

TR: Trench

Lesson One

Victim Management

DOMAIN: COGNITIVE / PSYCHOMOTOR

LEVEL OF LEARNING: COMPREHENSION / APPLICATION

MATERIALS

IFSTA 7th Edition Fire Service Search and Rescue; Trench Rescue Training Levels: Awareness, Operations, Technician 2nd Edition, by C.V. Martinette Jr., NFPA 1006, Standard for Technical Rescuer Professional Qualifications; NFPA 1670, Standard on Operations and Training for Technical Rescue Incidents 2009 Edition; OSHA 29 CFR 1926.650 OSHA Construction Standard, Subpart P; multimedia projector and laptop computer; access to white board or flipchart; assorted marker pens; timber shoring material to include: plywood trench panels, (minimum 1 1/8 inch thick) or commercial panels; Shore Form, Finn Form, (minimum of 1 inch thick), 2"x12"x12' strongbacks for attachment to panels, large steel or concrete pipe (minimum 18" diameter), backhoe old automobile, carts to move equipment around on site, water supply and appropriate hoses, 5 gallon buckets, a straight wall trench, a T-trench, an L-trench and a deep wall trench (12-15 feet), timbers for shoring and waling, 4'x8'ground pad, 2"x12"x12' ground boards, 2"x4"x12 foot timbers (for use as panel rails), 2 4"x4"x 12-14 foot timbers (for A-frame), utility ropes for panels and buckets, lifelines, rope rescue hardware and software, patient packaging equipment (example; Stokes basket, SKED Stretcher, LSP Halfback, Miller Board), heavy duty lifting straps, heavy duty come-a-long, Trench Shield, ventilation equipment atmospheric monitoring equipment, timbers for cross braces (minimum 4"x6"), timbers for walers; (minimum 6"x6") respiratory protection and air refill station, ventilation system, low pressure and high pressure air bags; cribbing, duct tape, aluminum walers, hydraulic shoring equipment, pneumatic shoring equipment, screw jacks, trench box, fire service ladders, timbers for walers, dewatering device with intake and discharge hose, 50 pounds of 16 penny nails, 50 lbs of

8 penny nails, 2"x4"x12' timber for scabs and wedges, cutting station with power cutting tools, nail pouches hammers, tape measurers, safety glasses long handled shovels (flat and pointed), trenching shovels, portable generators, extension cords, gas, oil (for generator), chainsaw with spare chains chainsaw chaps, lighting equipment, tarps to cover trenches (inclement weather), sledge hammers, steel yard rakes, nylon lifting straps, rescue mannequins or hose dummies, carpenter pencils, carpenter squares, hearing protection, portable radios, equipment tarps, shelter tarps, rehab supplies, rehab station, standby medical personnel, fire line tape or barricade fencing and or traffic cones, clean-up supplies such as soap, heavy duty brushes, and towels: maintenance supplies necessary to put all equipment back in service. Candidates should provide appropriate PPE to include; steel toed boots, gloves, helmet, safety glasses, ear plugs (optional) appropriate clothing, in addition a nail pouch or tool belt, carpenter pencils, one hammer and one 25 foot long tape measure.

NOTE: The amount of each listed piece of equipment should be able to support two trench operations simultaneously.

NFPA 1006, 2013 Edition JPRs

- 8.1.5 Release a victim from soil entrapment
- 8.1.6 Remove a victim from a trench
- 8.2.6 Release a victim from entrapment

Junior Member Statement:

Junior Member training activities should be supervised by qualified instructors to assure that the cognitive and psychomotor skills are completed in a safe and non-evasive manner. While it is critical that instructors be constantly aware of the capabilities of all students both mentally and physically to complete certain tasks safely and successfully, the instructor should take every opportunity to discuss with departmental leaders and students the maturity and job awareness each participant has for the hazards associated with fire and rescue training.

TERMINAL OBJECTIVE

The Technical Rescuer given the appropriate equipment, working as a member of a team, and following local protocols shall correctly demonstrate techniques for stabilizing a trench, gaining access to, releasing from entrapment, and removing the victim from a trench.

