

This Field Operations Guide contains specific information on technical rescue procedures.

THIS GUIDE IS NOT ALL INCLUSIVE!

It is intended to be used as a tool for training and for quick field reference. Refer to current training manuals and your department policies for detailed explanations. There is no substitute for regular, quality, hands-on training by a qualified instructor.



The techniques and procedures illustrated in this guide follow NFPA standards and OSHA regulations as much as possible. This guide can be used by rescuers at all skill levels but was specifically developed for fully qualified technical rescue technicians. Special operations are inherently dangerous and serious injury or fatality may result from improper performance of these techniques. The author accepts no responsibility for damage, loss, injury or death resulting from information contained in or omitted from this guide.

Thanks to the Phoenix Fire Department and everyone who helped make this guide possible. Special thanks to my friend Ron Jamison for helping to write this guide, Kathy Darrow for editing and to George Drees, Ken Phillips and Jim Frank for great ideas and input.

This guide is dedicated to all those people who go the extra inch every day to make themselves better rescuers.

This handbook is based on the Phoenix Fire Department and Arizona State Fire Marshall's Office technical rescue programs.

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Confined Space Command Checklist



Phase I: Size-up

- Primary assessment
 - Secure witness or competent person
 - Identify immediate hazards
 - Location, number, condition of victims
 - Attempt contact
 - Secure entry permit
- Secondary assessment
 - What type of space
 - Products in space
 - Hazards: atmospheric, mechanical, electrical
 - Diagram of space
 - Can non-entry retrieval be made?
 - Structural stability of space
 - Proper personnel and equipment on scene
 - Additional resources necessary
 - Atmospheric monitoring: ventilation, respiratory, retrieval system
 - Rescue or recovery/survivability profile

Phase II: Pre-entry operations

- Initiate Fire Department confined space rescue permit
- Make general area safe
 - Establish perimeter
 - Evacuate if necessary
 - Traffic and crowd control
- Make rescue area safe
 - Establish lobby control accountability
 - Test atmosphere: oxygen, flammable, toxic
 - Ventilate appropriately for space
 - Secure hazards: lock-out, tag-out
- Action plan with back-up plan
- Entry team ready
 - Back-up team in place

Confined Space Command Checklist

- Proper equipment
 - Personal protective equipment
 - Explosion proof lighting and communications
 - Respiratory system (SCBA, SABA)
 - Remote air monitoring
 - Personal atmospheric monitor
 - Class 3 harness
- Rigging team
 - Tripod, davit or crane
 - Retrieval system with back-up system
 - Patient packaging devices
- Air supply
 - Primary air supply
 - Back-up team air supply
 - Utility truck high pressure hook-up for refill of bottles
- Pre-entry briefing
 - Advise each team of expected task
 - Discuss emergency procedures for each team
 - Provide each team with site briefing
 - Advise each team of time limits

Phase III: Entry and rescue operations

- Entry system safety check
- Make entry
 - Continual atmospheric monitoring
 - Constant communication with the entry team
 - Monitor ventilation system
 - Assist entry team with line management
- Locate victim
 - Patient packaging and extrication

Phase IV: Termination

- Personnel accountability report
- Remove tools and equipment
- Decontamination
- Secure scene
- Consider debriefing
- Call OSHA



Confined Space Rescue



OSHA 29 CFR 1910.146 applies to general industry and the rescue service.

An OSHA confined space is defined as:

1. A space large enough for personnel to physically enter.
2. Not designed for continuous employee occupancy.
3. An area with limited entry and egress.

A confined space permit is required if the space has one or more of the following hazards:

1. Atmospheric hazards.
2. Configuration hazard.
3. Engulfment hazard.
4. Any other recognized hazard.

Acceptable entry conditions

Oxygen between:	19.5% and 22.5%
Lower explosive limit (LEL):	<10% of the LEL
Toxicity:	< IDLH

Immediately dangerous to life and health (IDLH)



Heat stress can quickly become a life threatening hazard. Rotate crews frequently.

- ✓ Take the extra time to carefully manage all lines.
- ✓ Be sure to have the lobby/attendant take up all lines as the entry team returns to the outside.
- ✓ Expect the atmosphere to suddenly become unsafe.
- ✓ Monitor the atmosphere continuously.

Confined Space Entry Safety Checklist

TSO commands for confined space entry

- Everyone take positions and prepare for entry checklist
- Attendant ready? *Attendant Ready*
- Retrieval ready? *Retrieval ready*
- Entry team egress bottle pressures? *Record pressure*
- Backup team egress bottle pressures? *Record pressure*
- Personal air monitor on *Monitor checks ok*
- Mechanical ventilation on *Ventilation on*
- Air supply ready? *Air supply ready*
- Entry team go on air *On air*
- Primary comm check *Primary comm OK*
- Secondary comm check *Secondary OK*
- Primary light check *Primary light OK*
- Secondary light check *Secondary OK*
- Entry team ready? *Entry team ready*
- Backup team ready? *Backup team ready*
- System safety check, any problems? *Solve any problems*
- Entry team make entry *Making entry*
- Attendant note time of entry *Time noted*

