categories. If the situation dictates entering the trench for any reason prior to acceptable air quality, SCBAs or supplied air with escape bottles must be worn at all times. Negative pressure ventilation may also be used as determined by personnel and intrinsically safe fans should be used whenever possible.
6. Assure that all utilities are shut off. Any product that is flowing, including water, must be secured and the use of drain pumps must be considered.
7. If conditions permit, provide victim with a helmet, goggles, and oxygen.
8. Do not touch any heavy equipment until it is determined that it is not in contact with electrical utilities.

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Phase III: Collapse Zone Operations

Collapse zone operations should be organized to include the following items:

- Limit personnel at the lip and collapse zone. The Rescue Group will be responsible for the placement of all shoring in accordance with the established plan. All shoring will be based upon the double funnel principle.
- The maximum amount of surface contact must be maintained at all times. Backfill, airbags, and wood may be used behind strongbacks in order to effectively transfer load.
- Pressure bulb principle states that soils can be compacted through adequate pressure. Two hundred (200) psi will be used at all times when pressurizing air shores. The only exception is when pressurizing corners, then 50 psi will be used until all corners are secured and then re-pressurized to 200 psi in the same order they were established.
- Air shores shall be used in available situations, unless dictated by distance, and then replaced with timber shoring. The creation of a "safe box" is required for rescue of victim. The optimal safe zone is 12 feet of shored safe area.
- The first set of panels shall be placed as close as possible to the patient for early EMS access.
- The safety zone during shoring is established using the "4 Foot Rule." All personnel are considered in the safe zone while remaining within 4 feet of a panel. Shores will always be placed on the strongback as the FinForm backing is for weight distribution only.
- Shoring must remain within 12-18 inches below the lip of the trench and 12-24 inches from the bottom of the trench.
- Placement of air shores is middle, bottom, top. Placement of timber shores is top, middle, bottom. Timber shores shall be pressurized using wedges and secured on all four sides.
- Walers may be used to span horizontally and span voids and intersections. They are used to create access space by allowing the exception to the 4 foot rule. 6"X6" lumber or airshore rails shall be used only. Allow a maximum of 8 feet between shores. Walers are placed in the order according to the shores and secured in a minimum of 2 spots.
- Ensure ventilation continues as needed and monitor air quality throughout incident. Ensure de-watering systems are operational.

Patient Access and Removal

The following describes the procedure for patient access and removal:

1. Once a safe zone is established, patient access may be made.
 - Remove all debris and dirt from around patients head first in order to access the patient's airway.
 - Uncover the patient from the head down.
 - Once the head and neck are clear of debris, place a cervical collar on the victim to stabilize any possible C-spine injuries.
 - After the victim's extremities are uncovered, establish an IV.
2. Hand tools shall be used at all times when accessing the patient. **Never use large machinery to gain access to the patient who is trapped or entangled.**
3. During hand digging operations, if more than 2 feet of trench wall is exposed, there is a danger of a slough-in and shoring shall be placed prior to continuing digging operations.
4. Personnel involved in digging and extrication should rotate approximately every 30 minutes.

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5. Victim Consideration are as follows:

- Make access to the victim as soon as possible once safe zone is established.
- Provide victim with goggles if possible.
- Treat for crush syndrome as indicated by protocols.
- Establish vital signs on the victim as soon as possible.
- Extricate victim(s) by using the LSP Halfback, SKED, stokes basket, etc.
- Once you are proximate to a victim, dig by hand.
- Ensure technical rescue personnel and patient care personnel are in coordination at all times for patient extrication.
- When removing victim from trench, take care not to dislodge any of the shoring materials.

Phase IV: Termination of the Trench Rescue

The termination of the incident should proceed in the following order:

1. Personnel accountability shall be ensured prior to beginning termination of the incident and all command and safety positions shall remain in effect during demobilization.
2. Shoring built solely from lumber should be left in trench, or removed with heavy equipment.
3. Perform removal operations in reverse order. First in / last out.
4. Beware of secondary collapse. If risk is too great, equipment shall be left in place. Power equipment may be used to tear down all shoring if danger is too great to remove by hand.
5. Secure the trench as necessary with all associated parties and turn over to responsible party.
6. If a fatality has occurred, as much equipment as is possible should be left in place for investigation.

Termination of the incident and removing shoring is one of the most dangerous parts of the operation.

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