ENABLING OBJECTIVES

1. The Technical Rescuer shall correctly identify strategic and tactical considerations for the rescue phase of a trench collapse operation.
2. The Technical Rescuer given the appropriate equipment, working as a member of a team, and following local protocols shall correctly demonstrate safe and efficient methods or techniques for stabilizing hazards, gaining access to, and releasing victims from entrapment.
3. The Technical Rescuer given the appropriate equipment, working as a member of a team, and following local protocols, shall correctly demonstrate stabilizing, packaging and removing a victim from a trench collapse accident.

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Victim Management

MOTIVATION

Once rescuers have gained access to the victim and all medical assessments have been made, a plan must be devised for packaging and safely removing the victim from the environment that will minimize any aggravation of the victim's medical condition. Considerations should include: Will the operation be a rescue or a recovery? Will advanced life support be necessary before the victim can be moved or can it be delayed until the victim reaches the surface? Will the patient packaging device available to the AHJ fit in the trench? Will it protect the victim from potential falling debris? Will a simple method such as a ladder slide work to evacuate the victim or will a more complex lifting system be required? Regardless of the situation these questions cannot be answered without a definite plan. The plan should include input from the medical group, interior division and the Operations Chief. This plan should begin as soon as the interior operations begin. Don't wait until you have the victim totally uncovered; the victim's injuries may require rapid evacuation. Develop at least two plans for evacuation and begin implementing some of the elements as soon as possible. Remember plans can always be altered.

PRESENTATION

ENABLING OBJECTIVE #1

The Technical Rescuer shall correctly identify strategic and tactical considerations for the rescue phase of a trench collapse operation.

1. Identify issues to be addressed during the course of accessing, stabilizing and removing the victim from the trench.
 - a) Once all of the preparations have been made, such as identifying and mitigating hazards (soil, water, electrical, atmospheric, and exposed

- pipes), identifying on-scene and potential needs for resources, and weighing the risk and benefits, the process of gaining access to the victim can begin.
- b) This process is commonly referred to as Phase III or simply the Rescue Operation phase.
 - c) This phase addresses two functions; personnel accountability and search and rescue tactics.
 - d) Have all personnel understand emergency evacuation procedures.
2. Discuss the purpose of an accountability system.
- a) This system ensures that only personnel who are authorized and properly equipped enter the collapsed trench work area.
 - b) An accountability system is designed to track all personnel's location and status during the course of any emergency operation.
 - c) The degree of formality of the accountability system should be reflective of the nature, size and complexity of the trench rescue incident.
 - d) Some trench rescue operations may only require one or two rescuers in the trench at a time and no respiratory protection is required and they are in close visual and verbal contact with surface personnel.
 - e) In the situation described above, the intent of the accountability system can be met by recording the interior trench crew's name; adding a class III harness and retrieval line to them and record their entry and exit time.
 - f) Personnel accountability is the responsibility of the IC, the Safety Officer, and the Personnel Accountability Officer.

Reference: IFSTA 7th Edition Fire Service Search and Rescue, page 263.

3. Identify the types of victim entrapments.
- a) Cave-in accidents fall into two categories; partially buried victim and totally buried victim.
 - b) Partially buried victims obviously have a greater chance of survival than totally buried victims, but they can die due to severe trauma if quick action is not taken to stabilize the victim.

- c) A third rescue condition is one with a victim in the trench, six feet deep, that has incurred trauma from a fall or a medical problem such as seizures, heart attack or stroke.

Reference: Trench Rescue Training Levels: Awareness, Operations, Technician 2nd Edition, page 162.

- 4. Discuss tactical considerations for making entry into the trench.
 - a) Soil may not be the only material entrapping a victim; pipes and heavy equipment may have to be lifted off the victim before access can be made. Only lift heavy object enough to remove the victim.
 - b) Lifting procedures can be accomplished from within the trench or from above using a lifting station and lifting straps. MAS can be set up while rescue operations are going on.
 - c) Depending on availability of equipment, a mechanical advantage system may be needed to include levers.
 - d) Consider the weight of the object to be lifted, depth of the trench, and limitations of on-scene equipment.
 - e) The cardinal rule for gaining access to the victim is to remove any entrapment mechanism and uncover the victim's head and chest first.

Reference: Trench Rescue Training Levels: Awareness, Operations, Technician 2nd Edition, page 162.