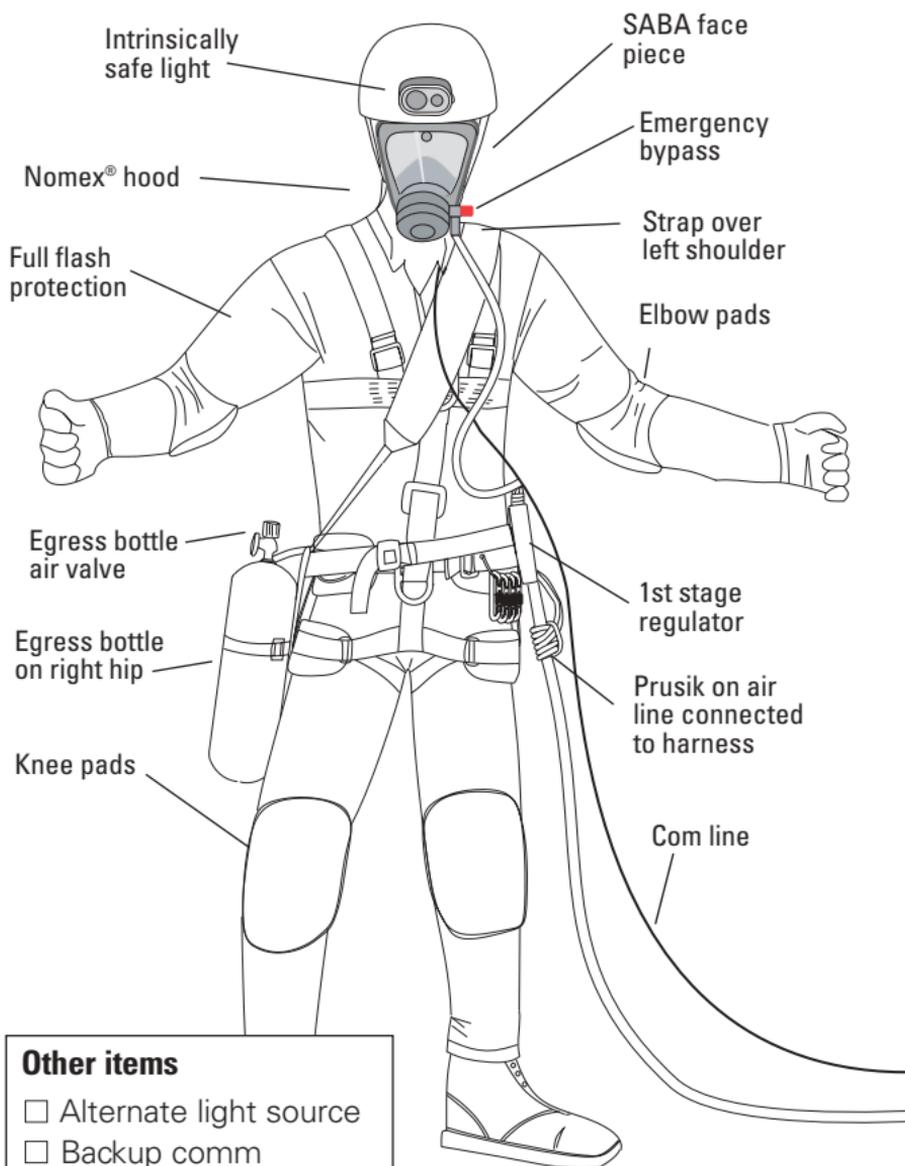
Emergency checklist for backup/rescue team entry

- Attendant ready? *Attendant ready*
- Retrieval ready? *Retrieval ready*
- Backup air supply ready? *Air supply ready*
- Rescue team go on air *On air*
- Personal air monitor on *Monitor checks ok*
- Primary comm check *Primary comm OK*
- Secondary comm check *Secondary OK*
- Primary light check *Primary light OK*
- Secondary light check *Secondary light OK*
- Rescue team ready? *Rescue team ready*
- Safety checks, any problems? *Solve any problems*
- Rescue team make entry *Making entry*
- Attendant note time of entry *Time noted*



Personal Protective Equipment

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A confined space harness must have a dorsal connection ring.

✓ Egress time should not exceed egress bottle capacity!

Supplied Air Station Operation

Setup

1. Assemble required equipment:
 - Remote air carts
 - SABA
 - Up to 300 ft. (90m) of hose per rescuer
 - Extra air bottles
2. Position air carts in close proximity to entry portal.
3. Stretch out all air hoses and unink.
4. Connect hose to entry team connection port on air cart.
5. Stack hose in figure eight coils or long loops as each section is connected.
6. Consider tagging each section of hose to identify rescuer.
7. Connect hose to rescuer SABA.

Air cart operation (air cylinders only)

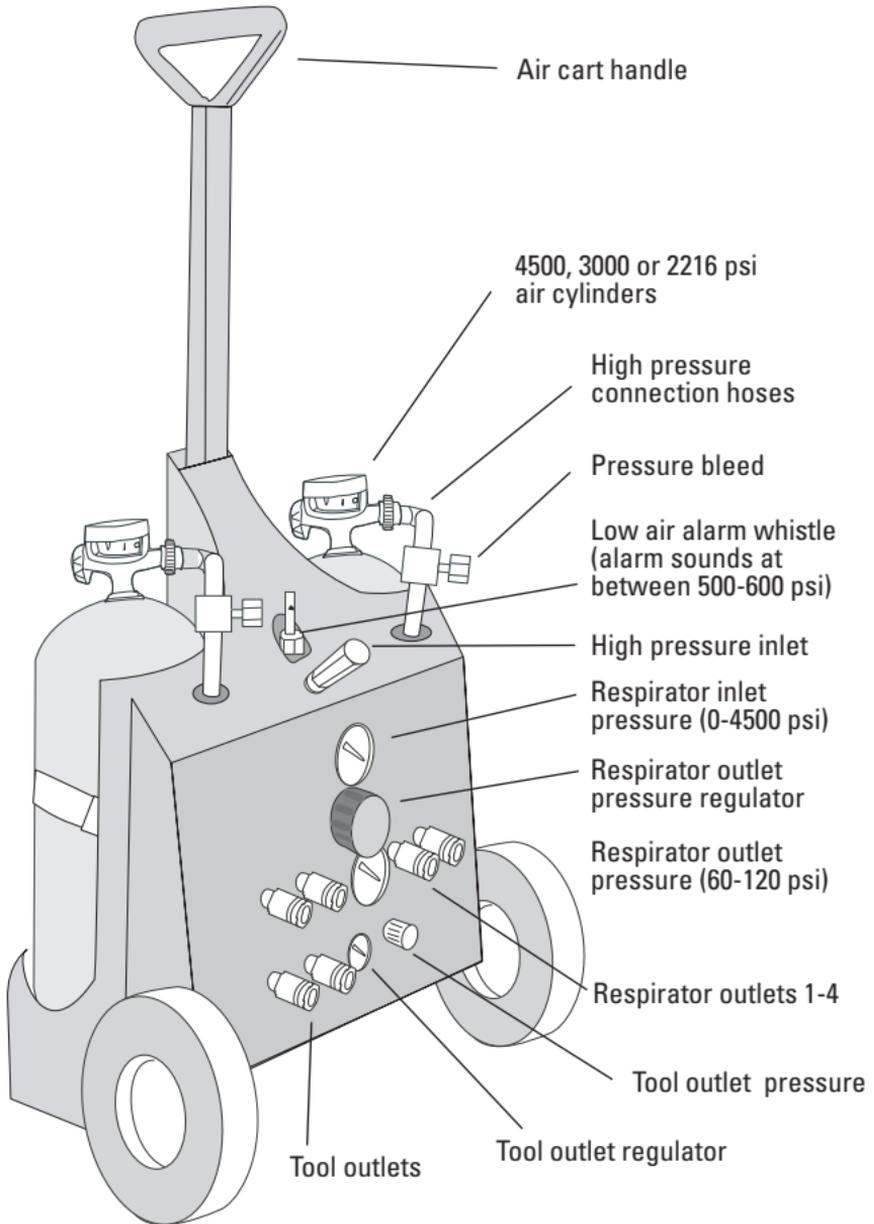
1. Confirm that both air tanks are full and that respirator regulator is turned fully counterclockwise.
2. Slowly turn on one of the two cylinders (primary). Alarm should sound briefly at initial start-up.
3. Confirm that outlet gauge pressure is set between 60 and 120 psi. without respirators attached (pressure will vary between different models of air supply cart).
4. When alarm sounds, open valve of secondary tank.
5. Alarm must stop before proceeding.
6. Close valve of used primary tank and replace with full tank.

SABA operation

1. Confirm that egress bottle is full.
2. Don SABA.
3. Keep egress bottle valve within easy reach at all times.
4. Connect air hose to first stage regulator.
5. Apply prusik to air hose and connect to harness.
6. Don face piece and test seal.
7. Don Nomex® hood and helmet.
8. Connect second stage regulator to mask.
9. Confirm operation of emergency bypass feature.



Remote Air Supply Cart



Communication Position (Attendant)

Setup

1. Position intercom kit in close proximity to entry portal (watch for hazardous atmosphere near the portal).
2. Stretch out comm line and un-kink.
3. Connect required number of comm line sections together.
4. If connectors will not lock into position, clean O ring mating surfaces with moist rag.
5. Connect female end of comm line to command module.
6. Stack comm line so as to inhibit kinking problems.
7. Connect operator head set to operator connection port on command module.
8. Determine whether entry team rescuer will use headset or ear piece and throat mike.
9. Connect male end of comm line to rescuer.
10. Secure comm line to rescuer harness with small loop of slack between harness and end connection.
11. Install batteries in command module and test.

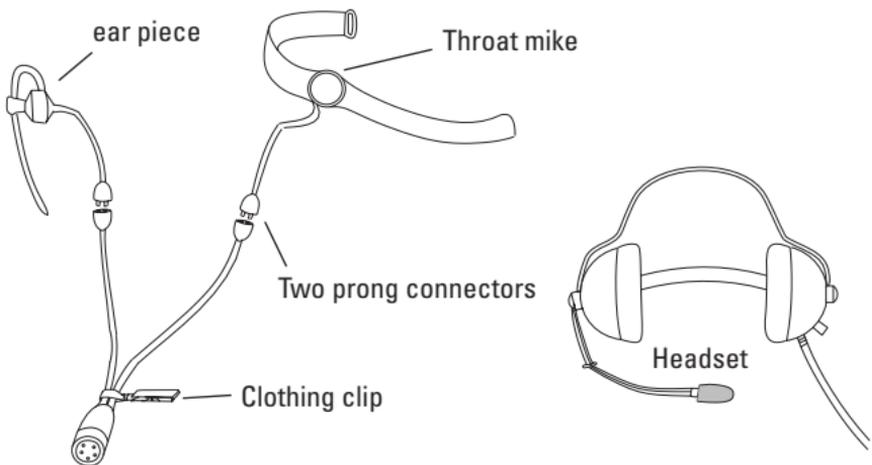
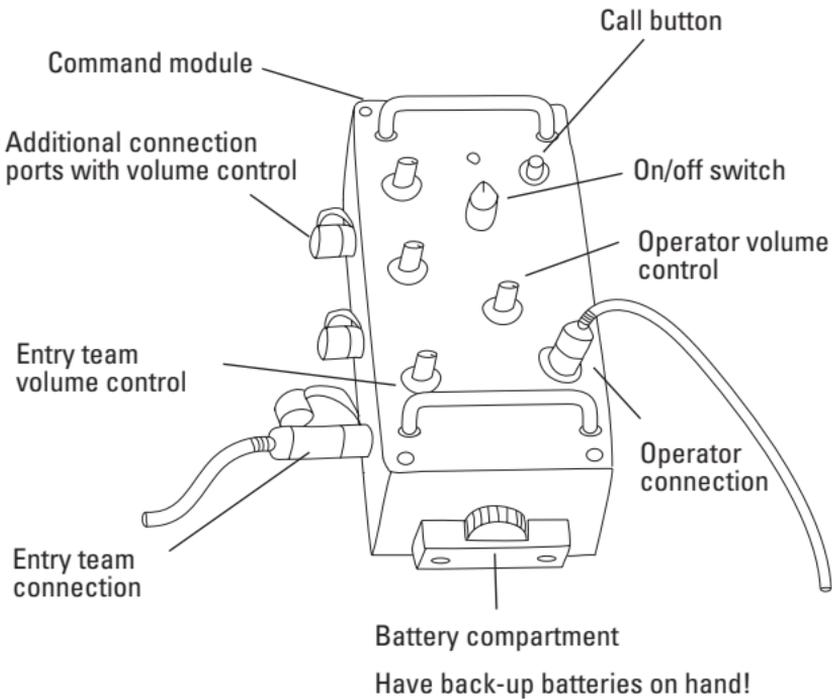
Operation

1. The attendant is required to maintain constant communication with the entry team.
2. The attendant can relay information to the TSO.
3. The TSO should not wear the headset unless it is a single side headset.
4. Adjust volume controls, as necessary.