- 5. Point out that as a means of entry and egress, a stairway, ladder, ramp, or other means of safe egress must be installed in trenches with a depth of 4 feet or greater, (OSHA CFR 1926.651 (c)(2)).
 - a) Horizontal spacing between points of entry and egress shall be no more than 25 feet (OSHA CFR 1926.651 (c) (2)).
 - b) For rescue operations a minimum of two points of entry/egress are recommended, using fire service grade ladders installed in close proximity to the interior rescue personnel, the top of the ladders should extend at least 3 feet (about 3 rungs) above the lip of the trench.

Reference: IFSTA 7th Edition Fire Service Search and Rescue, pages 248, 252, and 262.

Reference: Trench Rescue Training Levels: Awareness, Operations, Technician 2nd Edition, page 202.

6. Point out that for a non-intersecting trench, a minimum of 6 panels will be needed (3 on each side) to provide a minimum safe horizontal work area of 12 feet for rescuers.
7. Emphasize that when attempting to make initial contact with a victim, the AHJ will have to determine whether it is safe for a rescuer to make entry into the trench with less than a 12 foot work zone established.
 - a) Example: A victim is visible and exhibiting respiratory difficulty, one set of panels has been installed directly over the victim and a ladder is in place. Is it safe for the rescuer, staying on the ladder, to enter the trench to perform initial medical assessment and treatment?
8. Point out that some rescue team protocols require that at least 2 sets of panels must be set before any rescuer is allowed to enter the trench; some team protocols use the above example as a guideline.

Reference: Trench Rescue Training Levels: Awareness, Operations and Technician 2nd Edition, pages 202 and 203.

PRESENTATION

ENABLING OBJECTIVE #2

The Technical Rescuer, given the appropriate equipment, working as a member of a team, and following local protocols, shall correctly demonstrate safe and efficient methods and techniques for stabilizing hazards, gaining access to, and releasing victims from entrapment.

1. Discuss and demonstrate procedures for stabilizing hazards near the lip such as backhoes and pipes.
 - a) If the backhoe is running have it shut down and give the keys to the IC or Operations Officer.
 - b) Chock all wheels.
 - c) Stabilize the under carriage using cribbing and air bags (if needed).

- d) If the bucket is suspended or hanging over the work area, secure it using chains and a come-a-long.
 - e) Secure the chain around the bucket, attaching a come-a-long between it and an anchor point near the cab area. This prevents the bucket from moving in the event the hydraulic cylinder controlling the bucket begins to lose pressure.
 - f) Once the bucket is stabilized digging operations can begin to free an entrapped victim.
 - g) If space allows, cribbing can be used to stabilize the under carriage of the bucket.
 - h) The first step for stabilizing pipes near the trench lip is to move them away from the trench manually or mechanically, then shimmed and or picketed if it can be done safely.
 - i) If it is deemed unsafe to move the pipe in any manner then the pipes should be secured in place; ropes and pickets or shims are two possible choices.
2. Discuss and demonstrate procedures for lifting and stabilizing a pipe that is on a victim in the trench.
- a) The three options for stabilizing an object to retrieve a victim is: lift and crib, crib and dig out from under the object, or combine both methods.

Reference: Trench Rescue Training Levels Awareness, Operations, Technician, Unit 12, pages 113 through 114.

PRESENTATION

ENABLING OBJECTIVE #3

The Technical Rescuer when given the appropriate equipment, working as a member of a team, and following local protocols, shall correctly demonstrate stabilizing, packaging and removing a victim from a trench collapse accident.

1. Discuss action to consider for a partially buried victim.
- a) For partially or totally buried victims, Interview the foreman, competent person and workers to determine number of victims and the point last seen (PLS) for each.

- b) If the victim is visible and conscious, communicate with them and try to minimize their fears, insert a ladder close to their proximity.
- c) Oxygen use is permissible providing there is no potential for explosive gases to enter the trench.
- d) An air knife is an excellent tool for cutting and loosening up soil in an effort to gain access to a victim. It operates off compressed air at a working pressure of 90 psi and will not harm rescuers or victims if it comes into contact with the skin.
- e) In large cities a soil vacuum truck may be available; these trucks suck up large amount of soil and small debris and deposit them into a holding tank.

Reference: IFSTA Fire Service Search and Rescue 7th Edition, page 263.