Backup plan

1. The backup team must have a dedicated communication and air system.
2. Repeated contacts with entry team should be made via radio.
3. Test radio at junction points.
4. If communications fail, attempt brief troubleshooting and whistle or air horn signals (one long blast, repeat if necessary).
5. If communications cannot be re-established within one minute, send in the backup team.

Intrinsically Safe Intercom System



Atmospheric Monitoring

Principles of air monitoring



- Calibrate and span meter according to department procedures.
- If oxygen level is not normal, flammability readings will be affected.
- Spaces may have stratified atmospheres, all levels of space must be monitored.
- Allow for air intake in sampling hose at approximately 1 second per foot of hose.
- 10,000 parts per million = 1%.
- If oxygen reading is 1% low and it is being displaced by a contaminant, up to 5% of the total atmosphere may consist of that contaminant (50,000 ppm).
- Physical properties of a product can be found in the NIOSH pocket guide or MSDS.
- The calculated molecular weight of air is 29.

Below is an example of estimating the flammability and toxicity in a space in order to develop a victim survivability profile. A meter may not be required if the physical properties of the product are known.

Toluene Physical Properties		70°F (21°C) day	
Flash point	40°F (4.5°C)	>FP	yes
Molecular weight	92	>29	yes
LEL	1.1%	≥	yes
UEL	7.1%	≥	unknown
IDLH	500 ppm	est. ppm	11,000 ppm

- ✓ How long has the victim been down?
- ✓ Is this a body recovery?

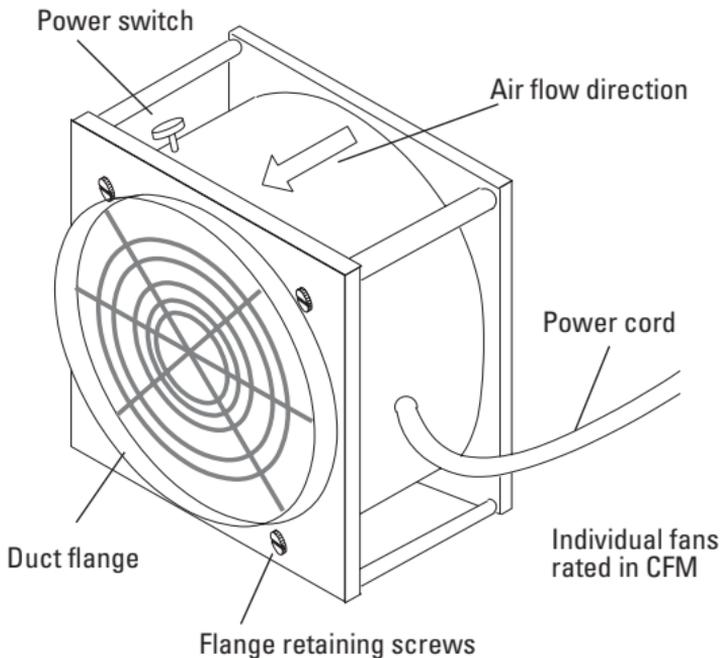
Ventilation

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Early and effective ventilation of the space may improve the patient survival profile and will increase rescuer survivability in the event of respirator failure.

The capacity of the fan in cubic ft. per minute (CFM) divided into the volume of the space in cubic feet equals the time it takes to exchange the air one time.

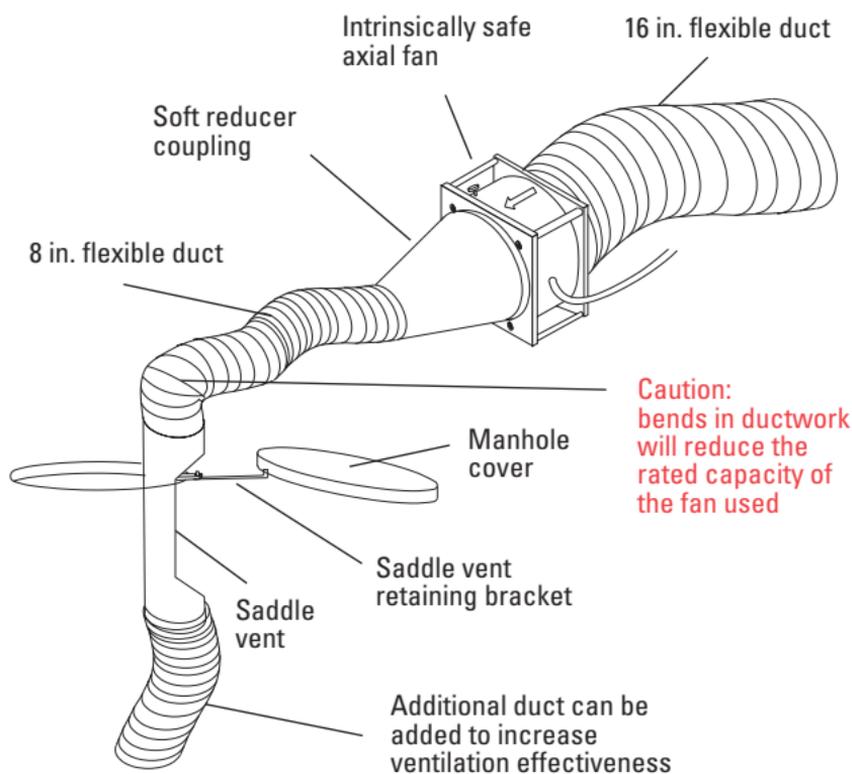
Intrinsically safe axial fan



- ✓ The ventilation goal is to exchange the air in the space as many times as possible.
- ✓ Fan should be rated intrinsically safe and grounded.
- ✓ Place fans where they will have maximum effect, as close to the hazard as possible, but outside the contaminated area.

Ventilation System Components

The axial fan is capable of positive and negative ventilation depending upon which side the duct is connected. The fan shown is only able to exhaust with the 16 in. duct. A soft reducer coupling is not suitable for exhaust ventilation. Know your equipment.

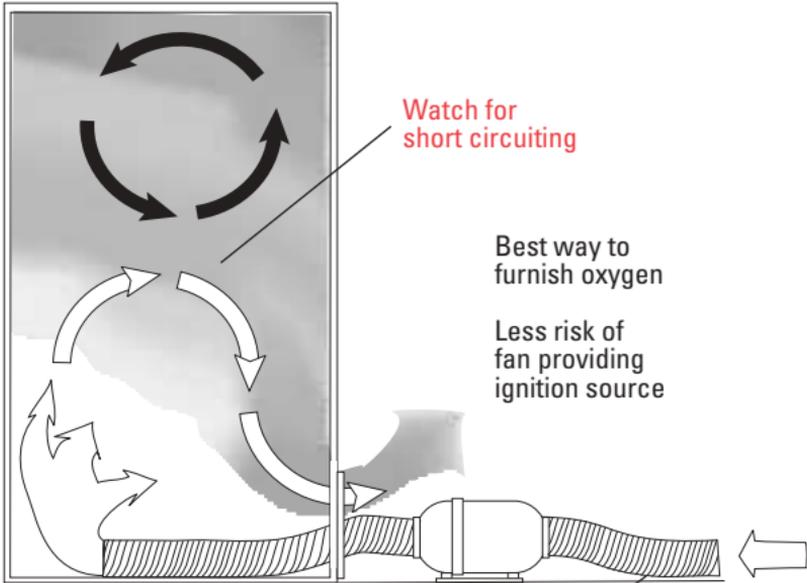


- ✓ Be extremely cautious when ventilating spaces with known flammable atmospheres due to the potential of the exhaust component reaching an ignition source.



Confined Space Ventilation

Supply Ventilation

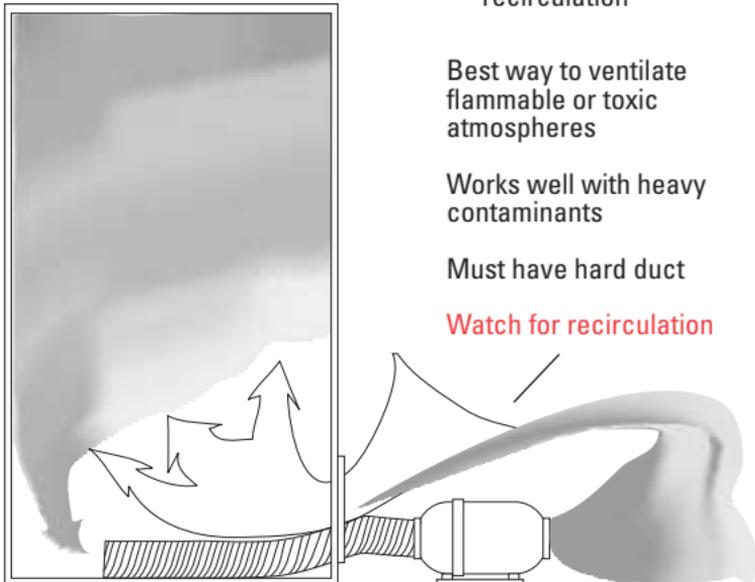


Best way to furnish oxygen

Less risk of fan providing ignition source

Extra duct can help direct contaminants and prevent recirculation

Exhaust Ventilation



Best way to ventilate flammable or toxic atmospheres

Works well with heavy contaminants

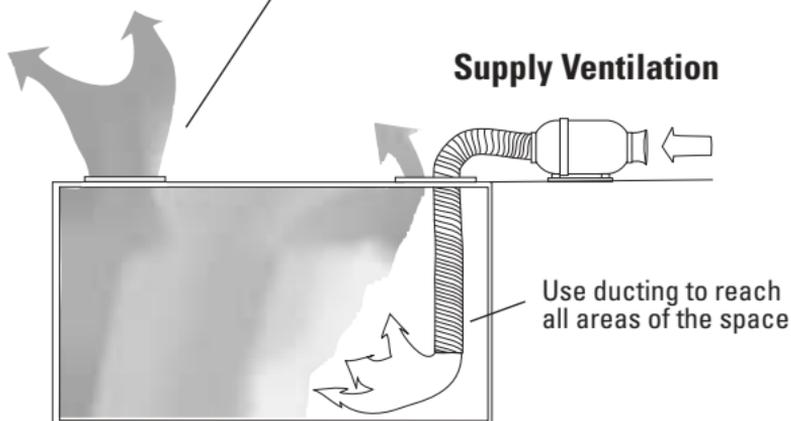
Must have hard duct

Watch for recirculation

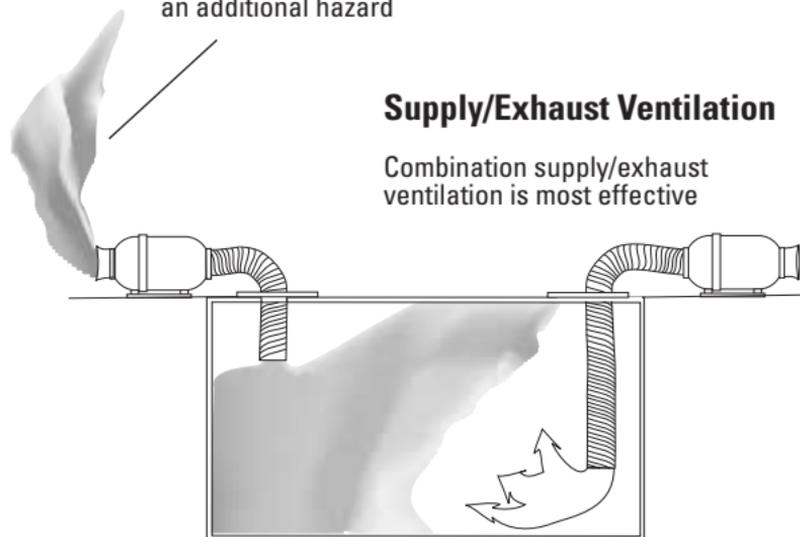
Confined Space Ventilation

Look for other openings to make ventilation more effective

Consider whether the contaminant is heavy or light and set up ventilation accordingly