2. Discuss actions to be taken for a totally buried victim.

- a) Search for clues; end of pipe string (should be the first place to start), grade pole, backhoe tracks, exposed pipe or other object in the trench, paint buckets, grease cans, solvents, refreshment containers, shovel, and helmet.
- b) At commercial sites check for an engineering hub (aka: Engineer's Flagstick) which will give information regarding the original depth of the trench and the centerline distance of the trench from the hub.
- c) The above clues can help with narrowing the initial search area.
- d) Once the work area has been established and a protective system is in place, interior rescuers can begin the long tedious process of locating the victim by removing the dirt.
- e) Pike poles can be used to probe in loose dirt.
- f) An Air Knife or a soil vacuum truck can be effective in loosening large amount of dirt for removal from the trench to expedite locating the victim.
- g) In some reported cases search dogs have been used effectively to narrow a search area.
- h) If the operation has been determined to be recovery, consideration may be given to cutting the trench walls back to a safe angle of repose,

- which according to OSHA is 1-1/2 foot horizontal for every foot vertical for Class C soil.
- i) An example would be a trench with a depth of 10 feet would require that each trench wall be cut back 15 feet. Add the original width of the trench, let's say 5 feet; the overall width of the opening would have to be 35 feet.
 - j) Allowable space and obstacles may not permit the above option.

Reference: IFSTA Fire Service Search and Rescue 7th Edition, pages 263 and 264.

Reference: Trench Rescue Training Levels: Awareness, Operations and Technician 2nd Edition, pages 164 and 165.

- 3. Identify the three rules for digging in a trench.
 - a) Never use a mechanical device or backhoe to dig out a partially buried victim.
 - b) Never attempt to pull out a partially buried victim.
 - c) Dig by hand when you get near the victim.

Reference: Trench Rescue Training Levels: Awareness, Operations and 22nd Edition, pages 165 and 166.

- 4. Identify concerns while attempting to locate and gain access to the victim from within the trench.
 - a) Be careful not to dislodge any shoring materials.
 - b) Stabilize all equipment near lip of trench to prevent a falling hazard.
 - c) The safety officer or appointee should monitor the integrity of the protective system throughout the operation.
 - d) Take time to evaluate your movement patterns and how the type of packaging device and lifting device, if used, will impact the victim's removal.
 - e) During the removal of the victim choose an appropriate packaging type, take care not to aggravate injuries, and provide definitive medical care as soon as possible.
 - f) Be careful not to build the shoring system so tight that you cannot extricate the victim.
 - g) If planning reveals that adjustments or moving of the shores is necessary, do so before victim packaging begins.
 - h) Another consideration during extrication is that because the packaging device may be too

cumbersome to manipulate through the shoring system, the victim may have to be lifted out of the hole.

- i) A lifting platform with a mechanical advantage system may have to be constructed to lift the victim out of the trench.

Reference Trench Rescue Training Levels: Awareness, Operations and Technician 2nd Edition, page 169.

- 5. Demonstrate packaging a patient in the trench using a packaging device available to the AHJ such as a Stokes litter, Reeves Sleeve, Miller board or an LSP Halfback.
 - a) KEDs, XP1s and other devices used for spinal immobilization are not rated for lifting.
 - b) Make sure that all of the victim's body parts are well protected.
 - c) See "Packaging Victim" guidelines in Unit 4, pages 147 through 153 in IFSTA Fire Service Search and Rescue 7th Edition. Incorporate local protocols for packaging as well.

Reference: IFSTA Fire Service Search and Rescue 7th Edition, pages 147 through 153.

- 6. Demonstrate performing an incline ladder slide to remove the victim out of the trench.
 - a) Make sure that the victim is well secured in the packaging device.
 - b) Attach a retrieval line to the head of the device and manually lift the victim up the ladder headfirst.
 - c) If manpower is in short supply, create a mechanical advantage system to accomplish the task.
- 7. Demonstrate setting up an A-Frame lifting platform to extricate the victim.
- 8. Demonstrate setting up a Ladder-as a-Derrick lifting platform.

Reference: International Manual of Rescue Methods 2004 Edition.

APPLICATION

Divide the class into working groups and have them perform the following:

Given the appropriate equipment and working as a member of a team the Technical Rescuer shall demonstrate establishing an appropriate IMS system, perform a size-up, develop an action plan and initiate appropriate steps to neutralize all existing and potential hazards, gain access to, stabilize and extricate a victim from the following trench accident scenarios.