Always consider where the contaminated exhaust is going and if it will pose an additional hazard

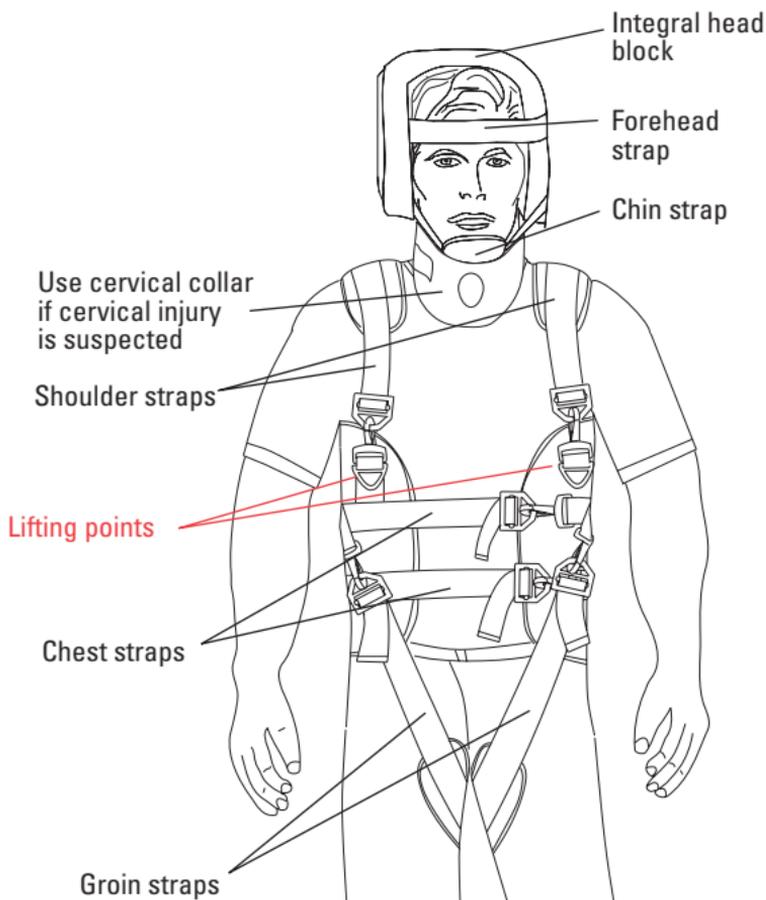


Extrication Device

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Application

1. Apply cervical collar and maintain spinal stabilization.
2. Position extrication device behind patient and under arms.
3. Release strap retaining flaps one at a time as each strap is applied.
4. Loosely fasten chest straps.
5. Fasten shoulder straps.
6. Fasten groin straps.
7. Have patient take a breath and tighten chest straps.
8. Tighten shoulder and groin straps.
9. Fasten forehead and chin straps.
10. Connect lifting strap to lifting points.



Rescue Tripod and Winch

Setup

1. Remove the tripod from its carry case and stand upright.
2. Move each leg outward into the working position.
3. Slide legs up into the headpiece to engage the leg locks.
4. Remove the winch from its case.
5. Position the winch onto the fixed pin on the tripod leg mounting bracket.
6. Tilt the winch against the mounting bracket and insert the detente pin into the detente pin hole.
7. Place the crank handle on the low speed shaft.
8. With an assistant, reverse the winch and reel out approximately 8 ft. (2.5m) of cable.
9. Remove the cable retaining pins from the headpiece.
10. Place the cable over both guide wheels.
11. Replace the cable retaining pins.
12. Lower the counterweight until it is near ground level.
13. With three rescuers, adjust the height of each leg and install the leg adjustment pins.
14. Install and adjust the leg anti-spread chain.
15. Position the tripod over the opening.

Operation

1. Attach the crank handle to either the low-speed or high-speed shaft.
2. To raise, crank handle in the direction that it will move.
3. To lower, slightly raise and simultaneously apply downward pressure to the ratchet brake lever.
4. Lower cable while holding the ratchet brake lever in the down position.

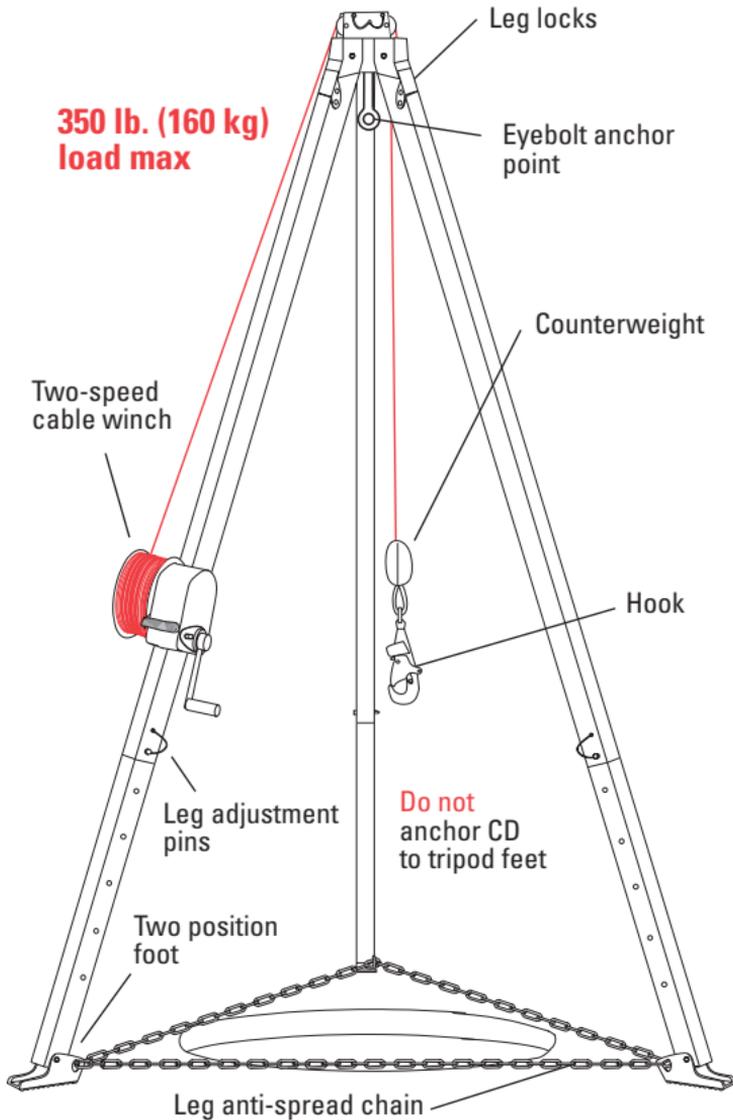


A rescue tripod is free standing and can easily collapse or tip over if used incorrectly.

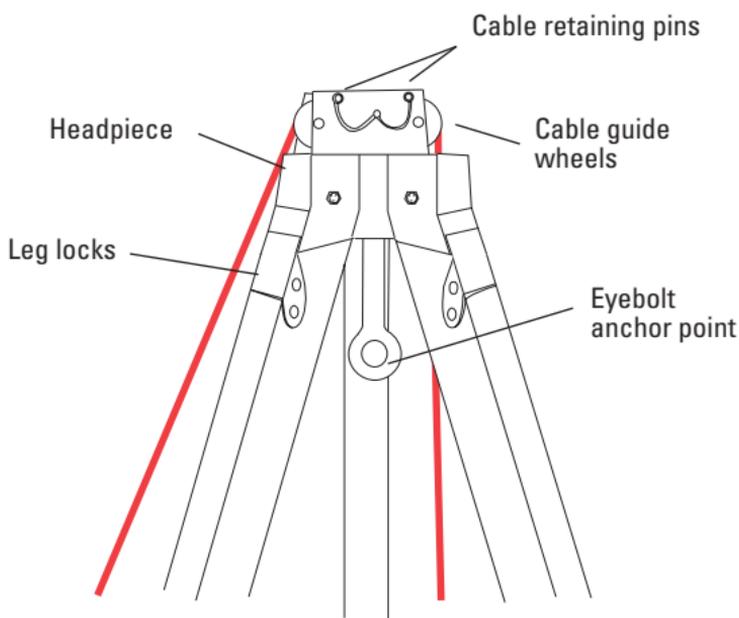
- ✓ Do not apply any lateral force to the tripod.
- ✓ Always use a separate belay line that does not go through a high directional on the tripod.