Scenario 1

You have responded to an accident involving a trench with the following dimensions: 5 feet wide, 7 feet deep and 16 feet long. The foreman tells you that they were repairing a water line when the lip of the trench caved in, partially burying one victim up to chest level. The spoil pile is less than 2 feet from the lip. There is approximately 18 inches of water in the trench and it appears to be filling with additional water. Upon initial assessment the victim is conscious but having trouble breathing. The accident occurred approximately 30 minutes prior to your arrival. Demonstrate implementing an IMS system; mitigate all on scene hazards including the installation of an appropriate protective system (using timbers only); provide safe entry and egress for rescue personnel and extricate the victim safely using a Ladder Slide system.

Scenario 2

You have responded to an accident involving a trench with the following dimensions: 4 feet wide, 8 feet deep and 16 feet long. The foreman tells you that the hydraulic systems on the backhoe malfunctioned causing the bucket to drop on a worker in the hole pinning him face down onto the floor of the trench. The spoil pile is a safe distance away from the lip of the trench. Upon initial assessment the victim appears unconscious and does not respond to verbal command. The accident occurred approximately 15 minutes prior to your arrival. Demonstrate implementing an IMS system; mitigate all on scene hazards including the installation of an appropriate protective system using pneumatic or hydraulic shoring (based on availability from the AHJ) and extricate the victim using an A-Frame lifting platform.

Scenario 3

You have responded to an accident involving a trench with following dimensions: 4 feet wide, 14 feet deep and 20 feet long. The foreman tells you that one of his workers has collapsed in the bottom of the trench and is non-responsive. The worker was checking the trench for a reported gas line leak. There is no protective system installed. The spoil pile is a safe distance away from the lip of the trench. Upon initial assessment the victim appears to be wearing a respirator. A strong smell of gas is noted coming from the trench. The accident occurred approximately 15 minutes prior to your arrival. Demonstrate implementing an IMS system, mitigate all on scene hazards including the installation of an appropriate protective system using pneumatic or hydraulic shoring (based on availability from the AHJ) and extricate the victim using a Ladder-as-a-Derrick lifting platform.

Scenario 4

You have responded to an accident involving a trench with following dimensions: 4 feet wide, 10 feet deep and 16 feet long. The foreman tells you that one of his workers has been totally buried by a lip collapse. He estimates that the worker is covered by approximately 2 -3 feet of dirt. There are several sheets of $\frac{1}{2}$ -inch plywood and some 4x4 timbers in the hole, suggesting the presence of a poorly constructed protective system that has failed. The spoil pile is sitting on the edge of the trench. Upon initial assessment you notice a shovel and a partially exposed construction helmet in the middle of the trench. The accident occurred approximately 40 minutes prior to your arrival. The foreman admits he tried to dig the worker out with a backhoe but was afraid that he might further injure the worker. Demonstrate implementing an IMS system, mitigate all on-scene hazards, including the installation of an appropriate protective system and supplemental shoring system using pneumatic or hydraulic shoring (based on availability from the AHJ) and extricate the victim using a Ladder Slide system.

Scenario 5

You have responded to an accident involving a trench with the following dimensions: 4 feet wide, 8 feet deep and 16 feet long. The foreman tells you that a heavy pipe has rolled into a trench as the result of a lip failure leaving a large void. The spoil pile is a safe distance away from the trench. Upon initial assessment you find the worker conscious and alert with his legs trapped by the pipe. He appears to be

experiencing a lot of pain. The accident occurred approximately 30 minutes prior to your arrival. Demonstrate implementing an IMS system, mitigate all on scene hazards, including the installation of an appropriate protective system to include the construction of an external waler system, an internal shoring system and a lifting platform to lift the pipe. Extricate the victim using an A-Frame system.

NOTE: The recommended student to instructor ratio should not exceed 10:1. A 7:1 ratio is preferred. The instructor should develop a plan for an unexpected real emergency and share the plan with all the students prior to beginning the exercise. Be sure all students exercise extreme caution when using all of the equipment to include wearing the appropriate PPE. All Command personnel should be wearing appropriate identifiers and all instructors should be readily identified.

SUMMARY

Considerations for victim packaging should begin before any protective system is installed. This will ensure that all shoring material will not impede access or removal of the victim. The Safety Officer or Assistant Safety Officer should continually monitor the integrity of the protective system especially during the extrication phase. Shores can get displaced during this phase. The best packaging device is one that will afford the victim the best protection and comfort without being too cumbersome and will not further aggravate the victim's medical condition.