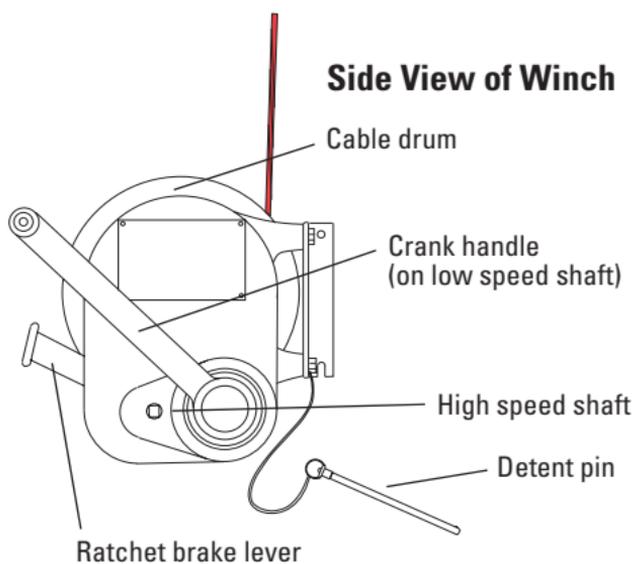
Rescue Tripod and Winch



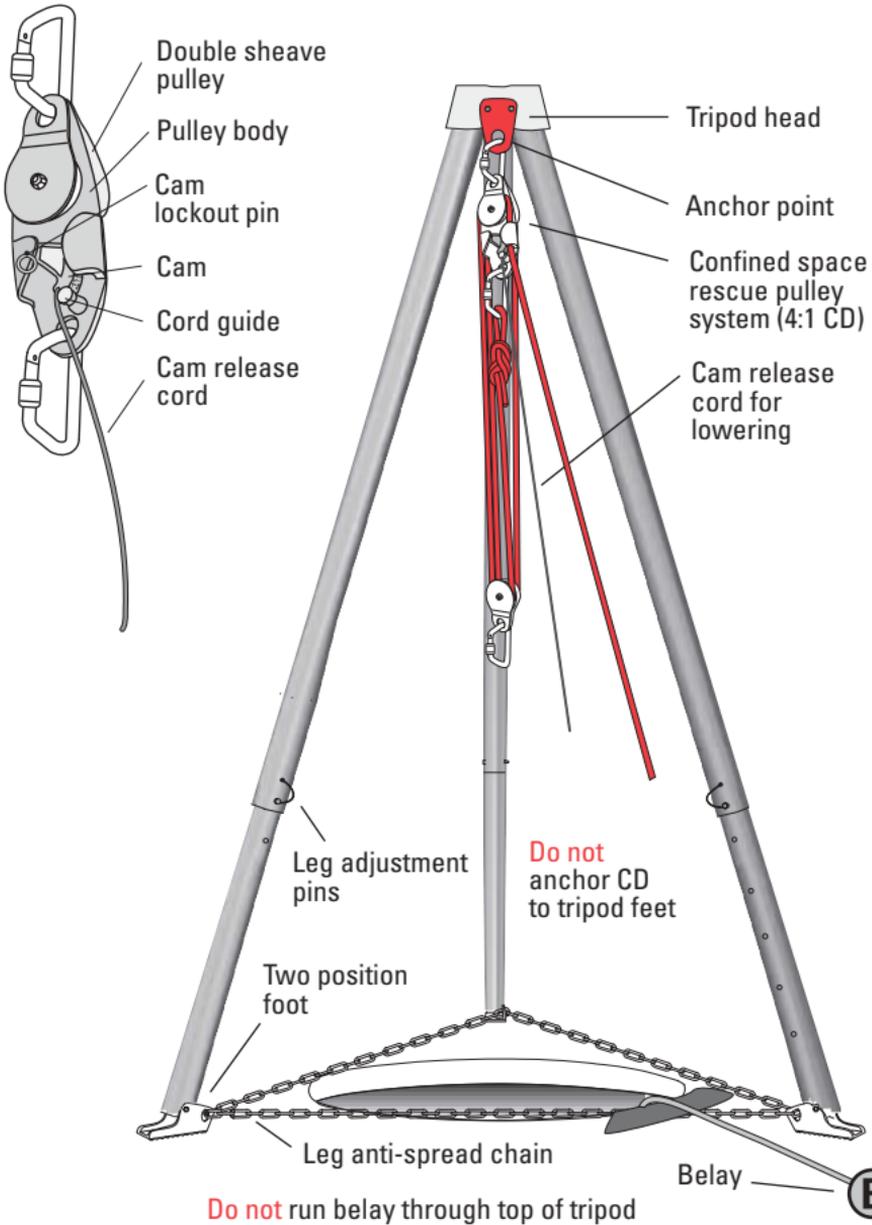
Winch Cable Setup



Side View of Winch



Rescue Tripod and Pulley System

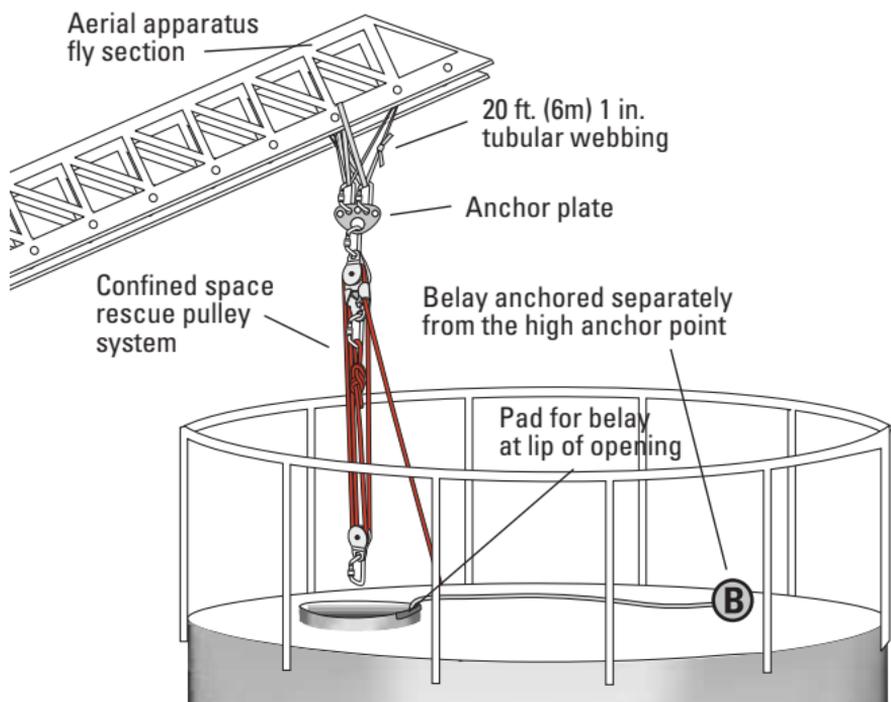


- ✓ Do not apply any lateral force to the tripod.
- ✓ Always use a separate belay line that does not go through a high directional on the tripod.

Aerial Apparatus as High Anchor Point

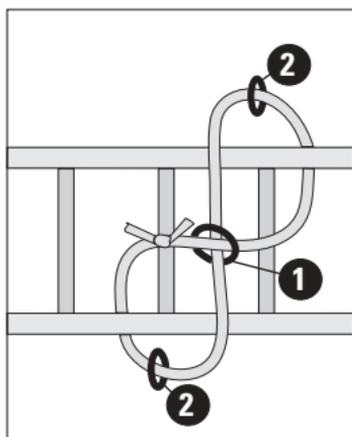
An aerial apparatus can create a safe and effective anchor point for a rescue system but **can fail catastrophically if not done properly.**

1. Spot apparatus as close to work area as possible.
2. Position tip of aerial directly over intended work area.
3. Check tip capacity chart on turn table to ensure that the aerial can support at least 500 lbs. (227kg) at that angle and extension.
4. If within capacity, return aerial to ground and rig anchor point and system.
5. Always keep haul force and system components in line with the center of the aerial. Lateral force on the aerial can cause structural failure.
6. Re-position aerial over work area.
7. Rig belay at separate anchor point.
8. **Lift only one person at a time and never rotate, extend or retract the aerial with a person on the system. The aerial is to be used as an anchor point only!**



Aerial Apparatus as High Anchor Point

1. Create the anchor point on a standard aerial to distribute weight between both beams and at least 2 rungs.
2. Lay a 20 ft. (6m) webbing over both rails and pull up ends through adjacent rungs.
3. Tie with overhand bend.
4. Clip steel carabiner through both loops at point marked 1 and pull down.
5. Clip second steel carabiner through each loop marked 2 and pull down.



6. Attach anchor plate to carabiners as shown.

